COLLEGE OF AGRICULTURE AND LIFE SCIENCES

ADMINISTRATION

Daryl B. Lund, dean

Brian F. Chabot, associate dean

Kevin Mahaney, assistant dean for public affairs

H. Dean Sutphin, associate dean and director of academic programs

Donald R. Viands, associate director of academic programs

W. Ronnie Coffman, associate dean and director of research

Anthony M. Shelton, associate director of research

Daniel J. Decker, associate director of research

Rosemary Loria, associate director of research

D. Merrill Ewert, associate dean and director of cooperative extension

R. David Smith, associate director of cooperative extension

Margaret E. Smith Einarson, associate director of cooperative extension

Norman T. Uphoff, director of international agriculture

James E. Haldeman, associate director of international agriculture

Office of Academic Programs Staff

Counseling and advising: Lisa Ryan, Bonnie Shelley

Registrar: Mary Milks, Patricia Austic

Admissions: Randy Stewart, Laurie Gillespie, Jason Locke, Anne LaFave

Career development: William Alberta, Amy Benedict-Martin, Sheri Mahaney

Minority programs: Catherine Thompson

Department Chairs

Agricultural and biological engineering: M. F. Walter, Riley-Robb Hall

Agricultural, resource, and managerial economics: A. M. Novakovic, Warren Hall

Animal science: A. W. Bell, Morrison Hall

Biometrics Unit: N. S. Altman, Warren Hall

Communication: R. E. Ostman, Kennedy Hall

Education: D. H. Monk, Kennedy Hall

Entomology: D. A. Rutz, Comstock Hall

Floriculture and ornamental horticulture: T. C. Weiler, Plant Science Building

Food science: D. Miller, Stocking Hall

Fruit and vegetable science: H. C. Wien, Plant Science Building

Landscape Architecture: H. W. Gottfried, Kennedy Hall

Natural resources: J. P. Lassoie, Fernow Hall

Plant breeding: E. D. Earle, Emerson Hall

Plant pathology: S. A. Slack, Plant Science Building

Rural sociology: D. L. Brown, Warren Hall

Soil, crop and atmospheric sciences: J. M. Duxbury, Emerson Hall

Statistical sciences: C. E. McCulloch, Warren Hall

Note: the Biological Sciences department names and chairs were still under consideration at the time of printing.

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, research, 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 Board 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.)]: H. D. Sutphin, Roberts Hall

Agricultural and Biological Engineering: J. A. Bartsch, Riley-Robb Hall

Agricultural Economics: R. N. Boisvert, Warren Hall

Animal Breeding: E. J. Pollak, Morrison Hall

Animal Science: R. L. Quaas, Morrison Hall

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

Biometry: S. J. Schwager, Warren Hall

Communication: M. A. Shapiro, Kennedy Hall

Development Sociology: P. McMichael, Warren Hall

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

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

Entomology: M. P. Hoffmann, Insectary

Environmental Toxicology: A. Yen, Rice Hall

Floriculture and Ornamental Horticulture: N. L. Bassuk, Plant Science Building

Food Science and Technology: S. S. Rizvi, Stocking Hall

*Genetics and Development: T. D. Fox, Biotechnology Building

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

International Development: N. T. Uphoff, Caldwell Hall

Landscape Architecture [M.L.A.], R. T. Trancik, Kennedy Hall

*Microbiology, S. C. Winans, Wing Hall

Natural Resources, M. E. Krasny, Fernow Hall

*Neurobiology and Behavior, S. T. Emlen, Seeley-Mudd Hall

Nutritional Sciences, N. Noy, Savage Hall

*Physiology, S. S. Suarez, Vet Research Tower

*Plant Biology, T. G. Owens, Plant Science Building

Plant Breeding, M. E. Sorrells, Bradfield Hall

Plant Pathology, J. W. Lorbeer, Plant Science Building

Plant Protection [M.P.S. (Agr.)], W. E. Fry, Plant Science Building

Pomology, I. A. Merwin, Plant Science Building

Soil, Crop and Atmospheric Sciences, S. J. Colucci, Bradfield Hall

Statistics, M. T. Wells, Caldwell Hall

Vegetable Crops, D. W. Wolfe, Plant Science Building

*Zoology, J. W. Hermanson, Schurman Hall

**Office of Undergraduate Biology*

Bachelor of Science Degree

Departments in the College of Agriculture and Life Sciences sponsor study for the B.S. degree in nineteen major fields. To qualify for the degree, students must fulfill requirements established by the faculty of the college and administered through the Office of Academic Programs. 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 within the major field.

Agricultural and Biological Engineering: R. E. Pitt, 318 Riley-Robb Hall

Agricultural, Resource, and Managerial Economics: D. A. Grossman, 204 Warren Hall

Animal Sciences: E. J. Pollak, B-47 Morrison Hall

Atmospheric Sciences: D. S. Wilks, 1113 Bradfield Hall

Biological Sciences, Division of: J. J. Doyle, 200 Stimson Hall; B. E. Comella, 216 Stimson

Biometry and Statistics: S. J. Schwager, 424 Warren Hall

Communication: B. O. Earle, 332 Kennedy Hall

Education: G. J. Posner, 416 Kennedy Hall

Entomology: Q. D. Wheeler, 3136 Comstock Hall

Floriculture and Ornamental Horticulture: K. W. Mudge, 20 Plant Science Building

Food Science: J. M. Brown, 101 Stocking Hall

Landscape Architecture: P. J. Trowbridge, 442 Kennedy Hall

Natural Resources: T. J. Fahey, 12 Fernow Hall

Nutrition, Food, and Agriculture: C. A. Bisogni, 334 MVR Hall

Plant Science Units (Plant Biology, Genetics and Breeding, Pathology/Protection, Pomology, Vegetable Crops): D. R. Viands, 140 Roberts Hall

Rural Sociology: L. Williams, 220 Warren Hall

Science of Earth Systems: K. Cook, 1110 Bradfield Hall

Crop and Soil Sciences: G. W. Fick, 505 Bradfield Hall

Special Programs in Agriculture and Life Sciences: L. A. Ryan, 140 Roberts Hall

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: 20 (pro-rated for transfer students) with maximum of one course per semester.

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

g. Credit for physical education **does not** count toward the 120 credit 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. Remedial courses (see #1A) **are** counted.

b. A minimum of seven semesters is required, with a GPA of 2.0 or greater.

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 (see #3 B).

Exception: Students with 8 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.

e. Students participating in the employee degree program may petition for part-time enrollment.

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

a. Cumulative GPA: **1.70** or above must be maintained. Includes only grades earned at Cornell after matriculating into the college.

b. Final semester: **1.70** or above based on a minimum of 12 credits, or **2.00** or above if graduating in 7 semesters.

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 sciences, students develop quantitative and analytic skills based on an understanding of the physical laws governing the universe and through study of the biological sciences, they 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 impact their work and role in society. Through development of written and oral expression skills, students master the essentials of effective communication.

Credits received for independent study, field, teaching, 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.

Group A: Physical Sciences. 9 credits of 100- or 200- level courses, in at least two disciplines, including at least one course in chemistry or physics.

Chemistry
Physics
*Mathematics (excluding Education 005, Mathematics 101 and 109)
Education 115
Soil, Crop and Atmospheric Sciences 131
Astronomy
Geology
Statistics and Biometry (including ARME 210, ILRST 210)

*The college mathematics requirement is described below.

Group B: Biological Sciences. 9 credits, to include 6 of introductory biological science (introductory courses include BIO G 101–104, 105, 106, 109, 110.)

Biological Sciences (excluding 160, 200 [unless permission of the director of Undergraduate Biology is obtained], 209, or 367)
Animal Sciences 100, 221, 300, 301
Entomology 212
Nutritional Sciences 262
Plant Breeding 201, 225
Plant Pathology 309, 401

Group C: 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):
Anthropology
Archaeology
ARME 100, 416
CEH 110/CEH 111 (cannot receive credit for these courses and Econ 101/Econ 102)

Communication 116, 120, 410, 418, 420, 422
Economics (excluding all ARME courses)
Education 271, 311, 317, 370, 378
Government
HDFS 150 (cannot receive credit for this course and Soc 243)
LA/CRP 261, 360, 363
Psychology
S & TS 324, 350, 390, 391, 400, 401, 402, 406, 407, 412, 425, 427, 431, 442, 467, 483
Sociology (includes Rural Sociology except RS 100, 175, 318, 442)

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

Africana Studies (literature and history)
Asian American Studies
Asian and Near Eastern Studies (literature and history)
Classics (literature and history)
Comparative Literature
English (*literature only*)
French, German, Italian, Russian, and Spanish (*literature only*)
History
History of Art/History of Architecture
LA 282
Music and Theatre Arts (theory, literature, and history only)
Natural Resources 407, 411
Philosophy
Religious Studies
Rural Sociology 100, 175, 318, 442
S & TS 205, 206, 233, 250, 281, 282, 286, 292, 358, 360, 381, 384, 389, 433, 444, 447, 472, 481, 490
WOMNS/S&TS 444

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

Freshman Seminars
Communication 117, 201, 350, 352, 260 (was 360), 263 (was 363), 365
English 280–281, 288–289, 382–385, 388–389

Students scoring 4 ot 5 on the English advanced placement exam may be awarded 3 credits and are exempt from one freshman seminar course.

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 exam score determines the college math graduation requirement, and provides placement information.

The exam has two components. Cutoff 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 Students in this group MUST complete a **math course at Cornell.***

Placement score *suggests* pre-calculus skill level (e.g., EDUC 115, Math 105, Biometry 101).

Group III Students in this group must take EDUC 005, basic review math in their first semester. Students must **ALSO** complete an additional **math course at Cornell.***

Transfer and AP math credit (up to 6) will be recorded in Group A of the college distribution requirements. Additional transfer credit in math will be recorded as general electives. Students scoring in Group II or Group III of the college math proficiency exam must take a **math course at Cornell***, *regardless* of transfer or AP math credit.

***Math courses at Cornell that may be used to fulfill math requirement:**

All courses in the Mathematics department (except 101 and 109)

EDUC 115

Biometry 101

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 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, but must notify the College Registrar of their intent to return for the eighth semester. 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. Students who are planning to graduate must complete an "Application to Graduate" by February 15th (for May graduate) or September 15th (for January graduate). The adviser signs the application after verifying that the requirements for the major have been completed. The college registrar signs after verifying that the college requirements have been met.

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 verfication may be necessary.

STUDENTS

Undergraduate enrollment is approximately 3,100, with about 56 percent in the upper division. Each year about 850 students are graduated, while 650 freshmen and 250 new transfer students are enrolled. Members of the faculty of the college serve as chairs of the special committees of roughly 1100 graduate students.

Admission

The College Admissions Committee selects applicants who are academically well prepared and appear most likely to profit from the college's various curricula.

Most students come from New York State, but about 30 percent come from other parts of the United States or abroad. Slightly more than half of the undergraduates are women. Approximately 22 percent are identified as members of minority ethnic groups.

Transfer Students

Approximately 18 to 20 percent of the ALS undergraduate students are transfers who have taken part of their collegiate work at community colleges, agricultural and technical colleges, or other four-year institutions. Many of them hold an associate degree.

A Cornell student in good standing may apply for intra-university transfer to pursue a course of study unavailable in his or her current college. Guidelines are available in the Admissions Office of the College of Agriculture and Life Sciences, 177 Roberts Hall. The procedure includes filing a transfer request, meeting with a faculty member in the proposed area of study and submitting a letter explaining reasons for the transfer.

Consideration is given to students who have demonstrated an interest in their intended field of study, by taking appropriate prerequisite courses and courses within this area of study. Academic achievement is also considered. Students are seldom allowed to transfer during their freshman year. In some cases a student may be referred to the Internal Transfer Division to study for one semester before entering the college. A second semester is considered under 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 selected 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 they want to take. For more information and guidelines, students should contact the Admissions Office, 177 Roberts Hall.

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 twelve (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 Admissions Office.

Graduation and Diplomas

Graduating seniors must complete the Application to Graduate (see the aforementioned 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; considering 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, commencement activities, and the activities of two student organizations, Ho-Nun-De-Kah, the college's honor society, and SONet, the CALS Student Organization Network. 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.

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

Within the university, the Office of Minority Programs is charged with acting as the college liaison with the central Office of Minority Education Affairs, the Learning Skills Center, and the State Programs Office. Other university connections include the Undergraduate Admissions Office and the Office of Financial Aid regarding the concerns of the minority student population.

The duties of the Office of Minority Programs are primarily carried out by the director with an assistant, part-time support staff help, and 10 to 12 peer advisers. Together, the staff acts as a major advocacy and advising group, as well as informational and referral center. Its constituency includes students, faculty, and the public.

Given the college's policy on non-exclusionary programming, the Office of Minority Programs is also responsible for some functions that serve the college's entire population. Presently, that includes reviewing non-minority applicant folders, 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 in a friendly environment to all students and alumni of the college. Career development includes self-awareness and assessment, career exploration, decision making, and job search. 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 eight hundred 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 80 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 members, assists students throughout their undergraduate years and beyond. For further information, students should contact Bill Alberta and the staff in 177 Roberts Hall.

Financial aid is administered through the university office in Day Hall. Endowment funds and annual donations provide supplemental aid for students in the college 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 advance permission
   - knowingly deprive other students of library resources, laboratory equipment, computer programs, and similar aids
   - in any other manner violate the principle of absolute integrity
3) Faculty members assume responsibility to make clear to students and teaching assistants specific regulations that apply to scholarly work in a discipline.
4) Faculty members fulfill their responsibility to
   - maintain in all class, laboratory, and examination activities an atmosphere conducive to academic integrity and honor
   - make clear the conditions under which examinations are to be given
   - make clear the consequences of violating any aspects of the code
   - provide opportunities for students to discuss the content of courses with each other and help each other to master that content and distinguish those activities from course assignments that are meant to test what students can do independently
   - state explicitly the procedures for use of materials taken from published sources and the methods appropriate to a discipline by which students must cite the source of such materials
   - approve in advance, in consultation with other faculty members, which work submitted by a student and used by a faculty member to determine a grade in a course may be submitted by that student in a different course
   - monitor the work and maintain such records as will support the crucial underpinning of all guidelines: the students' submitted work must be their own and no one else's

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

The Academic Integrity Hearing Board for the College of Agriculture and Life Sciences consists of three elected faculty members, three elected student members, a chair appointed by the dean, and the director of counseling and advising, who serves as a nonvoting record keeper. Professor D. 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 college registrar maintains for each student a complete record of academic achievement. A permanent record is maintained for each matriculated student and updated as new information becomes available. Staff 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.

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

Good academic standing means a student is eligible for, or has been allowed to register and enroll in, academic course work for the current semester. Whether an individual student is in good academic standing is determined by the college registrar and the Committee on Academic Achievement and Petitions. (See academic deficiency policies, below.)

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 determines whether there is evidence of mitigating and unforeseen circumstances beyond the control of the student that would warrant an exemption or other action.

Registration Procedures

All students must register with the university *and* "check-in" with this college at the beginning of each semester. Check-in materials are available in 140 Roberts Hall as announced each term by the University Registrar.

Course Enrollment Procedures

To enroll in courses, students will receive information from the university registrar; plan a schedule in consultation with their adviser; and pre-enroll by computer, through CoursEnroll in "Just the Facts" on the Bear Access menu. Pre-enrollment is not valid until the student enters the adviser key code into the computer. Adviser keys are provided by faculty advisers after a discussion of selections and requirements takes place. The 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 at the Registrar's Office, 140 Roberts Hall, on the official university course drop and add form.

Add/Drop/Changes are made by filing properly signed forms in the Registrar's Office, 140 Roberts Hall. Approval and signature of the faculty adviser and course instructor are required to change course enrollment.

Students may add courses during the first three weeks of the term and change grading options or credit hours where applicable 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. 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 work load, and scheduling prior to the end of the seventh week of the semester.

If a petition to drop a course is approved after the end of the seventh week of classes, the course remains on the student's record and a W (for "withdrawal") is recorded on the transcript.

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 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 them on probation, granting them leaves of absence, advising them to withdraw, suspension, or expulsion.

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 1.7
- cumulative GPA of at least 1.7
- 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– (1.7) or higher are prima facie evidence of satisfactory progress.

HONORS RESEARCH PROGRAM

The Bachelor of Science degree with distinction in research will be conferred upon those students who, in addition to having completed the requirements for the degree of Bachelor of Science, 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.

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 grade-point average of at least 3.0 at the time of entry.

Interested students must make written application no later than the end of the third 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. An application form is available from the college registrar, 140 Roberts Hall, or from the area committee chair. (Biological sciences students should get applications at 200 Stimson Hall.)

Written approval of the faculty member who will direct the research and of the honors committee in the area is required. After the college registrar verifies the student's grade-point average, the student will be officially enrolled in the honors program.

Academic credit may also be earned by enrolling in an appropriate independent study course. When applying for admission to the program, the student may, if appropriate, submit a budget and a modest request for funds to cover some of the costs the student incurs in doing the research.

The honors committee for each 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 honors.

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 honors 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 honors program must be accepted in one of the program areas approved by the faculty. Students are not eligible for honors by participating in a program offered by another college or administrative unit.

Animal Sciences

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

The objective of the animal sciences 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 an honors 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 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 honors project. That should be accomplished early in the second semester of the junior year.
- Preregister during the spring semester for AS 496, 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.
- Submit a written thesis to the honors committee by the scheduled deadline. Specific information regarding deadlines, format, and organization for the thesis will be provided.
- Meet with the honors committee for a short oral defense of the thesis following a review of the thesis by the student's sponsor and the honors 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 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. Applications and details pertaining to the program requirements may be obtained from the Office of Undergraduate Biology, 200 Stimson Hall. Information on faculty research activities is available in the Behrman Biology Center, 216 Stimson Hall.

Entomology

Faculty committee: B. L. Peckarsky, chair

An honors program in the area of entomology may be pursued by any qualified student in the College of Agriculture and Life Sciences (see the requirements at the beginning of this section). The student need not be specializing in entomology. Insects, because of their variety, small size, and easy availability, are convenient subjects for study in 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 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 honors study.

The honors committee requires that an undergraduate who is interested in embarking upon an honors project proceed with the following steps:

- Discuss the matter with his or her academic adviser, preferably in the junior year, so that a research project can be carefully planned. The possibility of conducting some research during the junior year and/or summer should be discussed.
- Discuss the project with an appropriate faculty member in the Department of Entomology who can serve as a supervisor to oversee the honors research. (The faculty adviser will be of assistance in determining which faculty entomologist might be the best supervisor, the decision being based primarily on available faculty members' areas of expertise.)
- Prepare a brief, tentative plan for the project for discussion and approval of the honors project supervisor. The plan should include a statement of objects 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.
- Present a completed application to the chair of the entomology honors committee no later than the end of the third week of the first semester of the senior year. Earlier submission is encouraged.
- Submit a brief progress report, approved by the project supervisor, to the entomology 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 (preferably as a Jugatae seminar) in the last semester of the senior year.
- Submit two copies of the final project report (honors thesis) to the chair of the entomology area 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 from the department honors committee. The committee 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 chair no later than the last day of classes.

Natural Resources

Faculty committee: M. E. Krasny, chair; B. A. Knuth, J. P. Lassoie, E. L. Mills

The honors program in natural resources provides an opportunity for undergraduates to pursue supervised independent research in the areas of (1) ecology and management of landscapes; (2) fish and wildlife biology and management; and (3) resource policy, management, human dimensions, and environmental education. The subject matter and nature of the research experience may be quite varied, but requires the guidance and supervision of a faculty member with substantial interest and expertise in the subject area chosen.

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

- Register for the honors program in the junior year or earlier.
- Select a faculty adviser who will help identify and formulate a research problem.
- Carry out an independent research effort that is original and separate from the work of others who may be investigating similar subjects.
- Describe and summarize the work in the format of a conventional master's thesis or scientific paper ready for journal submission. About half of the theses have been published.
- Work closely with at least two faculty or staff members who will agree to serve as readers for the thesis. Provide readers with a copy of the guidelines for evaluation of honors theses, available from the department's honors program committee.
- Take the lead role for meeting each of the above expectations.

Nutritional Sciences

Faculty committee: M. N. Kazarinoff

The honors program offers students a research experience structured to give them the opportunity to choose a research project, search the literature relevant to it, plan and execute the research, and write it up in the form of a thesis. As in other types of research available to undergraduates, each student is guided by a faculty mentor. The honors project is designed to be spread over both semesters of the junior and senior years.

Students who consider this option should be aware that it involves a number of deadlines and considerable time commitment. Before signing on for honors they need to consult with their academic advisers to make sure that honors will not interfere with other academic objectives, such as preparation for admission to medical school or making the dean's list. Although honors research credits for spring semester junior year and both semesters senior year are designated LET, individual mentors may choose the R grade for work in progress until the project has been fully completed.* An outline of activities for both years is given below. Letters of invitation are sent to upcoming juniors during the summer.

Junior Year

Fall Semester Course No: NS 398 (1 credit, S-U): Students are oriented to the program, and provided material that summarizes the range of research activities in DNS. Students begin making arrangements with faculty members. When these arrangements have been completed, students will begin a literature search that focuses on their research problems.

Spring Semester Students register for NS 498 (1 credit, section 1). Additional faculty presentations of research opportunities are made, as well as orientation to supportive services available through DNS. Placements with faculty mentors should be completed by spring break. Each student may also register under the number NS 499 for a convenient number of credits, to be determined in consultation with the chosen adviser. Work carried out will have two objectives:

1. to become familiar with literature and/or research methods appropriate to the problem for the honors research,
2. to develop a research proposal.

The semester outcome will be written reports/discussions of the method(s) or literature searches and a short research proposal, evaluated by the research adviser.

Senior Year

Fall Semester Students will register under the number NS 499 (2–4 credits, LET, by arrangement with their mentors). They may begin their research earlier than fall, e.g., during the summer, or even earlier, but should be prepared to begin research **early in the fall semester at the latest**. The objective for the semester will be to conclude most of the hands-on research/data acquisition.

Spring Semester Students will again register under course number NS 499 for 2–4 credits LET, by arrangement with their research mentors. Much of the allotted time will be spent on data analysis and on writing the honors thesis.

Several important deadlines should be noted.

1. **Last week in March:** The names of thesis readers** are to be in the hands of the honors committee.
2. **Third to fourth week of April:** A final draft of the thesis is handed to the readers.
3. **First to second week of May:** Scheduled seminars for oral presentations of each student's research.
4. **Last day of classes:** Final form of the thesis is handed to the honors chairman.

To help students meet these deadlines, students register for NS 498 (1 credit, section 2) class sessions will be held before spring break for guidance in thesis writing and/or informal reporting of preliminary data. After spring break the group will meet once or

twice (depending on number of students) to practice oral presentations of completed research.

*Grade is determined by each student's mentor.

**Two readers knowledgeable in the area of the student's research topic to be chosen by the honors committee and faculty advisers.

Physical Sciences

Faculty committee: S. S. H. Rizvi, chair; S. Colucci, C. E. McCulloch, J.-Y. Parlange

The 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 Agricultural and Biological Engineering or Food Science or Soil, Crop and Atmospheric Sciences or Biometrics.

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

- Identify a thesis advisor and thesis topic before the end of junior year.
- Working with the thesis advisor, prepare a budget and application form (due by the third 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 6 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 advisor 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 honors committee.

Plant Sciences

Faculty committee: R. L. Obendorf, chair; L. L. Creasy, A. M. Petrovic, F. S. Rossi, W. A. Sinclair

Students perform independent scientific research under the guidance of faculty members in 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 Honors Committee a project proposal (2–3 pages) which includes a title; a brief background to 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 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 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 honors.

The 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 honors. One copy of the accepted report will be returned to the student with review comments from the committee.

Social Sciences

Faculty committee: R. D. Colle, chair; K. A. Strike, M. J. Pfeffer, W. H. Lesser

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

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

- **Research Topic:** State the problem to be studied or the topic of interest. Review the relevant literature and the background of the problem or topic; include a more extensive bibliography.
- **Research Questions/Empirical Hypotheses:** Specify the questions to be answered or hypotheses to be empirically tested via collection of data and some mode of analysis accepted in the social sciences.
- **Research Methods:** Discuss the models to be constructed, data collection procedures (including survey instruments or experiments, if appropriate), and methods of analysis.
- **Expected Significance:** State what new knowledge or information is likely to be forthcoming and why it is important.

Faculty advisers must be members of the graduate faculty. Exceptions to this rule will be granted for persons with special expertise who are deemed capable of thesis supervision; exceptions will be granted pending petition to the social science honors committee. Students may register for honors credit directed by the faculty adviser in conjunction with an honors project.

Honors degrees are awarded upon approval of the honors thesis by the social science honors committee. The research should deal with a substantive issue within one of the fields in the social sciences. Both the results of the research and the methodology (or the 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 fields. 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. 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 Field Program in Agricultural and Biological Engineering 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. Students pay the engineering college tuition during the senior year. The curriculum is accredited by the Accreditation Board for Engineering and Technology. The B.S. degree is awarded in cooperation with the College of Engineering.

The Program in Landscape Architecture offers a first professional degree curriculum in landscape architecture at both undergraduate and graduate levels, as well as a graduate second professional degree program. 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 undergraduate nutrition major is based in the College of Human Ecology, and the nutrition, food, and agriculture major is based in the College of Agriculture and Life Sciences. Students may study nutrition in areas such as animal sciences; food-industry management; food science; microbiology; nutrition, food, and agriculture; and fruit or vegetable science. Students may also plan a concentration in biological sciences or a concentration in general studies in agriculture to include a human nutrition component.

The Department of Science and Technology Studies is an academic unit based in the College of Arts and Sciences that engages in teaching and research involving the interactions of science and technology with social and political institutions. The program draws its students, faculty, and research staff from the various divisions of the university. It offers an interdisciplinary undergraduate major in Biology and Society. Students in the College of Agriculture and Life Sciences may plan a general studies major in consultation with a faculty adviser to fulfill a biology and society program. Further information, including a list of courses, may be obtained from the Science and Technology Studies undergraduate office, 275 Clark Hall.

The American Indian Program (AIP) is a multidisciplinary intercollege 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 are challenged by such 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 focusing on American Indian life from pre-contact times to the present, and from the perspectives of Native people as much as possible. Core courses are supplemented by a variety of offerings in several different departments.

Research areas among faculty active in the program include Indian education, social and economic development, agriculture, environmental issues, history, literature and the arts, and cultural preservation. Their research topics, which are highly relevant to Indian communities, will be of interest to Indian and non-Indian graduate students. Extension and outreach efforts within the program seek to develop solutions to problems identified by Indian communities and to facilitate the application of institutional resources, research, and expertise to community needs.

The American Indian Program publishes its own multidisciplinary journal, *Native Americas*, and sponsors conferences, guest lectures, and forums on important local, national, and international issues. 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 Indian Studies to undergraduate students in conjunction with their major defined elsewhere in the university. The concentration will be earned upon completion of five courses: Rural Sociology 100 (Indian America to 1890) and Rural Sociology 175 (Issues in Contemporary American Indian Societies), plus three other courses selected from the following course listing (ANTHR 230, ANTHR 665, ENGL 260, ENGL 269, ENGL 278, ENGL 659, ENGL 669, ENGL 687, HIST 209, HIST 276, HIST 277, HIST 370, HIST 429, HIST 624, R SOC 100, R SOC 175, R SOC 318, R SOC 440, R SOC 442), 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 300 Caldwell.

AIP also offers a graduate minor. Students interested in choosing the minor should contact Daniel Usner, History Department, 255–6753.

Science of Earth Systems (SES) is a new program for students in the Colleges of Agriculture and Life Sciences, Arts and Sciences, and Engineering. The SES program emphasizes the rigorous, 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. The program, described in more detail in the "Interdisciplinary Centers, Programs, and Studies" and the CALS "Interdepartmental and Intercollege Courses" sections, coalesces Cornell's teaching and research strengths across a broad range of earth and environmental sciences to provide students with a rigorous scientific foundation for the study of our complex, highly interactive earth.

The SES curriculum includes a freshman/sophomore emphasis on strong preparation in mathematics, physics, chemistry, and biology, and an introduction to the breadth of the major. In the junior and senior years, students take a set of common SES core courses and an additional set of four advanced disciplinary or interdisciplinary courses that build on the basic sequences.

Several interdisciplinary tracks are available within the SES program, and these are chosen by the student according to interests and career goals. This tracking is accomplished through the selection of courses beyond the core sequence. These courses build on the core sequence and generally include junior and senior level courses with prerequisites in the basic sciences and mathematics. Effective tracks can be designed to prepare students for careers or graduate study in specific environmental science disciplines including atmospheric sciences, hydrology, biogeochemistry, ecology, oceanography, and geophysics. Meaningful and effective combinations of these disciplines are also possible. The selection of the course sequences must be approved by the SES Coordinating Committee to ensure that depth as well as breadth is attained.

The SES courses are listed in the college's "Interdepartmental and Intercollege Courses" section. For more information, see the web site at http://www.geo.cornell.edu/ses/SES_home.html

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 http://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, inter-college unit affiliated with the Center for the Environment. 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 is comprised of three program areas in environmental resource inventory, remote sensing, and geographic information systems. A description of these programs and general information is available from the Institute director through the Cornell IRIS office in 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. Students receive an intensive orientation to state government and attend a lecture-seminar program composed of three two-credit components and offered by professors-in-residence. An internship experience, supervised by an internship committee, provides up to six additional academic credits. Independent study and research courses offered by the various departments in ALS and/or courses offered by academic institutions in the Albany areas may be elected.

Three opportunities are available. The Assembly Intern Program provides a placement with a member of staff of the New York State Assembly. The Senate Assistants Program has placements with New York State senators and selected staff. The Albany Semester Program provides experience with a state agency such as the Departments of Environmental Conservation, Education, or Labor.

Applications are collected and processed by the ALS 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 twelve credits must be carried to meet the residence requirement. Seniors should note that their last term average must be 1.7 or above.

All interns will audit the orientation sessions and meet participation requirements in at least two of the lecture-seminar sections. The paper required in each section constitutes an independent study project to be directed and

evaluated by a Cornell faculty member in an appropriate discipline. Normally a faculty member will not sponsor more than one of the independent study courses for any one student. 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 Career Development Office, 177 Roberts Hall.

Cornell-in-Washington

The Cornell-in-Washington Program offers students from all colleges within 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. 20, inquire at 471 Hollister Hall, 255–4090, or visit the Cornell-in-Washington website at http://www.info.cornell.edu/ciw/ciw.html.

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 twelve weeks in length. Six weeks are spent in Woods Hole, the following six weeks are spent on either one of SEA's two sailing vessels: the R/V Westward, or the R/V Corwith Cramer. For more information, students should contact the Cornell Marine Programs office, G14 Stimson Hall (607–255–3717). ALS students should file the 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

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 undergraduate, beginning graduate students, 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.

Internships

Several departments in the college offer supervised internships for academic credit. Arrangements should be made with the offering department for assignment of a faculty member who will be responsible for placement, for planning the program of work, and for evaluating student performance.

For internships not governed by an established internship course, the student must enroll in a 497 course for the number of credits to be assigned. If the work is done during the summer, the student must enroll in the Cornell summer session for the agreed-upon credits.

In cases where the work is not done at Cornell, the awarding of credits depends upon a prior contractual arrangement between a Cornell professor and the student. Specific terms for receiving credit and a grade should be recorded, using the Independent Study, Research, Teaching, or Internship form, available in the Registrar's Office, 140 Roberts Hall.

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. No more than 6 of the 15 credits allowed for independent study may be awarded for internships consisting of off-campus work experiences that do not have the continued presence of a Cornell faculty member. The 6-credit allotment includes transfer credit and credit for internships in other colleges at Cornell. The 6-credit limit does not apply to secondary, postsecondary, and cooperative extension teaching internships in the Department of Education.

The College of Agriculture and Life Sciences does not offer a field study option. In general, a rather narrow view is taken toward awarding academic credit for work experience, "life" experience, or apprenticeships. Credit will only be assigned or accepted in cases where a professor is directly involved in determining both the course content and in evaluating a student's work. 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. All students enrolling for an internship must file and Independent Study, Research, Teaching or Internship form with the Office of the College Registrar.

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 one of seven international student exchange programs—the Instituto Technologico y de Estudios Superiores de Monterrey (ITESM) in Monterrey, Mexico, the Agricultural College of Sweden at Uppsala, Nanyang Technological University in Singapore, or the National University of Singapore (NUS), the University of Sydney in Australia, the University of Lausanne in Switzerland, or the University of Agricultural Sciences in Gödöllö, Hungary. (Please note that the Nanyang program is for Communication majors only, the NUS program for Plant Sciences majors only, and the Lausanne program for Food Science.) CALS students may take courses relevant to their major and graduation requirements by earning a maximum of 15 transfer credits per semester. There can be no duplication of credit, and grades received must be C- or better.

These undergraduate exchange opportunities are for **CALS students only**. 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. For more information on programs and application process, see the CALS Study Abroad Adviser in 140 Roberts Hall or visit our web site http://oap.cals.cornell.edu/C&A/International.html.

MAJOR FIELDS OF STUDY

The college curriculum consists of 17 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. 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 minimum distribution requirements of the college.

Agricultural and Biological Engineering

The Department of Agricultural and Biological Engineering is at the focus of 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 Agricultural and Biological Engineering has a unique focus on biological systems, including the environment, that is realized through a combination of fundamental engineering sciences, biology, applications courses, and liberal studies. The program leads to a joint Bachelor of Science degree from 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).

Three concentrations in agricultural and biological engineering are offered: environmental systems engineering, biological engineering, and agricultural engineering. Students take courses in mathematics, 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, bioenvironmental and facilities engineering, bioinstrumentation, engineering aspects of

animal physiology, environmental systems analysis, and waste treatment and disposal. Students select other courses in the College of Engineering that reflect their concentration, such as environmental engineering or biomedical engineering. Students planning for medical school also take organic chemistry. Throughout the curriculum, emphasis is placed on communications and teamwork skills. **Specific course requirements and other information for the Agricultural and Biological Engineering joint program are in the College of Engineering section of this publication.**

The department also offers two technology programs: environmental systems technology and agricultural systems technology. The technology programs emphasize applied and technical aspects of agricultural, biological, and environmental 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. The student develops his or her own program of advanced and elective courses in consultation with a faculty adviser, and may have an informal minor in an area such as communication, business, education, or international agriculture.

Many undergraduate students participate in teaching assistantships, research assistantships, design teams, Engineering Coop, and study abroad. Students 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 of this century has given rise to a growing demand for engineers who have studied biology and the environment, who have strong math and science skills, who can communicate effectively, and who appreciate the challenges facing society. The Department of Agricultural and Biological Engineering is educating the next generation of engineers to meet these challenges.

Specific course distribution requirements for the academic programs in environmental systems technology and agricultural systems technology include (for the engineering program, see the College of Engineering section):

		Credits
A.	*Basic Subjects*	
1.	Calculus	8
2.	Chemistry	6
3.	Physics	8
4.	Introductory biological sciences	6
5.	Computer applications	4
6.	Statistics or probability	3
7.	Written and oral expression	9
B.	*Advanced and Applied Subjects*	
1.	Five courses in the environmental, agricultural, or biological sciences	15
2.	Five engineering or technology courses at the 300 level or above; at least 9 credits in agricultural and biological engineering	15
C.	*Electives*	
	Additional courses to complete college requirements	
D.	*Total (minimum)*	*120*

For further details on the Agricultural and Biological Engineering and Technology Programs, see the department's Undergraduate Programs brochure, available at 207 Riley-Robb Hall; contact the advising coordinator, Professor Ron Pitt, at 255–2492; or visit the department's web site at http://www.cals.cornell.edu/dept/aben

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 at a campus location.

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. Upperclass students whose academic records warrant it may, by arrangement with individual faculty members, engage in research (either for credit or for 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.

Applied Economics and Business Management

The undergraduate program in applied economics and business management is based in the Department of Agricultural, Resource, and Managerial Economics. Courses in agricultural, resource, and managerial economics are supplemented with others in related areas such as computer science, economics, sociology, history, government, industrial and labor relations, hotel administration, consumer economics, animal sciences, plant sciences, natural resources, mathematics, and statistics.

Six areas of specialization are offered:

Agribusiness management is designed for students who have a special interest in the economics and management of businesses that provide services for the agricultural sector of the economy.

Agricultural and applied economics provides a general program in the economics of the agricultural sector and of resource use. It is an appropriate major for those students who (1) are interested in applied economics; (2) want to survey offerings in agricultural, resource, and managerial economics, such as management, marketing, economic development, policy, and environmental and resource economics; and (3) want to prepare for graduate work in agricultural economics. It is an appropriate option for those interested in the application of the principles of economics to problems in both the public and private sectors.

Business management and marketing applies the principles of economics and the tools of management to prepare students for careers in business. Special emphasis is given to developing decision-making skills and to the study of the structure and practices of business institutions. This prepares students for careers in market analysis, sales, banking, merchandising, production management, and general business management.

Environmental and resource economics provides training for students interested in applying economic concepts to problems of the environment and resource use. This specialization is a good option for those wishing to take positions as analysts with agencies that have environmental responsibility or face environmental regulations.

Farm business management and finance is intended for students with farm experience who are interested in farming, farm management, or farm finance careers, in such positions as agricultural lenders, extensions specialists, or consultants.

Food-industry management is designed for students interested in management or sales positions with the processing, manufacturing, or distribution segments of the food industry.

All of these areas of specialization can provide a strong foundation for graduate work. In planning a course schedule, students must work closely with their faculty adviser. Each area of specialization has its own set of required and recommended courses, yet all the areas have enough flexibility to satisfy the interests and abilities of individual students.

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. Student services associated with the major, such as the Behrman Biology Center and the Office of Undergraduate Biology, 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 animal physiology, biochemistry, cell biology, ecology and evolutionary biology, general biology, genetics and development, microbiology, neurobiology and behavior, systematics and biotic diversity, and plant biology. A special program of study is available for qualified students with an interest in nutrition. Students interested in the marine sciences may consult the Cornell Marine Programs Office, G14 Stimson Hall, 255–3717, for academic advice and career counseling. For more details about the biology curriculum see the section in this catalog on Biological Sciences.

Biometry and Statistics

Biometry is 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 a statistician or biometrician can encompass research, teaching, consulting, and computing in almost any mix 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 a major in biometry and statistics, 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, 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., Computer Science 100), mathematics courses (at least three semesters of calculus), and Biometry and Statistics 100, 101, 102, 261–302, 408–409, 417, and Industrial and Labor Relations 310, and Operations Research and Industrial Engineering 270. Experience gained through summer employment or work as an undergraduate teaching assistant is highly recommended. Students should contact Steven J. Schwager for information.

Communication

The single most important thing for you to learn in college is how to assess and manage constantly changing information. No longer are skills and knowledge enough. The amount of information the public receives and is expected to understand is increasing 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.

When you graduate from our department, you will be better at the basic communication skills of speaking, writing, and listening. Equally important, as a communication major you will also understand:

- communication processes, such as how communication influences attitudes, opinions, and behaviors
- how communication systems work in our society and in others
- how to apply your understanding of communication to solving problems in science, government, industry, health, and education.

The communication major is a program with a strong core (eight courses) of contemporary communication knowledge, theory, and practice. Required freshman courses are:

Fall semester:

Comm 120 Contemporary Mass Communication

Comm 121 Investigating Communication

Spring semester:

Comm 116 Communication in Social Relationships

Comm 117 Writing about Communication

This set of courses will provide you 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, you will take:

Fall semester:

Comm 201 Oral Communication

Comm 230 Visual Communication

Spring semester:

Comm 253 Information Gathering and Presentation

Comm 282 Communication Industry Research

After completing the eight courses in the core curriculum, all majors take an additional six courses (18 credits) in communication. You can choose to concentrate your advanced study in one of four focus areas:

- Communication in the Life Sciences. (Studies of the impact of communication on environmental, health, science and agricultural issues, as well as 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 as a Social Science. (Study of communication research and methods with emphasis on communication as a social science discipline.)
- Communication Systems and Technology. (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 within society at large. Both are critical to successful careers and enlightened citizenship in the twenty-first century.

Education

The focus of the Department of Education is on the improvement of teaching and learning within school and other settings, as well as on the role of education in society. Students study concepts and develop competencies necessary to analyze educational situations critically and to plan, implement, and evaluate educational programs. Study at the undergraduate level is structured around a core curriculum:

- An introductory course in current educational issues (Education 101) (3 credits)
- Course work in the social, philosophical, psychological, and social foundations of education (e.g., Education 271, 311, 317, 370, 378, 472, 477) (12 credits)
- Supervised field experience (e.g., Education 240 for non-majors and Education 420 for majors) (1–4 credits)
- A capstone course to integrate the students' undergraduate experience (Education 495) (2 credits)

Three specializations and three certification programs are available within the department.

Agricultural, extension, and adult education. Agricultural, extension, and adult education is a program that combines preparation in both the agricultural and social sciences. The program prepares students for teaching careers in agriculture, science, and technology in public schools, the Cooperative Extension service, and extension and adult programs of agricultural businesses, government agencies, and a variety of private and not-for-profit organizations. Students take a college program that includes a balance of courses in education as well as courses in a technical area of agriculture/biotechnology, community/economic development, natural resources, human ecology, or communication. Education courses prepare students to succeed as educators in a broad range of careers. Courses are selected to develop professional

leadership and teaching competence. Students may elect to focus their study on one or more of these areas: agricultural education, extension education, or adult education. As an alternative, students may elect to major in one of the college's technical departments and develop a complementary program of study in one or more of the three areas of agricultural, extension, and adult education. Further information is available from the agricultural, extension, and adult education coordinator, Kennedy Hall (Tel: 607–255–7381).

Educational psychology. Studies in educational psychology have traditionally focused on teaching and learning in schools. Yet schools are only one location in which learning and teaching take place. An undergraduate emphasis in educational psychology at Cornell applies principles of teaching and learning to educational enterprises, broadly defined.

While graduate study is required for many careers in psychology, an undergraduate emphasis in educational psychology provides excellent preparation for graduate work or for many post-baccalaureate positions. Educational psychologists develop and/or supervise training programs in business, industry, the military, and government; design and evaluate curriculum and instructional materials for publishers; develop tests for educational and professional associations; evaluate social programs; work in human resource management; and conduct applied research for educational research organizations.

Students interested in concentrating their studies in educational psychology complete a total of 20–25 hours in educational psychology and related courses. Working with a faculty adviser, a student may design a program in one of a variety of applied areas: Instructional Systems Design and Development; Human Relations; Individual and Social Development; or the Educational Psychology of Human Development.

Students interested in careers in educational psychology should apply for admission to the Department of Education. For more information regarding a concentration in educational psychology, contact: Coordinator, Educational Psychology Program, Education Department, Kennedy Hall (Tel: 607–255–9258).

General education. The concentration in general education is appropriate for students seeking a solid foundation in the disciplines underlying the education professions. Students take courses in areas such as the art of teaching, philosophy of education, social foundations of education, curriculum and instruction, and related areas. Graduates of the concentration in general education may continue their studies in various areas of education or pursue careers in educational and human resource areas in business and industry, the human services, or government agencies. There are growing opportunities for employment of education graduates in the human resource management areas of agribusiness firms. Further information about the general undergraduate education is available from the undergraduate coordinator (Tel: 607–255–9269).

Teacher Certification

Students at Cornell may pursue secondary, grade 7–12 teaching credentials in agricultural education or a technical field of agriculture, mathematics, biology, chemistry, physics, earth science, and general science. The New York State Board of Regents has approved significant changes in NYS teacher certification requirements, and all registered teacher education programs in New York will be applying for re-registration with the State. Currently, Cornell operates a registered program with the State, and the faculty is preparing its re-registration application.

Agriculture. Students completing the registered program as undergraduates in agriculture are eligible to teach agricultural subjects, introduction to occupations, occupational science or math, and introductory technology for grades 7 and 8. Passing scores on the National Teacher Examination (NTE) or New York State Teacher Certification Exam (NYSTCE) and one year of agricultural work experience are required for provisional certification, which is valid for five years. The master's degree required for permanent certification is offered through graduate study at Cornell. Students who complete the required course work may also be dual-certified to teach selected science subjects and work as a work experience coordinator through direct application to the State Education Department. For more information, contact the coordinator for teacher certification (Tel: 607–255–9255).

Science and Mathematics. Students completing the registered program in science and mathematics may pursue secondary teaching credentials in biology, chemistry, earth science, general science, mathematics, and physics. Students can begin the program as Cornell juniors or seniors by completing their undergraduate major in their subject matter and five courses in education. Students from all Cornell colleges may apply. In a year of graduate study, students take additional math and/or science courses and student teach. Students may begin their certification studies as graduate students and complete a Master of Arts in Teaching (M.A.T.) degree in three semesters. Students who choose to earn certification and do a research project can complete a Master of Science degree (M.S.) in a minimum of four semesters. Both the M.A.T. or the M.S. can be used to satisfy state requirements for permanent certification. Students who complete either graduate program option after passing the New York State Teacher Certification Exam (NYSTCE), are eligible for New York State Certification. For more information, contact the coordinator for teacher education 607–255–9255.

Administrator Certification

In the process of earning a Ph.D. in education, graduate students may also earn New York State certification as a school district administrator. This certificate is normally required of all candidates for a district-level position as a school administrator (e.g., superintendent, curriculum director, etc.). The certificate also makes its holder eligible for building-level positions as principal and vice principal. New York State certification as a school administrator is usually recognized in other states.

The program is unique in that it is specifically designed to prepare administrators for small and rural school districts. Course work, the internship, and the doctoral dissertation are all oriented toward addressing the practical problems that characterize such districts and preparing candidates to assume a leadership position within them. To earn certification, a student must complete at least one year of full-time, on-campus study followed by a one-year, half-time administrative internship in a cooperating school district. To be eligible for this program, students should possess the equivalent of a master's degree, have a satisfactory graduate and undergraduate record, and three years of teaching experience. For more information, contact the coordinator for Administrator Certification Program (Tel: 607–255–7758).

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
- Chemistry 206–208 or 207–208
- Chemistry 257 (organic)

General Biology

- Introductory Biology
- Biological Sciences 281 (Genetics)
- Biological Sciences 387 (Evolutionary Biology)
- A choice of one: Biological Sciences 261 (Principles of Ecology) or Biological Sciences 330 or 331 (Principles of Biochemistry)

Entomology

- Entomology 212 (Insect Biology)
- A choice of two:
  - Entomology 322 (Insect Morphology)
  - Entomology 331 (Insect Systematics)
  - Entomology 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 mission of the Food Science Program is to educate students for careers in food science and technology. Graduates are prepared for entry level positions in industry, government, and research organizations or for advanced study in food science and related disciplines. Food scientists qualify for satisfying careers which focus on ensuring 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 choose one of five specialization options: 1) Basic Food Science, 2) Food Engineering, 3) Food Processing, 4) Food Industry Operations and Management, 5) Food Biotechnology. The first three options meet minimum curriculum standards set by

the Institute of Food Technologists, the premier professional society for food scientists. Students choose an option based on individual interests and career goals.

The first two years of the program are focused on establishing a solid background in the physical and biological sciences, math, and communication. Required courses include chemistry (intro and organic), biology, microbiology, calculus, physics, freshman seminar, food science, and nutrition. The second two years emphasize the application of basic science and technology to the processing, storage, distribution, marketing, and final preparation of foods. Required courses include Food Engineering Principles, Unit Operations in Food Manufacturing, Food Safety Assurance, Food Chemistry, Sensory Evaluation of Foods, Food Microbiology, and Statistics. Students choose electives to satisfy college distribution requirements and individual interests.

Students are strongly encouraged to participate in research supervised by a faculty member and/or to work as an intern in a food company during summer breaks. Most faculty in the department have active research programs and welcome participation by undergraduate students. Students may receive academic credit or wages for faculty directed undergraduate research. Many food companies recruit on campus for their summer internship programs. These internships are excellent opportunities for students to gain experience and establish contacts for future employment.

A state-of-the art food processing and development laboratory, a full-scale dairy plant, and extensive laboratory facilities are available for training, research, and employment.

Landscape Architecture

Landscape Architecture focuses on the art of landscape design as an expression of cultural values combined with 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 intellectually, technically, artistically, and ethically 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, housing, 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; 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 several parts: 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 concentrations 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, Design and Plant Establishment in the Urban Environment	3
*LA 201, Medium of the Landscape	5
†Biological Sciences elective	3
†Social Sciences or Humanities elective	3
*HORT 335, Woody Plant Materials for Landscape Use	3
	17
Spring Term	
*LA 202, Medium of the Landscape	5
*LA 315, Site Engineering I (1st 7 weeks)	2
*Historical studies	3
†Written or oral expression elective	3
†Physical sciences elective	3
	16

Third Year

Fall Term	
*LA 301, Integrating Theory and Practice	5
*LA 316, Site Engineering II (2nd 7 weeks)	2
*LA 317, Site Construction I (1st 7 weeks)	2
*Historical studies	3
‡Free electives	3
	15
Spring Term	
*LA 302, Integrating Theory and Practice	5
**Concentration	6
‡Free elective	3
*LA 318, Site Construction II (2nd 7 weeks)	2
	16

Fourth Year

Fall Term	
**Concentration	6
†Social sciences or humanities elective	3
‡Free elective	3
(Optional landscape architecture study abroad semester in Denmark or Rome)	12
Spring Term	
*LA 402, Urban Design in Virtual Space	5
**Concentration	3
*LA 412, Professional Practice	1
‡Free elective	3
	12
Summary of credit requirements	
*Specialization requirements	54
†Distribution electives	39
‡Free electives	12
**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, 6 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	3
*LA 501, Composition and Theory	5
*HORT 335, Woody Plant Materials for Landscape Use	3
*LA 491, Design and Plant Establishment in the Urban Environment	3
	17

Spring Term	
*LA 502, Composition and Theory	5
*Historical Studies	3
**Concentration	3
*LA 615, Site Engineering I (1st 7 weeks)	2
*LA 590, Theory Seminar	3
	16

Second Year

Fall Term	
*LA 601, Integrating Theory and Practice	5
*LA 616, Site Engineering II (2nd 7 weeks)	2
*LA 617, Site Construction I (1st 7 weeks)	2
*Historical Studies	3
**Concentration	3
	15

Spring Term	
*LA 602, Integrating Theory and Practice	5
*LA 618, Site Construction II (2nd 7 weeks)	2
*Historical Studies	3
**Concentration	6
	16

Third Year

Fall Term	
‡Free electives	3
*LA 701, Urban Design and Planning	5
‡Free elective	3
**Concentration	3
	14

Spring Term	
*LA 800, Master's Thesis in Landscape Architecture	
or *LA 702, Advanced Design Studio	5
*LA 412, Professional Practice	1
‡Free elective(s)	6
	12 or 16

Summary of credit requirements	
*Specialization requirements	60 or 64
**Concentration	15
‡Free electives	15 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 are therefore expected to 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 are permitted some flexibility in establishing programs that take full advantage of the teaching and research resources of the university.

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 history, two courses in engineering, a seminar in design theory, a course in professional practice, a concentration, and electives.

Undergraduate Concentration for Non-Majors

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 inquires to professors H. Gottfried or S. Baugher.

Required.

Visual Studies (choose one):

Arch 11 Introduction to Architectural Design (4 cr)

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)

DEA 114 Drawing (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 261 Urban Archaeology (3 cr)

+LA 262 Laboratory in Landscape Archaeology

+LA 360 Pre-Industrial Cities and Towns of North America (3 cr) offered alternate years [1999–2000]

LA 363 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

The undergraduate curriculum provides students with an integrated, broadly-based approach to understanding the relationships of organisms to their environment, and the ways in which humans affect these relationships. Natural resources are construed in the broad sense to include both the more traditional topics of renewable natural resources (e.g., wildlife, fisheries, forests) and the Earth's ecosystems of which these and other natural resources are a part. Students are encouraged to understand the scientific, ethical, and societal basis for protection and management of natural resources and environments through the application of ecological principles and knowledge of societal needs.

Required Core Curriculum

Students who desire to graduate with a specialization in Natural Resources are expected to complete, as a minimum, the courses specified in the following two-part Core Curriculum. First is a broad group of courses taken primarily outside the department, which, as their presentation suggests (Groups A–D), also fulfill this college's course distribution requirements described on page 30.

Group A—Physical Sciences	*Total Hours*
Mathematics—2 courses	6–8
Chemistry—2 courses	7–8
Group B—Biological Sciences	
Introductory biology (BIOG 101–104 or 105–106)—8 cr. hours	8
General ecology—1 course	4
Group C—Social Sciences	
3 credits in addition to 3 credits in economics	6
Humanities	
6 credits in addition to a course in "normative" ethics (NTRES 407, 411, B&SOC 206, or PHIL 241, 246, or 247)	9
Group D—Written and Oral Expression	
Freshman Writing Seminars—2 courses	6
Oral communications—1 course	3
Courses outside the Distribution Groups	
Statistics—1 course	3
Computer applications or programming—1 course	3

The Core Curriculum's second portion is composed entirely of courses offered by the Department of Natural Resources; a minimum of 19 hours in department courses is required.

YEAR 1 *Total Hours*

One of 2 introductory courses: 3

NTRES 100 Principles of Conservation (Fall, 3 cr.)

NTRES 201 Environmental Conservation (Spr., 3 cr.)

YEAR 2

both courses listed:

NTRES 210 Introductory Field Biology (Fall, 4 cr.) 4

NTRES 253 Applied Ecology and Ecosystem Management (Spr., 3 cr.) 3

YEARS 3 AND 4

At least 9 credit hours from selected upper-level courses, with a minimum of 3 credit hours in ecology and 3 credit hours in management emphasis. Consult the current course list in G12, Fernow Hall for courses meeting this requirement.

Students pursuing this specialization have approximately 40 credit hours remaining to develop one or more concentrations of their choice within or outside this field.

Students who wish to do so may specialize further in natural resource ecology and management (including wildlife, fishery, forest, and aquatic sciences), or natural resource policy, management, and human dimensions.

Opportunities for field-oriented studies are available nearby at Cornell's Arnot Teaching and Research Forest, the Cornell Biological Field Station on Oneida Lake near Syracuse, as well as at numerous natural areas near campus. An honors program is available for qualified students.

Students should 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 and Health: Concepts and Controversies, 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 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 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 Martha Van Rensselaer Hall is used by students for study and small group discussion. The center contains class materials, computers, audiovisual 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.

Plant Sciences

Plant sciences students can specialize in plant biology, plant genetics and breeding, plant pathology, plant protection, or horticultural sciences, including floriculture and ornamental horticulture, fruit science, or vegetable science. Students with well-defined interests upon arrival at Cornell can specialize in one of these programs in their freshman year. Others may prefer to start in the general plant sciences curriculum and specialize after exploring the program offerings.

Plant sciences is a multidepartmental program, sponsored by the Department of Plant Breeding in Emerson Hall, and the Departments of Floriculture and Ornamental Horticulture, Fruit and Vegetable Science, Plant Pathology, and the Section of Plant Biology, all located in the Plant Science Building.

General plant science is intended for students whose interest in studying plants has not yet centered on any one of the specializations within the area. Students may continue with this option throughout their undergraduate years, particularly if they are likely to be interested in and qualified for advanced studies beyond the bachelor's degree. Students who plan to seek employment upon graduation may prefer to specialize. There are, however, excellent opportunities for general plant science graduates at the bachelor's degree level in the service and supply industries, as Cooperative Extension educators, as teachers, and as research technicians.

More than one hundred courses are offered that deal directly with some area of plant science. Other courses relating to plant science are offered in other departments. In addition, an interest in plant science may be combined with another specialization, such as agricultural and biological engineering, education, statistics, international agriculture, food science, or agricultural, resource, and business management.

Undergraduates are encouraged to obtain practical experience, which may involve internship and/or research under the direction of a faculty member or work in a commercial industry, research institute, botanical garden or arboretum, nursery, greenhouse, or farm operation. Departments will assist students in finding positions that will provide useful experience.

Floriculture and ornamental horticulture applies principles of plant science, business management, and many other disciplines to the production and marketing of greenhouse, nursery, and turfgrass crops, as well as to the selection and management of plants in both indoor and outdoor landscapes. Programs prepare students for careers at the professional and managerial levels in horticultural business, landscape management, botanical gardens and arboreta, research, teaching, communications, and extension and public education.

The core curriculum consists of the following courses:

BIO G 109 and 110, Biological Principles or an equivalent course

CHEM 206 or 207 and 208 or an equivalent course

HORT 100, Introduction to Floriculture and Ornamental Horticulture

HORT 102, General Horticulture

HORT 230, Woody Plant Materials

HORT 243, (BIO PL 243), Taxonomy of Cultivated Plants

HORT 300 Herbaceous Plant Materials

HORT 400, Principles of Plant Propagation

BIOPL 241, Plant Biology (Introductory Botany)

BIOPL 242, Plant Physiology (lecture)

BIOPL 244, Plant Physiology (laboratory)

SCAS 260, Introduction to Soil Science

ENTOM 241, Applied Entomology

PLPA 241, Plant Diseases and Disease Management or PL PA 401, Basic Plant Pathology

Although mastery of these subject areas is considered essential for students planning to enter a production or landscape horticulture career, justifiable exceptions to the core curriculum may be granted by the student's adviser.

With permission of the adviser, a transfer student may receive core curriculum credit for similar courses taken at other institutions provided that transfer credit is granted by the College of Agriculture and Life Sciences. In addition, all transfer students must complete a minimum of 12 credits in floriculture and ornamental horticulture courses at Cornell. No more than two of the following landscape architecture courses may be included in this 12-credit requirement: LA 141, 142, 282, 315, 316, 317, 318, 410, 480. No other landscape architecture or freehand drawing courses may be applied to the requirement because they do not contain horticultural subject matter.

Students may select an area of emphasis in either production or landscape horticulture, or they may study generally across the specialization. Concentration in production prepares students for careers in greenhouse and/or nursery management and wholesale- and retail-product marketing. Specialization in landscape horticulture trains students for careers in turfgrass management, golf course management, exterior and interior landscape contracting and service, retail- and wholesale-marketing of services, public and botanical garden and arboretum management, urban horticulture, agroforestry, arboriculture, and related areas. Some students choose to pursue a general program in production and landscape horticulture including courses in both areas. Similarly, programs in horticultural business management, research, teaching, extension and public education, and communications/journalism may be arranged across two specialization areas. Students wishing to prepare for graduate study may develop a program in basic sciences and their application in horticultural science. Lists of recommended courses for the areas of specialization are available from student advisers and from the undergraduate program coordinator.

Working with a faculty adviser, each student will tailor a program to achieve individual educational objectives in production horticulture, landscape horticulture, horticultural business management, or general horticultural science. A core of management courses also is strongly recommended for students planning horticultural business careers. Students are also encouraged to take courses in these areas: agricultural and biological engineering, soil science, computer science, ecology, entomology, geology, plant breeding, plant pathology, plant physiology, oral and written expression, plant taxonomy, and weed science. Use of electives to pursue study in the humanities and in other areas of special interest to the student is encouraged. Numerous opportunities to become familiar with the horticultural industries and professions are provided through field trips, guest lectures, undergraduate seminars, independent or small-group study, optional internships, and work-experience programs.

Questions concerning the undergraduate curriculum, advising, and related manners should be addressed to Associate Professor Kenneth W. Mudge, Undergraduate Program Coordinator, Department of Floriculture and Ornamental Horticulture, 20 Plant Science Building, Ithaca, New York 14853–5908; telephone: 607–255–1794; e-mail: kwm2@comell.edu.

The department's office is located at 20 Plant Science Building. Departmental facilities include classrooms and laboratories in the Plant Science Building, greenhouse and laboratory facilities at the Kenneth Post Laboratory, the Test Garden, the Turfgrass Research Field and Laboratory, the Long Island Horticultural Research Laboratory and freehand drawing studios in Mann Library.

Plant biology provides undergraduates with preparation for graduate study in the plant sciences that stresses basic, rather than applied, research. In cooperation with an adviser, each student plans a curriculum with a concentration in basic sciences supplemented by courses in applied areas that seem appropriate. Options include molecular biology, plant physiology, plant biology, genetics, cytology, organic chemistry, biochemistry, anatomy, taxonomy, ecology and evolution, and statistics. A core of courses, including mathematics, plant biology and physiology, and cytology, is strongly suggested. However, different specialties within plant biology afford a flexible curriculum.

Plant genetics and breeding provides undergraduates with (1) preparation for graduate study leading to advanced degrees in plant breeding and plant genetics and (2) preparation for work in producing and marketing plant varieties and making varietal recommendations; for positions in seed analysis, regulation, and quality control; and for work in biotechnology laboratories.

In cooperation with an adviser, each student plans a curriculum with a concentration in basic sciences supplemented by courses in applied fields best suited to his or her individual goals. Options include plant breeding; genetics, cytology, and cytogenetics; statistics; organic chemistry and biochemistry; plant anatomy, ecology, taxonomy, and physiology; crop production; plant pathology; entomology; and molecular biology and biotechnology.

Students are encouraged to gain hands-on experience in plant genetics and breeding by conducting independent research under direction of a faculty adviser and/or by working for a faculty member on his/her research. Field, greenhouse, and laboratory facilities are available.

Plant pathology is the study of the causes of plant diseases, the mechanisms of the interactions of disease-causing agents and plants, and the methods of preventing or controlling plant diseases. 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, this concentration also prepares students for careers as technical representatives for agribusiness, as Cooperative Extension agents, as state or federal regulatory agents, or as research technicians in laboratories of plant pathology, mycology, microbiology, and biotechnology.

Courses include chemistry, mathematics, introductory biology, botany, plant physiology, and introductory plant pathology. Additional plant pathology courses and other relevant courses from other fields are selected according to the particular interests of the student. Options include entomology; plant breeding; pomology; vegetable crops; floriculture and ornamental horticulture; and soil, crop, and atmospheric sciences.

Plant protection is offered for 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. This concentration can prepare students for careers in agribusiness, the agrichemical industry, Cooperative Extension, pest management consulting, state and federal regulatory work, and a variety of other technical positions. Although designed as a terminal program for students desiring a practical preparation in general plant protection, this specialization can also provide an adequate background for graduate work in entomology, plant pathology, or weed science.

The following subjects are considered essential to the plant protection specialization: botany and plant physiology, general ecology, soils, crop science, and microbial ecology. Additional courses in introductory entomology, introductory plant pathology, plant disease control, weed science, and integrated pest management are recommended.

In addition, a number of other subjects pertinent to plant protection are recommended, depending upon the student's interests: agricultural economics, agricultural and biological engineering; soil, crop, and atmospheric sciences; biochemistry; communication; pathology and entomology; general physics; genetics; meteorology; mycology; pesticides in the environment; and plant anatomy. Employment involving practical experience in plant protection between the junior and senior years is encouraged. The job may be on a farm, at an experimental station, with an agrichemical company, or with a regulatory agency.

Pomology (the science of fruit growing) provides students with knowledge of the scientific technology and the influence of environmental factors on the production, handling, and storage of deciduous fruit crops. New York is a national leader in fruit production.

Courses are selected by students in consultation with a faculty adviser. Flexibility in programs makes it possible to establish a course of study to fit the desired goals of individual students. The diverse pomology curriculum, complemented by courses in basic sciences and arts and electives in a student's area of interest, prepares pomology majors for a career in fruit production, agricultural business related to the fruit industry, storage and merchandising, or professional pomology. Job opportunities for graduates can be found in fruit production, marketing, sales and service, research, teaching, and extension.

Vegetable crops is offered for students with an interest in either applied or basic aspects of vegetable production. The high value of vegetables and their importance in the human diet assures a continued demand for trained personnel in all aspects of vegetable technology. A flexible curriculum is provided to prepare undergraduates for careers in a diversity of fields, including: horticultural

research, teaching, extension, production, processing, and marketing. A faculty adviser assists individual students in the selection of courses, which usually include: general horticulture, soils, botany, vegetable types and identification, vegetable production, and post-harvest handling or marketing. Additional course work depends upon the interest of the student, and may include: vegetable physiology; plant breeding; entomology; plant pathology; weed science; ecology; soil, crop, and atmospheric sciences; nutritional science; agricultural economics; international agriculture; and agricultural and biological engineering.

The vegetable industry is an economically important component of agriculture in New York and in the United States. Recently, there has been increased interest in growing vegetables in tropical countries. Exciting challenges are facing the industry. Greater awareness of environmental and health issues is driving farming practices to depend less upon agricultural chemicals. New technologies are being developed and implemented to help growers make this change while remaining profitable. Among these technologies are: integrated pest management, genetic engineering, breeding for insect and disease resistance, low-input and organic cropping systems, and cultural practices that improve production efficiency and conserve agricultural resources.

The Department of Fruit and Vegetable Science has on-campus greenhouses and laboratories as well as two research farms in the Ithaca area that support our teaching program. Students are encouraged to gain hands-on experience growing vegetables and to pursue their individual interests through course work and by taking advantage of the many resources available in the College of Agriculture and Life Sciences.

Rural Sociology

Technological, economic, demographic, and environmental changes are social processes, and 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. Among the topic areas in which faculty members in the Department of Rural Sociology specialize are international agricultural and rural development, community and regional development and changes in the United States, environmental sociology, aging and the life course, sociology of agriculture, rural industrialization and labor markets, technology and social change, population and development, political economy, women in development, race and ethnic relations, and research methodology. Most courses provide background in both domestic and international aspects of the subject matter. Normally, students will develop a specialization with either a domestic or international 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.

Recognizing that students are concerned with future career opportunities, the undergraduate program emphasizes acquisition of skills as well as general knowledge in preparation for jobs or further study upon graduation. Accordingly, students are expected to become involved in the application of theory, methodology, 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., or 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. For many years, the department and graduate field have been recognized as among the top programs in the country, and both are known for innovative program orientations. 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 other topics. Faculty members in this department are committed to both quality instruction and research programs. Being located in a college of agriculture, faculty members maintain strong ties to the technical fields within the college as well as with the International Agriculture Program, the Biology and Society Program, the Cornell Institute for Social and Economic Research, the Community and Rural Development Institute, the Gender and Global Change Program, the Life Course Institute, the Rural Development Program, the Hispanic Studies Program, the Program on Science, Technology, and Society, and the Center for International Studies. Nearly half of the department faculty are associated with one or more area studies programs (the Southeast Asia Program, South Asia Program, Latin American Studies Program, East Asia Program, or 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 course work by electing courses in these other departments and programs, thereby rounding out their educations with different perspectives.

The courses offered in rural sociology can be grouped into three broad categories: development sociology; population, environment, and society; and social data and policy analysis. All students majoring in Rural Sociology are required to take five core courses: an introductory course (R SOC 101), methods (R SOC 213), theory (R SOC 301), social stratification (R SOC 370), and a course in statistics. Four elective Rural Sociology courses are also required of all majors.

The focus area in development sociology provides an understanding of the processes and policies that influence social and economic development in rural settings in North America and low-income countries in the developing world. Courses provide background in the sociology of development in both the advanced and developing countries. Students normally select a set of elective courses in which either domestic or international development is emphasized. These courses provide background in several aspects of development sociology, including (1) an understanding of the processes of socioeconomic development in low-income or Third World countries and training in the formulation of strategies to enhance the socioeconomic well-being of citizens of those countries, (2) analysis of the social structures and processes for development in nonmetropolitan settings in the United States, (3) analysis of the processes of agricultural change and development in industrialized and low-income countries, and (4) an understanding of the processes of technological development and change in agriculture and other rural industries in developed and developing countries.

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.

Courses in the population, environment, and society focus area provide an understanding of (1) the causes and consequences of the major components of population change—fertility, mortality, and migration; (2) the major patterns of population distribution and population characteristics in the United States and the developing world; (3) the relationships between social structure and the biophysical environment; (4) the relationships between population change and natural resource utilization in development; and (5) impacts of public policy interventions on population size, growth and composition or on natural resource availability and environmental quality. Students normally select the elective courses for the major so as to stress either population studies or sociological aspects of natural resources and the environment.

Students are encouraged to complement courses in the department with course work in demographic methods, household analysis, ecology and evolution, environmental studies, natural resources, and policy sciences.

Courses in the social data and policy analysis focus area provide (1) knowledge of research methodology, statistics, and computer applications, (2) an understanding of social, economic, political, and historical concepts essential for conducting meaningful analyses of practical problems and issues faced by organizations, communities, regions, and states, and (3) knowledge and practice in policy analysis. Students ordinarily select electives in order to specialize in either policy analysis or in a particular area of public policy (international development policy, domestic rural development policy, environmental policy, or population policy, etc.).

Students are encouraged to complement courses in the department with course work in data collection and research design, evaluation research, computing, and advanced statistics.

Soil, Crop, and Atmospheric Sciences

The Department of Soil, Crop, and Atmospheric Sciences provides instruction in five specializations: atmospheric science, agronomy, crop science, science of earth systems, 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 some of these specializations.

Atmospheric science is the study of the atmosphere and the processes that shape our weather. The core curriculum in meteorology is designed to provide students with an understanding of the fundamental physical and dynamic properties and processes of the

atmosphere. All students are required to complete a minimum of five semesters of calculus; two semesters of physics; a semester each of chemistry, computer science, and statistics; and a sequence of eight courses covering observational, general, theoretical, and synoptic meteorology. Additional courses are available for students interested in specialized areas of meteorology. The curriculum satisfies the basic requirements for employment as a professional meteorologist and provides a sound background for graduate study or work in the numerous specialized areas of meteorological science. Students are encouraged to choose additional course work in related or complementary areas of interest, such as agriculture, biology, computer science, mathematics, statistics, physics, chemistry, or engineering.

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.

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.

Science of Earth Systems integrates atmospheric and soil science as well as other earth studies to develop a scientific basis for managing the basic resources of the planet. This is an interdisciplinary program described in detail elsewhere (see index).

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 4 credits in the introductory course. In addition, chemistry, mathematics, physics, and microbiology are required, as well as 6 credits of crop science to satisfy the major.

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, 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.

International Agriculture 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 are designed to acquaint students with the socioeconomic factors in agricultural development, with the physical and biological nature of tropical crops and animals, and the various world areas for which study programs exist. Study of a foreign language is required.

In addition to the college distribution requirements, students in International Agriculture must take a minimum of 30 credits toward the major. A minimum of 7 credits in International Agriculture and 8 credits in a modern foreign language are required. 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.

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 full-time semesters of Cornell credits in residence, 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 full-time semesters of Cornell credits in residence, 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 full-time semesters of Cornell credits in residence, 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 honors research 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 Honors Research 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 10 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.

Phi Kappa Phi is an honor society that recognizes outstanding scholarship in all academic disciplines. Members are nominated from among juniors, seniors, graduate students, and faculty. Seniors must be in the top 10 percent of their class, and juniors in the top 5 percent of their class to be eligible.

DESCRIPTION OF COURSES

Undergraduate and graduate courses in the college are offered through the sixteen 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 relationship to other peoples in the United States and Canada. Students are challenged by such 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 focusing on American Indian life from pre-contact times to the present, and from the perspectives of Native people as much as possible. Core courses are supplemented by a variety of offerings in several different departments.

The American Indian Program offers a concentration in American Indian Studies to undergraduate students in conjunction with their major defined elsewhere in the university. The concentration will be earned upon completion of five courses: American Indian Studies 100 (enroll for Rural Sociology 100) and American Indian Studies 175 (enroll for Rural Sociology 175), 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 should obtain application materials from the AIP office in 300 Caldwell. AIP also offers a graduate minor.

Students interested in choosing the minor should contact Daniel Usner, History Department, 255–6753.

J. Mt. Pleasant, Director; D. J. Barr, S. Baugher, C. C. Geisler, D. J. Greenwood, J. Henderson, B. Lambert, D. L. Moore, K. Shanley, D. H. Usner, R. W. Venables, K. Walkingstick

Until American Indian Studies courses are entered into the registrar's computer listing, students should register for these courses in the cross-listed department.

AIS 100 Indian America to 1890 (enroll for Rural Sociology 100)
Fall. 3 credits. S-U optional. Enrollment limited to 550. W 7:30–10 p.m.
R. W. Venables.
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 which 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 Societies (enroll for Rural Sociology 175)
Spring. 3 credits. S-U grades optional. Lecs, W 7:30–9:30 p.m.; sec, various times.
Staff.
American Indian cultural and political history from 1890 to the present will be the primary focus of this course, with a review of important earlier events in U.S./Native American national relations. Emphasis will be on Native American perspectives, with guest lectures and media presentations.

[AIS 209 Political History of American Indians in the U.S. (enroll for History 209)]

AIS 230 Cultures of Native North America (enroll for Anthropology 230)

AIS 260 Introduction to American Indian Literatures (enroll for English 260)

[AIS 261 Urban Archaeology (enroll for Landscape Architecture 261)]

[AIS 276 American Indian History 1500–1850 (enroll for History 276)]

[AIS 277 American Indian History since 1850 (enroll for History 277)]

[AIS 278 Native American Poetry (enroll for English 278)]

AIS 318 Ethnohistory of the Northern Iroquois (enroll for Rural Sociology 318)

[AIS 329 Indians, Settlers, and Slaves in the early South (enroll for History 329)]

AIS 360 Preindustrial Cities and Towns of North America (enroll for Landscape Architecture 360)

[AIS 361 Sociology of American Indians (enroll for Rural Sociology 360)]

AIS 363 American Indians, Planners, and Public Policy (enroll for Landscape Architecture 363)

AIS 367 American Indian Tribal Governments (enroll for Rural Sociology 367)

[AIS 370 Resistance and Adaptation: Native American Responses to the Conquest (enroll for History 370)]

[AIS 394 Topics in American Indian Literature (enroll for English 394)]

[AIS 429 Undergraduate Seminar in Indians of Eastern North America (enroll for History 429)]

AIS 442 American Indian Philosophies: Selected Topics (enroll for Rural Sociology 442)

[AIS 471 American Indian Women's Literature (enroll for English 471)]

[AIS 494 Special Topics in American Indian Studies]

[AIS 624 Graduate Seminar in American Indian History (enroll for History 624)]

[AIS 659 Trickster in American Indian Literature and Culture (enroll for English 659)]

[AIS 665 Native American Contributions to Anthropological Thought (enroll for Anthropology 665)]

[AIS 687 American Indian Literature: Issues of Transition, Collaboration and Alternate Discourse (enroll for English 687)]

Science of Earth Systems

During the past several decades, with the increasing concern about air and water pollution, nuclear waste disposal, the ozone hole, 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 systems individually. The interconnectedness of these systems is a fundamental attribute of the Earth System, and understanding their various interactions is crucial to understanding our environment.

A new major in the Science of Earth Systems (SES) is now available for students in the College of Agriculture and Life Sciences. As described in the "Interdisciplinary Centers, Programs, and Studies" section at the front of this catalog, SES is an intercollege major which is also accessible to students in the Colleges of Engineering and Arts and Sciences.

The SES curriculum emphasizes strong preparation in mathematics, physics, chemistry, and biology, and an introduction to the breadth of the major during the freshman and sophomore years. In the junior and senior years, students take a set of common SES core courses (SES 301, 302, 321, 402) and an additional set of advanced disciplinary or interdisciplinary courses that build on the basic sequences.

The SES program provides strong preparation for graduate school in any one of the Earth Systems Sciences and related engineering fields, in addition to preparing students for a wide variety of careers in environmental work with the B.S. degree. The SES major also provides a sound background for students who are interested in entering fields such as environmental law and policy with a strong scientific understanding of the environment.

For complete information about the SES major, see the Web site at http://www.geo.cornell.edu/ses/SES_home.html

For more information, contact a SES adviser to explore the possibility of entering the SES major in the College of Agriculture and Life Sciences: K. H. Cook (SCAS), T. E. Dawson (Ecology and Systematics), L. O. Hedin (Biological Sciences), J.-Y. Parlange (ABEN), S. J. Riha (SCAS), J. Yavitt (NTRES).

Science of Earth Systems Courses

SES 301 Climate Dynamics (enroll for ASTRO 331 or SCAS 331)

SES 302 Evolution of the Earth System (enroll for GEOL 302 or SCAS 332)

SES 321 Biogeochemistry (enroll for GEOL 321 or NTRES 321)

SES 402 Mechanics in the Earth and Environmental Sciences (enroll for ABEN 385)

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 in the "Interdisciplinary Centers, Studies, and Programs" section at the front of this catalog (see p. 22).

NONDEPARTMENTAL COURSES

ALS 101 Transition and Success in Cornell

Fall. 1 credit. Prerequisites: must be an entering student in CALS. Letter grade only. B. O. Earle (assisted by W. N. Alberta).

Discussion-oriented course to enable all new CALS students to enjoy their experience at and transition to Cornell. Lecture, discussion, guest speakers, and assignments that explore Cornell's history, services, and organizations will be 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. S-U grades optional. Prerequisite: none—but basic and advanced first aid recommended. Lec, M 2:00–5:30; lab, W 2:00–5:30. G. J. Conneman and A. E. Gantert.

E.M.T. is an intensive 140-hour course taught throughout the fall and spring semesters. 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. Classes will be conducted in the Class of '44 classroom-fieldhouse.

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 500 Politics and Policy: Theory, Research, and Practice (also HSS 404 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, 471 Hollister Hall.

ALS 661 Environmental Policy (also Biology and Society 461 and BIOES 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 p.m. D. Pimentel.

This course uses an interdisciplinary approach to focus on complex environmental and policy issues. Ten to twelve students, representing several disciplines, investigate significant environmental problems. The research team spends two semesters preparing a scientific report for publication in Science or BioScience.

AGRICULTURAL AND BIOLOGICAL ENGINEERING

M. F. Walter, chair; B. A. Ahner, L. D. Albright, D. J. Aneshansley, J. A. Bartsch, P. C. Baveye, T. J. Cook, J. R. Cooke, A. K. Datta, K. G. Gebremedhin, W. W. Gunkel, D. A. Haith, P. E. Hillman, J. B. Hunter, L. H. Irwin, L. Jelinski, W. J. Jewell, D. B. Lund, C. D. Montemagno, J.-Y. Parlange, R. E. Pitt, N. R. Scott, T. S. Steenhuis, M. B. Timmons, L. P. Walker

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.

ABEN 102 Introduction to Microcomputer Applications

Fall or spring. 3 credits. S-U grades optional. PC or Mac labs available. All students, including those pre-enrolled, must attend the first lecture to guarantee admittance and to select a laboratory section. Lec, fall: W F 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 p.m., or R 1:25–4:25 p.m. Fee, $15. P. E. Hillman.

Introduction to application packages on microcomputers. Laboratories provide experience with word processing, spreadsheets, database management, presentation graphics, and Web page authoring. An independent project related to the student's major is required. PC or Mac labs cover the same software material. These packages and others such as desktop publishing, multimedia, statistical software, searching the Internet for information are discussed and demonstrated in the lectures, as well as computer hardware and operating systems.

ABEN 104 Introduction to Programming in Java and Fortran

Spring. 4 credits. S-U grades optional. Each lab section limited to 22 students. Lecs, T R 11:15–12:05; lab T 12:20–2:15 or W 7:30–9:25 p.m.. Fee, $15. P. E. Hillman.

An introductory course in computer programming with an emphasis on handling data and algorithm development. Problem sets are on topics of general interest. The first third of the course utilizes Fortran 90 to introduce students to procedural programming concepts and style. For the remainder of the course, students will be introduced to object-oriented programming using Java. Students are expected to spend 5 to 8 hours outside their scheduled laboratory periods to complete problem sets. No prior knowledge of computers or computer language is necessary.

ABEN 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 7–10. T. J. Cook.

Emphasis on selection of proper materials and techniques to accomplish a variety of metal fabrication and maintenance projects. To include both 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.

ABEN 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 7–10. T. J. Cook.

Principles and practice of wood construction. To include 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 will plan and construct an approved carpentry project.

ABEN 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 agricultural and biological engineering. No previous programming experience is assumed.

ABEN 200 Life after Graduation

Spring. 1 credit. S-U grades optional. Lec, T 1:25. R. E. Pitt.

A required course for freshman majors in Agricultural and Biological Engineering. A forum to discuss the career opportunities for engineering students and the activities and

curricula that will 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 personalized written career plans, do a web search for jobs and internships, and select future courses to meet their career goals.

ABEN 250 Engineering Applications in Biological Systems (also Engineering Distribution 250)
Fall. 3 credits. Prerequisite: enrollment in an engineering curriculum. Recommended for the sophomore year. Lec, M W F 12:20. B. A. Ahner.
Case studies of engineering problems in agricultural, biological and environmental systems, including bioremediation, crop production, environmental controls, energy, biomedicine, and food engineering. Emphasis is on the application of mathematics, physics, and the engineering sciences to energy and mass balances in biological systems.

ABEN 300 Career Development
Spring. 1 credit. S-U option. Prerequisites: ABEN 200 or permission of instructors. Lec, T 2:30–3:20. Staff.
Career development for juniors who are thinking about jobs, graduate or professional school, or anything else. Students will work on planning their options after graduation. Development of resumes and cover letters, contacts with potential employers or graduate schools, job and school searches on the Web, professional engineering registration, entrepreneurial opportunities, career offices at Cornell, and practice interviews. Students are active participants. In addition to ABEN 300 sessions, attendance at four sessions of ABEN 200, selected by each student, is required.

ABEN 301 Renewable Energy Systems
Spring. 3 credits. Prerequisite: college physics. Lec, T R 8:40–9:55. 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 will cover solar energy, small-scale hydropower, wind, bio-conversion processes, house energy balances, and the public policy implications of alternatives. Use of spread sheets will be extensive.

ABEN 305 Principles of Navigation (also Nav S 301)
Fall. 4 credits. Four classes each week (lecture-recitation-project work). Lecs, M W F 8:00–8:50; lab, R 8:00 or 9:05. J.-Y. Parlange.
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. This course does not satisfy ABEN technical electives.

ABEN 310 Advanced Metal Fabrication Techniques
Spring. 1 credit (2-credit option available). Prerequisite: ABEN 110 or permission of instructor. Lab, F 1:25–4:30. T. J. Cook.
Principles and practices extending beyond the scope of ABEN 110. To include out-of-position, high carbon steel and cast iron welding. Soldering and brazing of aluminum, hard surfacing, both tungsten (TIG) and metallic (MIG) inert gas welding, plasma-arc and oxy cutting of metals. Planning, development, and fabrication of a metal construction project for the 2 credit option.

ABEN 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. K. G. Gebremedhin.
Understanding the principles of heat and mass transfer in the context of biological and environmental systems. Emphasis is on physical understanding of transport processes and simple reaction rates with application examples from plant and animal biology, the environment (soil/water/air), and industrial processing of food and biomaterials.

ABEN 365 Properties of Biological Materials
Spring. 3 credits. S-U grades optional. Prerequisites: one semester of math and physics. Lec, T R 12:20–1:10; lab W 2:30–4:25 or F 2:30–4:25. J. A. Bartsch.
Mechanics and structural properties of biological materials. Mechanical damage 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.

ABEN 367 Introduction to Biological Engineering
Spring. 3 credits. Prerequisites: one year each calculus and introductory biology; minimum one term each college chemistry and physics. Not open to freshmen. S-U grades optional. Lecs, T R 10:10; lab R or F 1:25–4:25. J. B. Hunter.
Explores the use of engineering principles to solve biological problems in the context of laboratory experiments. Topics may include artificial organs, neuromuscular electrical signals, mass transfer in fermentation, enzyme kinetics, mechanics of plant or animal tissue, and DNA transfer. Many topics relate to ongoing research at Cornell. Appropriate for engineering and life science students. Field trips, demonstrations, and readings in current scientific literature.

ABEN 371 Hydrology and the Environment (also Soil, Crop, and Atmospheric Sciences 371 and Geology 204)
Spring. 3 credits. Prerequisite: one course in calculus. 2 lecs, 1 lab. Lecs, T R 9:05; lab, F 2:30–4:25. T. S. Steenhuis, P. C. Baveye, L. Cathles.
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, computer programs, and laboratories foster an understanding of concepts and principles of hydrologic processes. This course satisfies the capstone design experience requirement.

ABEN 385 Mechanics in the Earth and Environmental Sciences
Spring. 4 credits. S-U option. Lecs, M W F 11:15; sec, W 2:30–4:25. P. Baveye, J.-Y. Parlange, and W. Brutsaert.
The study of the earth and the environment requires an understanding of transport and other physical processes within and at the surface of the earth. This course encourages the students to develop a broad working knowledge of mechanics and its application to the earth and environmental sciences, providing the background necessary to study the professional literature.

ABEN 411 Biomass Processing: Modeling and Analysis
Spring. 3 credits. Prerequisites: ABEN 250; ABEN 350 (or any course in heat and mass transport); BIOBM 331, 332, or BIOMI 290. Lec, M W F 9:05. 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. There is a strong emphasis on the use of differential equations to model process dynamics.

ABEN 425 Science and Technology of Environmental Management
Fall. 3 credits. Prerequisite: graduate or senior. Letter only. Lec, T R 2:55–4:10. W. J. Jewell.
Quantitative description of decline in environmental quality caused by human activities, and exploration of science and technology solutions to pollution and their limits. Tools used by engineers and scientists to understand the environment will be used to focus on water quality problems (two-thirds), air quality (one-sixth) and land quality (one-sixth).

ABEN 435 Principles of Aquaculture
Spring. 3 credits. Prerequisite: junior standing and above. Lec, T R 1:25–2:15; lab, R 2:30–4:25. M. B. Timmons.
An in-depth treatment of the principles of aquaculture: fish biology, waste treatment, engineering design, fish health, nutrition, processing, etc. This course is intended to build upon the undergraduate's previous course background and interests. Supervised "hands-on" laboratory experiences.

ABEN 449 Computational Tools for Engineers
Spring. 3 credits. S-U or letter grade optional. Prerequisite: completion of the undergraduate engineering math sequence or permission of instructor. Labs, M W F 2:30. J. R. Cooke.
This laboratory course provides a hands-on exposure to contemporary engineering software with applications from applied mathematics and the engineering sciences. The symbolic computational software, Mathematica, provides the focus for the course. Topics from Math 191–294 and more advanced topics relevant to the upper-level undergraduate curriculum and research are treated.

ABEN 450 Bioinstrumentation
Fall. 4 credits. Prerequisites: MATH 294, ABEN 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. Course satisfies the capstone design requirement.

ABEN 453 Computer-Aided Engineering: Applications to Biomedical and Food Processes
Spring. 3 credits. Prerequisite: computer programming (ABEN 151 or CS 100) and heat and mass transfer (ABEN 350 or equivalent). Lecs, M W 11:15; 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 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 part of the course (no final exam). The course satisfies the College of Engineering upper-level computing application requirement. It also satisfies the capstone design experience requirement for ABEN students.

[ABEN 454 Physiological Engineering
Fall. 3 credits. Corequisite: fluid mechanics. Lecs, T R 12:20–1:10; lab T R 1:25–4:25. Not offered 1999–2000. R. E. Pitt.
Engineering analysis and design in the physiology of animals and humans. 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.]

ABEN 456 Biomechanics of Plants
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 3:35–4:25. 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.

ABEN 471 Geohydrology (also Civil and Environmental Engineering 431 and Geology 445)
Fall. 3 credits. Prerequisites: Mathematics 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.

ABEN 473 Watershed Engineering
Fall. 3 credits. Prerequisite: fluid mechanics or hydrology. Lecs, T R 9:05; disc, R 1:25–4:30. M. F. Walter.
Engineering principles are applied to the design of soil and water management technologies aimed at solving natural resource problems in the context of watersheds. Emphasis will be placed on rural and countryside engineering and small-scale design for water conveyance, soil erosion control, flood damage control, earthen dams, ponds, moisture conservation, drainage, and water supply. This course satisfies the capstone design experience requirement.

ABEN 474 Drainage and Irrigation Design
Spring. 3 credits. Prerequisites: fluid mechanics or hydrology. Lecs, M W F 12:20. T. S. Steenhuis and L. D. Geohring.
This course will focus on design of drainage and irrigation systems for agriculture and non-agricultural 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 capstone design experience requirement.

ABEN 475 Environmental Systems Analysis
Fall. 3 credits. Prerequisites: computer programming and one year of calculus. Lecs, M W F 10:10–11:00. L. P. Walker.
Systems analysis and its use in environmental quality management. Emphasis is on modeling of environmental problems, translation of models into efficient computational algorithms, and use of computer simulation and optimization procedures (search techniques, linear programming, and dynamic programming) to evaluate management alternatives. Applications include water quality management, air pollution control, solid waste management, and industrial ecology.

ABEN 476 Solid Waste Engineering
Spring. 3 credits. Prerequisites: 1 semester of physics and chemistry. Lecs, M W F 1:25. 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; hazardous waste management. Emphasis on quantitative analyses.

[ABEN 477 Treatment and Disposal of Agricultural Wastes
Fall. 3 credits. Prerequisites: one environmental science course and at least junior-level standing; or permission of instructor. T R 2:30–3:45. Not offered 1999–2000. W. J. Jewell.
Overview of pollution problems in agriculture, legal restrictions, and technologies used to control pollution. Biological, physical, and chemical processes are applied to solve problems associated with animal wastes, food production, and food and fiber processing.]

ABEN 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.
Natural waste treatment systems are sustainable, driven by solar power, and generate useful and valuable by-products. Constructed wetlands, hydroponic applications of plants, wastewater farming, sludge and industrial residue application to land, soil restoration, bioremediation of toxics, and biofilters for air purification are examples of pollution control systems that depend on natural processes. Pollution control mechanisms in soils and plants are defined and used to design innovative treatment systems for agriculture, municipalities, and industry. This course satisfies the capstone design experience requirement.

ABEN 481 Design of Wood Structures
Spring. 3 credits. Prerequisite: ENG 202. Lecs, M W F 12:20 (Hollister Hall).
K. G. Gebremedhin. Two evening prelims.
Computer-aided and manual computation procedures of engineering wood structures. Topics include national design codes; estimation of design loads (dead, live, wind, snow, and seismic loads); mechanical properties of wood and wood products; designs of beams, columns, trusses, frames, arches, bridges, diaphragms; connections, and special wood structural systems. Engineering judgment and individual responsibility in engineering design are also emphasized. ABEN students who want to take the course to satisfy the capstone design must sign up for additional 1 credit hour of ABEN 496.

ABEN 482 Biothermal Engineering
Spring. 3 credits. Prerequisites: ABEN 250 and 350, or equivalent. Lecs, T R 11:15; lab, W 1:25–4:25. N. R. Scott.
Analysis and design of the thermal and aerial environments of plants, animals and humans. Thermal environmental requirements dictate the design of buildings to act as buffers between biological systems and weather. Heat flow, air flow, psychrometrics, energy balances, thermal biology, animal and plant models, thermal modeling, mechanical and natural ventilation, solar energy, and weather phenomena. This course satisfies the capstone design experience requirement.

ABEN 491 Highway Engineering (also Civil and Environmental Engineering 462)
Fall. 3 credits. Prerequisites: junior standing in engineering, fluid mechanics, and soil mechanics (may be taken concurrently). Lec, T R 10:10; lab, T 1:25–4:25. L. H. Irwin.
An introduction to highway engineering with an emphasis on design. Students will work in teams to apply the current standards and design criteria used in professional practice to several highway design projects. Topics of discussion include route location and design, traffic engineering, economic analysis, human factors and public safety, hydrology and drainage design, highway materials, pavement design, and maintenance. This course satisfies the capstone design experience requirement.

ABEN 494 Special Topics in Agricultural and Biological Engineering
Fall or spring. 4 credits maximum. S-U grades optional. Hours to be arranged. Staff.
The department teaches "trial" courses under this number. Offerings vary by semester and will be advertised by the department. Courses offered under the number will be approved by the department curriculum committee, and the same course will not be offered more than twice under this number.

ABEN 496 Senior Design in Agricultural and Biological Engineering
Fall and spring. 1–3 credits. Prerequisite: senior standing in ABEN engineering program or permission of instructor. Note: completing an independent study form is required to register. Hours to be arranged. Staff.
Involves capstone design experience, including a team project, incorporating analysis, design, evaluation, synthesis, and a written report of the end-product. This course may be taken in conjunction with an approved ABEN course (for an approved ABEN course, see ABEN Undergraduate Program publication).

ABEN 497 Individual Study in Agricultural and Biological 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 upper two-fifths of their class. Students must register with an independent study form (available in 140 Roberts Hall). Hours to be arranged. Staff.
Special work in any area of agricultural and biological 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.

ABEN 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). Hours to be arranged. Staff.
The student assists in teaching an agricultural and biological 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.

ABEN 499 Undergraduate Research
Fall and spring. 1–3 credits. Prerequisites: normally reserved for seniors in upper two-fifths of their class. Adequate training for work proposed. Written permission of instructor. Students must register with an independent study form (available in 140 Roberts Hall). Hours to be arranged. Staff.
Research in any area of agricultural or biological 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.

ABEN 501–502 M.P.S. Project
Fall and spring. 1–6 credits. Required of each M.P.S. candidate in the field. Hours to be arranged. ABEN graduate faculty.
A comprehensive project emphasizing the application of agricultural technology to the solution of a real problem.

ABEN 551–552 Agricultural and Biological Engineering Design Project
Fall and spring. 3–6 credits. Prerequisite: admission to the M.Eng. (Agr.) degree program. Hours to be arranged. ABEN 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. However, there 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 6 design project credits are desired in one semester, both 551 and 552 may be taken.

ABEN 651 Bioremediation: Engineering Organisms to Clean Up the Environment
Spring. 3 credits. Prerequisites: BIOMI 290 or BIOMI 398 or BIOBM 331 or permission. 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, we will evaluate the benefits as well as the current obstacles. We will examine the current efforts to genetically engineer organisms for bioremediation and the potential risks of releasing them into the environment.

ABEN 652 Instrumentation: Sensors and Transducers
Spring. 3 credits. Prerequisites: linear differential equations, introductory chemistry and introductory physics, or permission of the instructor. 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 will be emphasized. Image processing techniques will be introduced. A final project is required.

ABEN 655 Thermodynamics and Its Applications
Spring. 3 credits. Prerequisite: Mathematics 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, structure of organizations).

ABEN 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 after that). 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 Civil and Environmental Engineering 633—a complementary, but not identical, course.

ABEN 672 Drainage
Spring. 4 credits. Prerequisites: ABEN 471 and two calculus courses. S-U grades optional. Offered alternate years. Lecs, M W F 12:20; lab, T 1:25–4:25. T. S. Steenhuis.
Theory of water and solute flow in aquifers, hillslopes, 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 will be 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.

[ABEN 677 Treatment and Disposal of Agricultural Wastes
Fall. 3 credits. Prerequisite: permission of instructor. Lecs, T R 2:30–3:45. Not offered 1999–2000. W. J. Jewell.
Emphasis is on the causes of agricultural waste problems and the application of fundamentals of treatment and control methods to minimize related pollution. Fundamentals of biological, physical, and chemical pollution control methods are used in design problems with animal wastes, food production, and food and fiber processing. A semester-long design project is required. This course satisfies the capstone design experience requirement.]

ABEN 678 Nonpoint Source Models
Spring. 3 credits. Prerequisites: computer programming and calculus. Lecs, M W F 2:30. 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.

ABEN 685 Biological Engineering Analysis
Spring. 4 credits. Prerequisite: T&AM 310 or permission of instructor. Lecs, M W F 11:15. 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.

ABEN 692 Pavement Engineering (also Civil and Environmental Engineering 643)
Spring. 4 credits. Limited to engineering seniors and graduate students. Prerequisite: one introductory course in soil mechanics or highway engineering. Lec, W 1:25–2:15. L. H. Irwin.
Application of geotechnical engineering principles to the selection of materials and the design of highway and airfield pavements, computer-based methods for pavement design, structural evaluation of pavements, and pavement systems management. Topics of discussion will include bituminous mixture design; base courses; soil stabilization methods; seal-coat design; design of flexible and rigid pavements; pavement design for frost conditions; and pavement evaluation using nondestructive test methods. Laboratory will provide a case study of pavement systems management.

ABEN 694 Graduate Special Topics in Agricultural and Biological Engineering
Fall or spring. 4 credits maximum. S-U grades optional. Hours to be arranged. ABEN graduate faculty.
The department teaches "trial" courses under this number. Offerings vary by semester, and will advertised by the department. Courses offered under the number will be approved by the department curriculum committee, and the same course will not be offered more than twice under this number.

ABEN 697 Graduate Individual Study in Agricultural and Biological Engineering
Fall or spring. 1–6 credits. Prerequisite: permission of instructor. S-U grades optional. Hours to be arranged. ABEN graduate faculty.
Topics are arranged by the staff at the beginning of the term.

ABEN 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.

ABEN 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; remainder to be arranged. J. A. Bartsch.
An introduction to ABEN research policy, programs, methodology, resources, and degree candidates' responsibilities and opportunities.

ABEN 754 How to Manage a Watershed (also Government 644)
Spring. 2–3 credits. S-U grades optional. T. Steenhuis, M. Walter, N. Uphoff and R. Barker.
Examines watershed development and its relation to agriculture, irrigation and other activities within its boundaries. Emphasis on social, technical and economic processes within watersheds, including political and administrative aspects. Provides an opportunity to examine systematically the interaction of various aspects of watershed management and design in developing countries.

ABEN 771 Soil and Water Engineering Seminar
Fall and spring. 1–3 credits. Prerequisite: graduate status or permission of instructor. S-U grades optional. Hours to be arranged. 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.

ABEN 781 Structures and Related Topics Seminar
Spring. 1 credit. Prerequisite: graduate status or permission of instructor. S-U grades only. Hours to be arranged. Staff.
Advanced analysis and design of production systems with emphasis on structural and environmental requirements, biological responses, and economic considerations. Hours to be arranged.

ABEN 785 Biological Engineering Seminar
Spring. 1 credit. Prerequisite: graduate status or permission of instructor. S-U grades only. Hours to be arranged. 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.

ABEN 800 Master's-level Thesis Research
Fall and spring. 1–15 credits. Prerequisite: permission of adviser. S-U grades. ABEN graduate faculty.

ABEN 900 Graduate-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 before the "A" exam is passed.

ABEN 901 Doctoral-level Thesis Research
Fall and spring. 1–15 credits. Prerequisite: passing of Admission Candidacy Exam and permission of adviser. S-U grades. ABEN graduate faculty.

AGRICULTURAL, RESOURCE, AND MANAGERIAL ECONOMICS

A. M. Novakovic, chair; D. J. Allee, B. L. Anderson, C. B. Barrett, N. L. Bills, R. N. Boisvert, L. D. Chapman, N. H. Chau, R. D. Christy, G. J. Conneman, J. M. Conrad, H. de Gorter, G. A. German, D. A. Grossman, J. M. Hagen, J. S. Hopkins, M. J. Hubbert, H. M. Kaiser, S. M. Kanbur, W. A. Knoblauch, S. C. Kyle, E. L. LaDue, D. R. Lee, W. H. Lesser, E. W. McLaughlin, M. G. Meloy, R. A. Milligan, T. D. Mount, G. L. Poe, J. E. Pratt, C. K. Ranney, W. D. Schulze, M. W. Stephenson, D. H. Streeter, L. W. Tauer, W. G. Tomek, C. L. van Es, G. B. White, L. S. Willett

Courses by Subject

Farm management, finance, and production economics: 302, 402, 403, 404, 405, 406, 605, 608, 708

Statistics, quantitative methods, and price analysis: 210, 410, 411, 412, 415, 416, 417, 710, 711, 712, 713, 714, 717

Business management, law, and accounting: 220, 221, 320, 321, 323, 324, 325, 326, 327, 328, 422, 424, 425, 426

Public policy: 430, 431, 433, 630, 633, 634, 730, 731, 735

Marketing and food distribution: 240, 340, 342, 346, 347, 443, 446, 447, 448, 449, 640, 641, 740

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

Economics of development: 464, 665, 666, 667, 762, 763

General, contemporary issues, research, and other: 100, 380, 494, 497, 498, 499, 694, 698, 699, 700, 800, 900, 901

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.

ARME 100 Economics for Business in a Global Economy
Fall. 3 credits. Priority given to CALS majors. Prerequisite: past or concurrent enrollment in Economics 101, or the equivalent, required. Lecs, M W F 11:15–12:05; labs M 12:20–1:10, 1:25–2:15, 2:30–3:20, 3:35–4:25, 7:30–8:20 p.m., or 8:35–9:25 p.m.; T 8:00–8:50, 9:05–9:55, 10:10–11:00, 11:15–12:05, 12:20–1:10, 1:25–2:15, 2:30–3:20, or 3:35–4:25. W. D. Schulze.
Understanding individual markets and the world economy is critical for business success. This course focuses on understanding economic theory useful for formulating business strategy, such as highly competitive markets, asset markets functioning, market power, government regulation, environmental policy, international trade, and macroeconomic policy. Students participate in eight laboratory market experiments.

ARME 210 Introductory Statistics
Fall. 4 credits. Prerequisite: EDUC 115 or equivalent level of algebra. Lecs, M W F 1:25–2:15; secs, T 10:10–12:05, 12:20–2:15 (2 secs), or 2:30–4:25 (2 secs); W 10:10–12:05, 2:30–4:25 (3 secs) or W 7:30–9:25 p.m.; or R 12:20–2:15 (2 secs) or 2:30–4:25 (2 secs). 2 evening prelims. C. van Es.
An introduction to statistical methods. Topics to be 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.

ARME 220 Introduction to Business Management
Spring. 3 credits. Priority given to CALS majors. Lecs, M W F 10:10–11:00; secs, M 2:30–3:20; T 12:20–1:10 (2 secs), 1:25–2:15 (2 secs), 2:30–3:20, or 3:35–4:25; W 12:20-1:10 (2 secs), 1:25–2:15 (2 secs), 2:30-3:20, or 3:35–4:25; or R 12:20–1:10 (2 secs), 1:25–2:15 (2 secs), or 2:30–3:20. 2 evening prelims. J. M. Hagen.
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 globalization, ethics, quality, and strategic alliances. Case studies and guest executives are an important part of the course.

ARME 221 Financial Accounting
Spring. 3 credits. Not open to freshmen. Priority given to CALS majors. Lecs, M F 11:15–12:05 or 12:20–1:10; sec, T 10:10–12:05 (2 secs), 12:20–2:15, or 2:30–4:25; W 10:10–12:05, 12:20–2:15 (2 secs), 2:30–4:25 (2 secs), or 7:30–9:25 p.m. (2 secs); or R 10:10–12:05, 12:20–2:15, or 2:30–4:25. 2 evening prelims and a comprehensive final, weekly homework assignments, and 1 written case study and one project using an electronic spreadsheet. J. S. Hopkins.
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 statements interpretation. Elements examined include inventory, depreciation, internal control of assets, time value of money, notes, stocks, bonds, and the statement of cash flows. Limited use of a financial data base of publicly held companies; introduction to financial information on the World Wide Web.

ARME 240 Marketing
Fall. 3 credits. Priority given to CALS majors. Lecs, M W F 10:10–11; secs, M 2:30–3:20; T 12:20–1:10 (2 secs), 1:25–2:15 (2 secs), 2:30–3:20, or 3:35–4:25; W 12:20–1:10 (2 secs), 1:25–2:15 (2 secs), 2:30–3:20, or 3:35–4:25; or R 12:20–1:10 (2 secs), 1:25–2:15 (2 secs), 2:30–3:20, or 3:35–4:25. 5 discussion sections are held during the semester. M. G. Meloy.
This course provides a broad introduction to the fundamentals of marketing. We will explore the components of an organization's strategic marketing program, including how to price, promote, and distribute goods, services, ideas, people, and places. We will examine specifically the central role played by changing consumers; our primary emphasis will be placed on consumer goods industries. The principles and concepts from this course apply equally well to the marketing of goods and services in all sectors of the economy. Case studies, industry guest lectures, and current marketing applications from various companies will be presented and analyzed.

ARME 250 Environmental Economics
Spring. 3 credits. Lecs, T R 2:55–4:10. D. Chapman.
Concepts and methods used in the public and private analysis of environmental resources. Subjects include valuation, benefit-cost analysis, and ecological economics. Major current economic problems such as economic incentives in environmental policy, endangered species protection, forestry, energy use, world petroleum resources, and global warming. The growing world trade in resource-intensive manufactured products and the impact on income, employment, and pollution. Comparative resource use and environmental protection in industrialized and developing countries.

ARME 302 Farm Business Management
Fall. 4 credits. Not open to freshmen. This course is a prerequisite for ARME 402 and 405. Lecs, M W F 9:05–9:55; sec, W or R 1:25–4:25. 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.

ARME 320 Business Law I
Fall. 3 credits. Limited to juniors, seniors, and graduate students. Lecs, M W F 9:05–9:55. 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, property, and the landlord-tenant relationship.

ARME 321 Business Law II
Spring. 3 credits. Limited to juniors, seniors, and graduate students. Prerequisite: a course in business law or permission of instructor. Lecs, T R 8:40–9:55. 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 will review selected topics in business law, like employment discrimination, secured transactions, product liability, unfair competition, and international business law.

ARME 323 Managerial Accounting
Fall. 3 credits. Priority given to CALS majors. Prerequisite: ARME 221 or equivalent. Lecs, M W 12:20–1:10; secs, R 10:10–12:05, 12:20–2:15 (2 secs), or 2:30–4:25 (2 secs); or F 10:10–12:05 or 12:20–2:15 (2 secs). 2 evening prelims, a third exam, weekly homework, one written case study, and one project using an electronic spreadsheet. J. S. Hopkins.
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, inventory control, variance analysis, measuring divisional performance, and accounting systems in the manufacturing environment. Use of electronic spreadsheets is required.

ARME 324 Financial Management
Spring. 4 credits. Priority given to CALS majors. Prerequisite: ARME 220 or equivalent. Recommended: ARME 221 and 210 or equivalents. Lecs, M W F 9:05–9:55; secs, W 2:30–4:25 or R 10:10–12:05, 12:20–2:15, or 2:30–4:25, or F 10:10–12:05 or 12:20–2:15. 2 evening prelims. Staff.
Focuses on three major questions facing management: how to evaluate capital investment decisions, how to raise the capital to finance the firm, and how to generate sufficient cash flows to meet the firm's cash obligations. Major topics include methods to analyze investment decisions, impact of taxes, techniques for handling risk and uncertainty, effects of inflation, sources and costs of debt and equity, capital structure, leverage, and working capital management.

ARME 325 Personal Enterprise and Small Business Management
Spring. 4 credits. Limited to juniors and seniors. Prerequisites: ARME 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. Lecs, T R 12:20–1:10; sec, W 2:30–4:25. Two additional hours to be arranged. 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 no fewer than three.

ARME 326 Human Resource Management in Small Businesses
Fall. 3 credits. Prerequisite: ARME 220 or ARME 302 or equivalent. S-U grades optional. Lecs, T R 10:10–11:25 or 11:40–12:55. R. A. Milligan.
An introduction to the management of human resources in small businesses. The focus is on developing and utilizing all of the capabilities of all small business personnel including owners, family members, and employees. Topics include recruitment, selection, compensation, training, empowerment, team building, leadership, performance management, and conflict resolution. Student involvement and active learning experiences are emphasized.

ARME 327 Accounting for Entrepreneurs
Spring. 3 credits. This course is intended for non-ARME majors. Students may not receive credit for this course in addition to credit for ARME 221 and/or ARME 323. Lecs, T R 10:10–11:25; sec W 2:30–3:20 or R 1:25–2:15. M. J. Hubbert.
This course provides an introduction to the principles of accounting used by entrepreneurs who plan, direct, control, and make decisions about critical business activities in their companies. This course will provide future entrepreneurs with the requisite technical skills to accumulate, record, and communicate financial information about their businesses to internal and external parties of the firm. We will explore the principles of financial accounting (accounts receivable, inventory, fixed assets, liabilities, time value of money, investments, owners' equity) and managerial accounting (budgeting, product costing, inventory management, break-even analysis) as they apply to small businesses. Use of accounting software and the Internet will be required. This course is intended for students who have no prior accounting courses and who are preparing for an entrepreneurial career path.

ARME 328 Innovation and Dynamic Management (also Hotel Administration 418)
Spring. 3 credits. Limited to juniors and seniors. Lecs, T R 10:10–11:25. C. Enz.
For description, see H ADM 418.

ARME 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 ARME 210 or equivalent. S-U grades optional. Lecs, T R 10:10–11:25. W. H. Lesser.
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 will get some insights as well. Students will participate in a simulated trading exercise in which they will use price and

market information and input from industry experts to manage a hedge position.

ARME 342 Marketing Management
Spring. 3 credits. Limited to juniors, seniors, and graduate students. Prerequisites: ARME 240 and ECON 101–102. Lecs, M W F 10:10–11; secs, R 12:20–2:15 (2 secs) or 2:30–4:25 (2 secs); F 10:10–12:05 (2 secs), or 12:20–2:15 (2 secs). In weeks that secs are held, there will be no F lecture. R. D. Christy.
Deals with the central link between marketing at the societal level and everyday consumption by the general public. As such, this course emphasizes the management aspects of marketing by considering consumer behavior, strategies in product and brand selection, pricing, promotion, sales forecasting, and channel selection. Identification and generation of economic data necessary for marketing decisions are considered. Public policy and ethical dimensions of marketing are examined.

ARME 346 Dairy Markets and Policy
Spring, weeks 1–7. 1 credit. Limited to juniors and seniors. Prerequisites: ECON 101 or equivalent. S-U grades optional. Lecs, R 2:30–4:25. M. Stephenson.
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.

ARME 347 Strategic Marketing for Horticultural Firms
Spring. 1 credit. Prerequisite: ARME 240. Lec, M 12:20–1:10. G. B. White.
This course will emphasize applications in strategic marketing. Lectures focus on practical aspects of the planning, implementation, and control phases of the strategic marketing process. Students will develop a long-range marketing plan for a fruit, vegetable, greenhouse, nursery, or related horticultural firm.

ARME 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 ARME undergrad program office in Warren Hall.

ARME 402 Seminar in Farm Business Planning and Managerial Problem Solving
Fall. 3 credits. 4 half-day field trips. One all-day field trip. On days field trips are taken, class ends at 6:00. Prerequisite: ARME 302 or equivalent. Lecs, T R 12:20–1:10; sec, R 1:25–4:25. G. J. Conneman.
A capstone seminar/workshop designed for juniors and seniors who plan to return to the family business or home farm or to take positions in banking, credit, or agribusiness, as well as those who wish to establish entrepreneurial businesses. The objective of the course is to pull together interdisciplinary knowledge and apply it in a problem-solving/critical-thinking management context. Topics include managerial analysis and strategic planning, human resource management, and business and family arrangements.

ARME 403 Farm Management Study Trip
Spring. 1 credit. Prerequisite: ARME 302. Open by application only. Secs, arranged. W. A. Knoblauch.
A special program to study production and management systems in diverse agricultural regions of the U.S. 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.

ARME 404 Advanced Agricultural Finance Seminar
Spring. 2 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. W 2:30–4:25. 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.

ARME 405 Farm Finance
Spring. 4 credits. Prerequisite: ARME 302 or equivalent. Lecs, M W F 9:05–9:55; sec, T 2:30–4:25. E. L. LaDue.
The principles and practices used in financing farm businesses, from the perspectives of the farmer and the farm 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.

ARME 406 Farm and Rural Real Estate Appraisal
Spring, weeks 7–15. 2 credits. Limited to 40 students. Prerequisites: ARME 302 or equivalent and permission of instructor. Lec, R 11:15–12:05; sec R 1:25–4:25. Five half-day field trips, 1 all-day field trip. On days field trips are taken, class ends at 6:00. G. J. Conneman.
The basic concepts and principles involved in appraisal. Factors governing the price of farms and rural real estate and methods of valuation are studied. Practice in appraising farms and other rural properties.

ARME 410 Business Statistics
Spring. 3 credits. Prerequisite: ARME 210 or equivalent. Lecs, M W F 11:15–12:05. Two evening prelims. C. van Es.
This course focuses on four major topics 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 non-parametric methods is also included. The course will involve a research project designed to give experience in collecting and interpreting data.

ARME 411 Introduction to Econometrics
Spring. 3 credits. Prerequisite: ARME 210 and either ECON 313 or PAM 200, or equivalents. Lecs, T R 10:10–11:25. C. B. Barrett.
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.

ARME 412 Introduction to Mathematical Programming
Spring. 3 credits. Primarily for juniors, seniors, and M.S. degree candidates. Prerequisite: ARME 210 or equivalent. Lecs, T R 9:05–9:55; sec, R 12:20–2:15. H. M. Kaiser.
This is a course in applied linear programming. The emphasis will be on formulation, specification, and interpretation of solutions to mathematical models of economic problems. Standard LP problems such as cost minimization, blending, resource allocation, capital budgeting, product mix, transportation and financial planning, inventory management, etc., will be studied. Integer and nonlinear programming will be introduced if time permits.

ARME 415 Price Analysis (also Economics 415)
Fall. 3 credits. Prerequisites: ARME 210 or equivalent. ECON 313 or PAM 200 or equivalent. Lecs, M W F 9:05–9:55. 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.

ARME 416 Demographic Analysis in Business and Government (also Rural Sociology 331)
Fall. 3 credits. S-U with permission of instructor. Prerequisite: RSOC 213 or a statistics course. Lecs, W F 1:25–2:15; sec, M 1:25–2:15 or 2:30–3:20. W. Brown.
For description, see RSOC 331.

ARME 417 Decision Models for Small and Large Businesses
Spring. 3 credits. Limited to juniors and seniors. Preference given to ARME majors. Prerequisites: ARME 210 or equivalent. Lecs, M W 2:30–3:20; lab W 7:30–9:25 or R 12:20–2:15 or R 2:30–4:25. C. L. van Es.
The course is focused on economic and statistical models of decision analysis and their application in large and small business settings. The course will demonstrate 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 will be emphasized, as well as the need to combine both quantitative and qualitative considerations in decision-making. Cases will be drawn from small business scenarios, the public policy arena, and

corporate settings. Implementing decision models with computers will be the focus of lab sessions.

ARME 422 Estate Planning
Fall. 1 credit. Limited to juniors, seniors, and graduate students. S-U grades only. Lecs, M 3:35–4:25. 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.

ARME 424 Stategic Management
Fall. 3 credits. Limited to seniors majoring in business management and marketing. T R 8:40–9:55, 10:10–11:25 or 1:25–2:40. B. L. Anderson.
This is a capstone course designed to integrate what students have learned in other ARME courses with an emphasis on strategic decisions. Issues will be approached from the standpoint of the board of directors, chief executive officer, or business unit manager. What should be considered and how strategic decisions should be made are the focus of the course. While the primary focus is on public corporations, not-for-profits, cooperatives, and small business strategic decisions will also be included. The course is built around several high-level guest executives and a series of case studies. Improving oral and written communication skills in a business context is emphasized.

ARME 425 Small Business Management Workshop
Fall. 4 credits. Limited to seniors. Prerequisite: ARME 325 or NBA 300 and permission of instructor. Term project work will amount to approximately $100 per team. Lecs, M W 2:30–4:25. 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.

ARME 426 Cooperative Management and Strategies
Spring. 3 credits. Recommended: ARME 220 or equivalent. Estimated cost of field trip, $60. Lecs, M W F 12:20–1:10. 2-day field trip required. 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, taxation, as well as the unique nature of corporate 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.

ARME 430 International Trade Policy (also ECON 263)
Spring. 3 credits. Prerequisites: ECON 101–102 or equivalents and intermediate microeconomics. Lecs, T R 1:25–2:40. Optional section to be arranged. 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.

ARME 431 Food and Agricultural Policies
Spring. 3 credits. Prerequisite: intermediate microeconomics. Lecs, T R 11:40–12:55; sec, R 2:30–3:20 or 3:35–4:25. H. de Gorter.
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.

ARME 433 Devolution and Public Sector Restructuring (also City and Regional Planning 412)
Fall. 3 credits. S-U grades optional. Lec, T 10:10–12:35. M. E. Warner.
For description, see CRP 412.

ARME 443 Food-Industry Management
Fall. 4 credits. Limited to juniors and seniors. Prerequisite: ARME 448 or 342 or permission of instructor. Lecs, T R 11:40–12:55; sec T 2:55–4:10. 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.

ARME 446 Food Marketing Colloquium
Fall. 1 credit. Limited to juniors and seniors with extensive course work in food industry management and marketing. Permission of the instructor. S–U grades only. R 3:35–4:25. D. J. Perosio.
ARME 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 will cover advanced topics in food marketing, many of which will have an important international dimension and will be presented by industry members. A number of field trips will be taken. Students will participate in research topics on various aspects of the food industry.

ARME 447 Food Marketing Colloquium
Spring. 1 credit. Limited to juniors and seniors with extensive course work in food industry management and marketing. Permission of instructor. S–U grades only. R 3:35–4:25. D. J. Perosio.
ARME 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 will cover advanced topics in food marketing, many of which will have an important international dimension and will be presented by industry members. A number of field trips will be taken. Students will participate in research topics on various aspects of the food industry.

ARME 448 Food Merchandising
Spring. 3 credits. Limited to juniors and seniors. Prerequisite: ARME 240. Lecs, T R 10:10–11:25. D. J. Perosio.
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 in this course. The consequences of food industry trends and initiatives for other industry members, public policymakers, and consumers are considered.

ARME 449 Global Marketing Strategy
Spring. 3 credits. Prerequisite: previous marketing course. Limited to seniors and graduate students. M W 2:55–4:10. 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.

ARME 450 Resource Economics (also Economics 450)
Fall. 3 credits. Prerequisites: MATH 111, ECON 313, and a familiarity with EXCEL. Lecs, M W F 2:30–3:20. J. M. Conrad.
Dynamic models of renewable, nonrenewable, and environmental resources will be constructed to examine market allocation and optimal resource management.

ARME 451 Environmental Economics and Policy (also Economics 409)
Spring. 3 credits. Prerequisites: ECON 313, or intermediate microeconomics course, and calculus. Limited to undergraduate students. S-U grades optional. Lecs, M W 2:55–4:10. 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 will be placed on the two leading economic paradigms of allocating public goods: the conventional economic approach, with specific emphasis on market failure, externalities, benefit-cost analysis, and the use of non-market valuation techniques; and a property rights/institutional perspective. Ecological economic concepts will also be examined.

ARME 464 Economics of Agricultural Development (also Economics 464)
Spring. 3 credits. Prerequisites: ECON 101–102, or permission of instructor. Lecs, T R 11:40–12:55. 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 will be covered in order 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 will be used to illustrate the basis for economic analysis.

ARME 494 Undergraduate Special Topics in Agricultural, Resource, and Managerial Economics
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.

ARME 497 Individual Study in Agricultural, Resource, and Managerial Economics
Fall or spring. Variable credit. S-U grades optional. Students must register with an Independent Study form (available in 154 Warren Hall). Staff.
To be used for special projects designed by faculty members.

ARME 498 Supervised Teaching Experience
Fall or spring. 1–3 credits. Total of 4 credits maximum during undergraduate program. Students must register with an Independent Study form (available in 154 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.

ARME 499 Undergraduate Research
Fall, spring, or summer. 1–4 credits. Limited to students with grade-point averages of at least 2.7. Students must register with an Independent Study form (available in 154 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.

[ARME 605 Agricultural Finance and Capital Management
Fall. 3 credits. Prerequisite: ARME 405 or equivalent. $35 charge for reading materials; no text. T R 8:40–9:55. Offered alternate years. Not offered fall 1999 and fall 2001; next offered fall 2000.
E. L. LaDue.
Advanced topics in capital management and financing of agriculture. Special emphasis on current issues. Example topics: farm-sector funds flows, financial risk and decision analysis, agricultural finance policy, financial intermediation and intermediaries, firm growth, inflation, loan evaluation, and selected topics on financing agriculture in developing countries.]

ARME 608 Production Economics (also Economics 408)
Fall. 3 credits. Recommended: ECON 313 and MATH 111 or equivalents. Lecs, M W F 10:10–11. L. W. Tauer.
The theory of production economics with emphasis on applications to agriculture and natural resources. Topics include the derivation, estimation, and use of production, cost, profit, demand, and supply functions. Production response over time and under risk is introduced.

ARME 630 Policy Analysis: Welfare Theory, Agriculture, and Trade (also Economics 430)
Spring. 4 credits. Prerequisites: ARME 608 or CE&H 603, ECON 313, or equivalent intermediate micro theory incorporating calculus. Lecs, T R 1:25–2:40.
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.

ARME 633 Devolution and Public Sector Restructuring (also City and Regional Planning 612)
Fall. 3 credits. S-U grades optional. Lec, T 10:10–12:35. M. E. Warner.
For description, see CRP 612.

ARME 634 Local Government Restructuring in New York State (also City and Regional Planning 618)
Spring. 4 credits. Prerequisite: ARME 633. S-U grades optional. Lec, F 9:05–12:05. M. E. Warner.
For description, see CRP 618.

ARME 640 Analysis of Agricultural Markets (also Economics 440)
Fall, weeks 1–7 (ends Oct. 15). 2 credits. Prerequisites: ARME 411 and 415 or equivalents. Lecs, M W F 8:40–9:55.
W. G. Tomek.
This course is about agricultural product markets. Focus is placed on their distinguishing characteristics, criteria for evaluating performance and models of price behavior including marketing margins.

ARME 641 Commodity Futures Markets (also Economics 441)
Fall, weeks 8–14 (starts Oct. 18). 2 credits. Prerequisites: ARME 411 and 415 or equivalents. Recommended: ARME 640. Lecs, M W F 8:40–9:55. W. G. Tomek.
This course is primarily 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.

ARME 651 Environmental and Resource Economics
Spring. 4 credits. Limited to graduate students. Lecs, T R 10:10–11:25.
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. Explore innovative market mechanisms for resolving public good, common property, and externality problems. Students will be 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. ARME 651 is a core course for the Environmental Management concentration/option.

ARME 652 Land Economics Problems (co-listed with Civil and Environmental Engineering 529)
Fall or spring. 1 or more credits. Limited to graduate students. Prerequisite: permission of instructor. S-U grades optional. W 7:30–9:25 p.m. D. J. Allee.
Special work on any subject in the field of land and resource economics.

ARME 665 Food and Nutrition Policy (also Nutritional Sciences 685)
Spring. 3 credits. Prerequisites: introductory microeconomics and intermediate statistics (i.e. through multiple regression), or permission of instructor. S-U grades optional. Lecs, M W 2:55–4:10. D. Sahn.
For description, see NS 685.

ARME 666 Economics of Development (also Economics 466)
Spring. 3 credits. Prerequisites: ECON 313 and 314 or permission of instructor. S-U grades optional. Lecs, T R 11:40–12:55. S. C. Kyle.
The course is designed as an introduction to the economics of development at the graduate level. The course will be split into two major sections, the first dealing with the microeconomics of households in developing countries and the second covering macroeconomic strategy and performance. A principal goal will be to illuminate the particular features of low-income countries which are important to economic analysis and policy. Special attention will be given to issues facing countries with important agricultural and resource sectors.

[ARME 667 Topics in Economic Development (also Economics 770)
Fall. 3 credits. Prerequisite: basic first-year courses in ECON or ARME, or instructor's permission. S-U grades optional. Lecs, T R 1:25–2:40. Not offered fall 1999. R. Kanbur.
This course is targeted to second-year graduate students. Topics covered will vary from year to year but may include: poverty, inequality, intra-household allocation, structural adjustment, debt. Examination will be by term paper.]

ARME 694 Graduate Special Topics in Agricultural, Resource, and Managerial Economics
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.

ARME 698 Supervised Graduate Teaching Experience
Fall or spring. 1–3 credits. Total of 4 credits maximum during graduate program. Students must register with an Independent Study form (available in 154 Warren Hall). Open only to graduate students. Undergraduates should enroll in ARME 498. S-U grades optional. Prerequisite: permission of instructor. 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.

ARME 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.

ARME 700 Individual Study in Agricultural, Resource, and Managerial Economics
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.

ARME 708 Advanced Production Economics
Fall. 3 credits. Prerequisite: ARME 608, 710, or equivalents; ECON 609 is highly recommended. Offered alternate years. Offered fall 1999 and 2001. Not offered fall 2000. Hours to be arranged. R. N. Boisvert.
Theoretical and mathematical developments in production economics, with emphasis on estimating production relationships, scale economies, technical change, factor substitution. Developments in flexible functional forms, duality and dynamic adjustment models are emphasized. Discussions of other topics (risk, supply response, and household production functions) based on student interest.

ARME 710 Econometrics I
Spring. 4 credits. Prerequisites: matrix algebra and statistics at the level of BTRY 417 and 601 (BTRY 409 or ECON 619 preferred). Undergraduates must have permission of instructor. Lecs, M W F 8:40–9:55. W. G. Tomek.
This intermediate-level course covers selected statistical models and associated estimators used in econometrics; dynamic and other stochastic regressor models, seemingly unrelated regression and simultaneous equation models, and models with nonspherical error terms and specification errors. Students seeking an introduction to econometrics should take ARME 411.

ARME 711 Econometrics II
Fall. 4 credits. Prerequisite: ARME 710 or equivalent. BTRY 417 recommended. Lecs, M W 10:10–12:05. T. D. Mount.
Coverage beyond that of ARME 710 of linear regression models, including alternative methods of incorporating non-sample information and testing restrictions, diagnostic techniques for collinearity and influential observations, pooling data, stochastic coefficients, limited dependent variables and latent variables.

ARME 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. Lecs, M W F 8:40–9:55. 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.

ARME 713 Quantitative Methods II
Spring. 3 credits. Prerequisite: ECON 609. S-U only. Lecs, M W F 9:05–9:55. 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.

ARME 714 Experimental Economics
Fall. 4 credits. Prerequisite: ECON 609. Offered alternate years. Offered fall 1999 and 2001. Not offered fall 2000. Lecs to be arranged. 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.

ARME 717 Research Methods in Agricultural Economics
Spring. 2 credits. Limited to graduate students. M 2:30–4:25. 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.

ARME 730 Seminar on International Trade Policy: Agriculture, Resources and Development
Spring. 3 credits. Limited to graduate students. Prerequisites: ARME 630 or equivalent. Offered alternate years. Offered spring 2000 and 2002. Not offered spring 2001. Hours to be arranged. 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.

[ARME 731 Seminar on the Political Economy of Agriculture and Trade
Fall. 3 credits. Limited to graduate students. Offered alternate years. Not offered fall 1999 and 2001. Next offered fall 2000. T R 11:40–12:55. H. de Gorter.
A review of the professional literature relating to agricultural policy issues and techniques appropriate to the analysis of such issues.]

[ARME 735 Public Finance: Resource Allocation and Fiscal Policy (also Economics 735)
Fall. 4 credits. Not offered fall 1999. Time to be arranged. R. Kanbur.
For description, see ECON 735.]

ARME 740 Agricultural Markets and Public Policy
Spring, weeks 1–7. 2 credits. Limited to graduate students. Prerequisite: familiarity with multiple regression techniques at the ARME 411 level or higher. Recommended: ARME 640. T R 12:20–2:15. 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 can be adjusted to students' interests.

ARME 750 Resource Economics
Fall. 3 credits. Prerequisites: ECON 609 and 618, or ARME 713. Lecs, M W F 9:05–9:55. J. M. Conrad.
Optimal control and other methods of dynamic optimization will be used to study the allocation and management of natural resources.

ARME 751 Environmental Economics
Spring. 4 credits. Prerequisites: ECON 609 and 618, or ARME 713. S-U grades optional. Hours to be arranged. R. N. Boisvert and L. D. Chapman.
Economic theory will be applied to the problems of managing environmental quality. Static and dynamic models of externality, decisions to preserve or develop natural environments, and methods of valuation will be presented.

ARME 762 Microeconomics of International Development
Fall. 3 credits. Prerequisite: completion of first year Ph.D. course sequence in ARME or ECON, or instructor's permission. S-U grades optional. Lecs, T R 10:10–11:25. 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.

[ARME 763 Macro Policy in Developing Countries
Spring. 3 credits. Prerequisites: ECON 609, 610, 613 (may be taken concurrently), or permission of instructor. Offered alternate years. Not offered spring 2000; next offered spring 2001. Lec, T 2–4:25. S. C. Kyle.
This course examines macroeconomic policies in developing countries and their interaction with economic growth, development, and stability. Theoretical models useful for analysis of macro policies will be covered as well as an examination of empirical studies. Emphasis will be on research topics of current interest to students and professionals in the field, particularly those relating to the interaction of macro policy with micro and sectoral analysis.]

ARME 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.

ARME 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.

ARME 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, D. H. Beermann, 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, R. C. Gorewit, H. F. Hintz, P. A. Johnson, K. Keshavarz, X. G. Lei, E. A. Oltenacu, P. A. Oltenacu, T. R. Overton, J. E. Parks, A. N. Pell, R. E. Pitt, 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 2–4:25. W. B. Currie, M. L. Thonney, and staff.
An introduction to the science of raising animals in the context of commercial animal production. Lectures and labs address the biology of economically important species (morphology, anatomy, and physiology) and application of the biology to the management of animals within major livestock industries. Topics covered include fundamentals of anatomy, regulatory mechanisms, vital systems, digestion, and metabolism. Students care for small numbers of cattle, sheep, pigs, and chickens in different phases of their life cycle to maximize hands-on contact. Living animals will be used noninvasively, and fresh organs and tissues from dead animals will be used in laboratories.

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. R. C. Gorewit and D. J. Cherney.
A forum to discuss the students' career planning and the contemporary and future role of animals in relation to human needs.

AN SC 120 Animal Domestication and Behavior
Fall. 3 credits. T R 8:40–9:55. E. A. Oltenacu.
This Freshman Writing Seminar will explore the relationship between humans and their domestic animals. Students will study the role of animal behavior in the domestication process, both historically and in modern attempts to domesticate new species, and in finding solutions to current issues related to animal welfare.

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 2–4:25. 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 will be used in laboratories, exercises, and demonstrations.

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 livestock 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 a nutritional experiment performed on a 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 2001; not offered spring 2000, 2002. 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 2000, 2002; not offered spring 2001. 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 will be discussed. Signs of nutrient deficiencies and excesses will be described.

AN SC 215 Exotic Avian Husbandry and Propagation
Spring. 2 credits. Limited to 100 students. Prerequisites: AN SC 100, 150 or Bio G 103, 104 or equivalent. Lec, M 2:30–4:30. 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). 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 2000; not offered fall 1999, 2001. 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 2–4:25. 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 250 Dairy Cattle Principles
Fall. 3 credits. S-U grade optional. Lecs, T R 10:10; lab, T 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 and AN SC 355.

AN SC 251 Dairy Cattle Selection
Fall. 2 credits. Prerequisite: AN SC 250 or equivalent. S-U grades optional. Lec, W 1:25–2:15; disc, W 2:15–4:25. D. M. Galton.
Application of scientific principles of genetic programs in herds with different breeding programs. Emphasis 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. C. Collyer.
Selection, management, feeding, breeding, and training of light horses.

AN SC 280 Molecular Biology in Agriculture and Medicine
Fall. 2 credits. Prerequisite: one year of introductory biology. Lec, T R 10:10. 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 transgenic animal production, mammalian cloning, genome projects, gene therapy and genetic screening. Ethical issues raised by use of these techniques will be discussed.

AN SC 290 Meat Science (also Food Science 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. Staff.

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 is taken.

AN SC 300 Animal Reproduction and Development
Spring. 3 credits. Prerequisite: AN SC 100–150 or equivalent and one 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 will be used in some demonstrations. Dissection and examination of tissues from vertebrate animals will be included in selected laboratories.

AN SC 305 Farm Animal Behavior (also BIOAP 312)
Spring. 2 credits. Prerequisites: introductory course in animal physiology; at least one animal production course or equivalent experience is recommended. S-U grades optional. Lec, T R 11:15. E. A. Oltenacu and K. A. Houpt.
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 314 Practice in Critical Thinking in the Biological Sciences
Fall. 1 credit. M 12:20. A. van Tienhoven.
The course will consist of four or five presentations by the instructor of the "scientific method." Each week the students will critically review a published paper in the biological sciences as if it were a manuscript and submit their typed review. Each week, a different student will be designated to collate these reviews and write an evaluation to the "editor-in-chief." This evaluation will be reported verbally and in writing. Students thus will learn to think, write and to speak critically. Enrollment is limited to 10 juniors and seniors. Preference will be given to transfer students.

AN SC 321 Applied Animal Genetics Seminar
Fall. 2 credits. Prerequisite: AN SC 221 or equivalent. S-U grades only. Lec, M 12:20; disc M 1:25. P. A. Oltenacu and E. J. Pollak.
Topics of interest related to the genetic definition and control of qualitative and quantitative traits in various species of animals are presented. Genetic conservation programs and current animal improvement strategies as well as challenges presented by new developments in reproductive biology and molecular genetics are addressed in a lecture discussion-type format.

AN SC 322 Applied Animal Genetics–Laboratory
Fall. 1 credit. Prerequisite: concurrent registration in AN SC 321 or instructor's permission. S-U grades only. M 2:30–4:25. P. A. Oltenacu and E. J. Pollak.
Many genetic concepts addressed in AN SC 321 are explored in depth using a computer-assisted instruction environment. Mendelian inheritance of qualitative traits, detection of carriers of recessive genes, artificial selection, inbreeding and heterosis, design and evaluation of genetic improvement and conservation programs, and role of population size are among the topics considered.

AN SC 323 Equine Genetics Seminar
Fall. 1 credit. Prerequisite: AN SC 221 or equivalent. S-U grades only. Disc, T 1:25-2:15. P. A. Oltenacu and staff.
Topics of equine genetics will be presented and discussed. Independent library research, a short written paper, and an oral presentation will be important parts of this course. Lecture topics may include the genetic aspects of color, abnormalities, metabolic diseases, unsoundness, and performance.

AN SC 330 Poultry Biology, Nutrition, and Management
Spring. 2 credits. Prerequisites: AN SC 100 and 150 or permission of instructor. Offered alternate years. Next offered spring 2000, 2002; not offered spring 2001. Lec, F 2–4 (occasional field trips run past 4 p.m.). K. Keshavarz.
The course focuses on anatomy and physiology of various organs of poultry. Principles of poultry nutrition, breeding and embryology are discussed with an emphasis on their practical application. The student becomes familiar with the concept of least-cost feed formulation for poultry. The course also is designed to provide an understanding of current technology involved in commercial poultry production.

AN SC 341 Biology of Lactation
Spring. 2 credits. Prerequisite: AN SC 100–150 or Animal Physiology. Offered alternate years. Next offered spring 2000, 2002; not offered spring 2001. 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 will be used.

AN SC 351 Dairy Herd Management
Spring. 4 credits. Prerequisites: AN SC 250 or permission of instructor. Recommended: ARME 302. Lecs, M W F 11:15; labs, M 1:25–4:25, and F (alternate weeks) 1:25–4:25. D. M. Galton and T. L. Batchelder.
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 355 Dairy Nutrition and Health
Spring. 3 credits. Prerequisite: AN SC 250 and permission of instructor. Letter only. Lecs, T R 9:05; lab, W 1:25–4:25. D. M. Galton, L. E. Chase and T. L. Batchelder.
Application of scientific principles to practical herd management with components of nutrition and herd health. Laboratories emphasize practical applications, analyses of alternatives, decision making, field trips, and discussion.

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 2000, 2002; not offered spring 2001. 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 will be presented. Digestive physiology, sources of nutrients, feeding programs for various classes of horses and interactions of nutrition and diseases will be discussed.

[AN SC 370 Swine Nutrition and Management
Fall. 3 credits. Recommended: AN SC 212. Lec, T R 11:15; lab, T 2–4:25. Offered alternate years. Next offered fall 2000; not offered fall 1999, 2001. 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 2001; not offered spring 2000, 2002. 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 392 Animal Growth Biology
Fall. 2 credits. Not open to freshmen; sophomores by permission of instructor only. Prerequisites: one year of college biology and one course in animal or human physiology, AN SC 212 and 221 or equivalent. Lec, R 1:25–3:20; sec, F 1:25–2:15. Staff.
A detailed discussion of the morphological and physiological aspects of growth of domestic and laboratory animals. Overview of the cell cycle and early embryo growth regulation, differentiation and cellular aspects of tissue development and growth, maternal influences on fetal growth and allometric patterns of postnatal growth are discussed. Endocrine, genetic and nutritional influences on protein and lipid metabolism, nutrient requirements and composition of growth will be emphasized.

AN SC 400 Tropical Livestock Production
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 will 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. Lec, M 4:30. W. B. Currie.
Review of literature pertinent to 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. Offered alternate years. Next offered spring 2001; not offered spring 2000, 2002. 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 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 Livestock and the Environment
Spring. 2 or 4 credits. No prerequisite for 2 credits (weeks 1–7). Students who have taken AN SC 411 (formerly 312) can sign up for 4 credits (full semester) for completing an independent project on whole-farm environmental planning. Lec, T R 11:15–12:05. D. G. Fox.
This course will explore controversial issues surrounding livestock and the environment, including competition with humans for food resources, impact of animal products on human health, and impact of livestock farms on environmental/community problems, including odor, pathogens, and excess nutrient effects on water quality. Those taking 2 additional credits will use computer software tools to evaluate aspects of whole-farm nutrient and environmental management on case study farms, with data collection and analysis continuing throughout the semester.

AN SC 414 Ethics and Animal Science
Fall. 2 credits. Enrollment limited to 20 students, juniors and seniors only. Lec, M 12:20; disc, W 12:20–1:10. One Saturday morning, required farm tour 9 a.m.–1 p.m., Saturday, September 4, 1999. D. J. 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 report on the farm tour or a book review, participation in discussion and a project of the student's choice will be used to evaluate the performance of each student.

AN SC 420 Quantitative Animal Genetics
Spring. 2 credits. Prerequisite: AN SC 221 or equivalent. Limited to 30 students. Lec, M 12:20; sec, M 2–4:25. 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 program 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 1999, 2001; not offered fall 2000. 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.

AN SC 427 Fundamentals of Endocrinology
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 456 Dairy Management Fellowship
Spring. 2 credits. Limited to seniors. Prerequisites: AN SC 351 and 355, and permission of instructor. S-U grades only. Hours to be arranged. D. M. Galton and T. Batchelder.
The program is designed for undergraduates who have a sincere interest in dairy farm management. Objectives are 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 will be advertised by the department. Courses offered under the number will be approved by the department curriculum committee, and the same course will not be offered more than twice under this number.

AN SC 496 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; identifying problems; devising hypotheses, realistic research plans; scientific writings and other forms of communication, including the publicizing of science; finding and managing reference materials; cost of research, funding and beneficiaries; obligations imposed on investigators by society and regulatory agencies; responsibilities and freedom in science; ethical issues that impact on scientists—interactions between sponsors, investigators, professors, trainees and others. Students make oral presentations and prepare brief items of technical writing.

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 two experiences during undergraduate career. Limited to students with grade-point averages 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 grade-point averages 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 2000, 2002; not offered spring 2001. 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 2000; not offered fall 1999, 2001. X. G. Lei and G. F. Combs Jr.
This course focuses on the metabolic roles and environmental impacts of mineral nutrition in animal, human, and food systems. Team-taught lectures include general biochemical and physiological aspects of mineral metabolism and specific mechanisms of gene expression, regulation, and mammal health disorders associated with individual elements.]

AN SC 604 Vitamins (also NS 604)
Fall. 2 credits. Lec, T R 10:10.
G. F. Combs, Jr.
Text-based discussion sessions on nutritional aspects of the vitamins, including recent developments in nutritional and biochemical interrelationships with other nutrients and metabolites.

AN SC 606 Ruminant Nutrition: Microbial Ecology and Forage Chemistry
Spring. 4 credits. Prerequisites: Animal Science 212, Biochemistry. S-U grades optional. Lecs, M W F 9:05; disc, W 8:00 or W 1:25. Offered alternate years. Next offered spring 2000, 2002; not offered spring 2001. 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 Seminar
Fall and spring. 1 credit. S-U grades only.

AN SC 619 Field of Nutrition Seminar
Fall and spring. No credit. No grades given.
Lectures on current research in nutrition.

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 to be arranged.

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. 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 will understand relationships between nutrition and toxicology; be prepared to conduct research concerning the effects of naturally occurring toxicants; and be able to use multimedia to present their understanding of a class of toxicants. Occasionally, the class will take walking field trips. In addition, students will 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 630 Bioenergetics/Nutritional Physiology
Spring. 3 credits. Prerequisites: AN SC 410 and biochemistry or physiology, or permission of instructor. S-U grades optional. Offered alternate years. Next offered spring 2001; not offered spring 2000, 2002. Lec, M W F 10:10. A. W. Bell and D. E. Bauman.
An integrated systems approach to the nutritional physiology and energy metabolism of productive animals. Emphasis on extracellular regulation of tissue and organ metabolism of specific nutrients in relation to pregnancy, lactation, and growth. Critical discussion of techniques and approaches to the study of animal bioenergetics.]

AN SC 640 Individual Study in Animal Science
Fall or spring. 1 or more credits. S-U grades optional. Hours to be arranged. 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. 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 will be 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, DNA sequencing and analysis, analysis of gene expression, protein expression). Lectures will introduce laboratory exercises and supplement laboratory topics. Students will perform an independent project requiring time outside scheduled laboratories and will 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 will be advertised by the department. Courses offered under the number will be approved by the department curriculum committee, and the same course will not be 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. Offered alternate years. Next offered spring 2000, 2002; not offered spring 2001. Hours to be arranged. 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 to be arranged, 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 to be arranged, 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 SCIENCES

The program of study in biology is offered by the Office of Undergraduate Biology. For course descriptions, see the section on Biological Sciences.

BIOMETRY AND STATISTICS

N. S. Altman, chair, G. Casella, C. Castillo-Chavez, M. Contreras, C. E. McCulloch, S. J. Schwager

The Department of Biometrics 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 90 Introduction to Biomathematics
Spring. 1 credit. S-U grades only. Prerequisite: one year of college-preparatory high school algebra.
An introductory course on the use of mathematics, computing, probability, and statistics in the biological sciences. Throughout the course, biological examples are used to develop quantitative ideas. Topics, which may change from semester to semester, will be selected from those covered in Biometry 101. Each semester, a selection of topics from a list that includes basic statistics and probability, curve fitting, elementary matrix algebra, differentiation, integration, and difference and differential equations, will be taught. The course will meet twice a week for 30 minutes. Each class will be followed by a computer laboratory for an hour and fifteen minutes, where the students will use Mathematica, a symbolic mathematics and graphics package to illustrate and expand the concepts covered in class.

BTRY 100 Statistics and the World We Live In (also STBTRY 100)
Fall. 3 credits.
Major concepts and approaches of statistics are presented at an introductory level. Three broad areas are covered: collecting data, organizing data, and drawing conclusions from data. Topics include sampling, statistical experimentation and design, measurement, tables, graphs, measures of center and spread, probability, the normal curve, confidence intervals, and statistical tests.

BTRY 101 Introduction to Biometry I
Spring. 4 credits. S-U grades optional. Prerequisites: pre-calculus.
An introductory survey course in the use of mathematics, computing, and probability and statistics in the biological sciences. Case studies are used to develop the ideas of statistics, curve fitting, elementary matrix algebra, basic probability, and differentiation. Selected topics in differential and difference equations and integration will also be covered. A symbolic mathematics and graphics package (e.g., Maple or Mathematica) will be taught and used throughout the course.

BTRY 102 Introduction to Biometry II
Fall. 4 credits. S-U grades optional. Prerequisite: BTRY 101 or 2 semesters of calculus.
This course is the continuation of Biometry 101. It provides a more in-depth view of the use of mathematics, computing, and probability and statistics in the biological sciences. Topics covered include discrete and continuous models, applications of differential and integral calculus, optimization methods, matrix algebra, and Markov models.

BTRY 261 Statistical Methods I (also STBTRY 261)
Fall. 4 credits. Letter only. Prerequisite: BTRY 100 [formally 200] or prior experience in data collection and interpretation. Limited to undergraduates.
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, 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. The lectures may co-meet with BTRY 601. Sections, homeworks and exams are administered separately.

BTRY 302 Statistical Methods II (also STBTRY 302)
Spring. 4 credits. Letter only. Prerequisite: BTRY 261 or BTRY 601. Limited to undergraduates.
A continuation of BTRY 261. 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 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 multiway factorial, nested and split plot designs; comparing two or more regression lines; analysis of covariance. Emphasis is on the appropriate design of studies prior to data collection and the appropriate application and interpretation of statistical techniques. For practical applications, computing is done using the SAS statistical package. The lectures co-meet with BTRY 602. Sections, homeworks and exams are administered separately.

BTRY 400 Biometry Seminar (also STBTRY 400)
Fall and spring. 1 credit. S-U grades only. Prerequisite: BTRY 302 or BTRY 409 or by permission of the instructor.
Students will attend weekly seminar, the Biometrics Unit Discussion Series. Can be taken concurrently with BTRY 600 only with permission of instructor. Students can only take course twice.

BTRY 408 Theory of Probability (also STBTRY 408)
Fall. 4 credits. Prerequisite: MATH 112, 122, or 192, or permission of instructor.
An introduction to probability theory: foundations, combinatorics, random variables and their probability distributions, expectations, generating functions, and limit theory. Biological and statistical applications are the focus. Can serve as either a one-semester introduction to probability or a foundation for a course in the theory of statistics.

BTRY 409 Theory of Statistics (also STBTRY 409)
Spring. 4 credits. Prerequisite: BTRY 408 or equivalent.
The concepts developed in BTRY 408 are applied to provide an introduction to the classical theory of parametric statistical inference. Topics include sampling distributions, parameter estimation, hypothesis testing, and linear regression.

BTRY 417 Matrix Algebra
Spring. 3 credits. Prerequisite: precalculus mathematics.
Definitions, basic operations and arithmetic, determinants, and the inverse matrix. Rank, linear dependence, canonical forms, linear equations, generalized inverses and eigenroots and vectors. Emphasis is on understanding basic ideas and on developing skills for applying matrix algebra.

[BTRY 451 Mathematical Modeling of Populations
Fall. 3 credits. S-U grades optional. Prerequisites: MATH 112, BTRY 408, or equivalent. Offered alternate years. Not offered 1999–2000; offered fall 2000.
This course will emphasize stochastic and deterministic models relevant to population genetics and population biology. Computer simulations and use of mathematical packages will be an integral part of the course.]

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 credits. S-U grades only. Limited to undergraduates. Prerequisites or co-requisites: BTRY 302 and 409 and permission of instructor.
Participation in the Department of Biometrics consulting service: faculty-supervised statistical consulting with researchers from other disciplines. Discussion sessions for joint consideration of 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 will 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.

BTRY 601 Statistical Methods I (also STBTRY 601)
Fall and summer. 4 credits. Limited to graduate students; others by permission of the instructor.
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.
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. Next offered spring 2001.
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. 3 credits. Prerequisites: BTRY 601 and 602 or permission of instructor. Offered alternate years. Not offered spring 2001.
Applications of experimental design including such advanced designs as split plots, incomplete blocks, fractional factorials. Use of the computer for both design and analysis will be stressed, with emphasis on solutions of real data problems.

BTRY 639 Epidemiology Seminar (also STBTRY 639)
Spring. 1 credit, variable. S-U grades only. Permission of instructor.
This course will develop skills in the preparation and interpretation of epidemiological data by discussing current research topics and issues.

BTRY 662 Mathematical Ecology (also STBTRY 662)
Fall. 3 credits. S-U grades optional. Prerequisites: a year of calculus and a course in statistics.
Mathematical and statistical analysis of populations and communities: theory and methods. Spatial and temporal pattern analysis, deterministic and stochastic models of population dynamics. Model formulation, parameter estimation, and simulation and analytical techniques.

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.
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 Methods for Molecular Biology (also STBTRY 682)
Fall. 2 credits. S-U only. Prerequisite: permission of instructor. Not offered 1999–2000.
Statistical and mathematical topics of current interest in molecular biology: genetic mapping, physical mapping, DNA sequence analysis, phylogenetic inference, population modeling. Topics may vary. The course may be repeated for credit.]

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 602 or equivalents. Offered alternate years. Next offered spring 2001.
Statistical modeling and inference using linear models and generalized linear models. Estimation by least squares, maximum likelihood, quasi-likelihood and generalized estimating equations. The use of link functions and generalized linear models to accommodate nonlinear models and non-normally distributed data. 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 795 Statistical Consulting (also STBTRY 795)
Fall and spring. 2 credits. S-U grades only. Limited to graduate students.
Participation in the Department of Biometrics consulting service: faculty supervised statistical consulting with researchers from other disciplines. Discussion sessions for joint consideration of selected consultations encountered by the services during previous weeks. Since consultations usually change from semester to semester, the course may be repeated for credit.

BTRY 798 Graduate Supervised Teaching (also STBTRY 798)
Fall and spring. 2–4 credits. S-U only. Permission of instructor and chair of special committee plus at least two advanced courses in statistics and biometry.
Students assist in teaching a course appropriate to their previous training. Students will meet with a discussion section, prepare course materials, and assist in grading. Credit hours will be 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 to be arranged. 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 to be arranged. 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 to be arranged. S-U grades only.

COMMUNICATION

R. E. Ostman, chair; K. Berggren, M. Campo, A. P. Chan, R. D. Colle, L. Cowdery, B. O. Earle, G. Gay, D. A. Grossman, J. Heyman, D. Krikorian, B. Lewenstein, T. M. Russo, C. Scherer, D. Scheufele, J. Shanahan, M. A. Shapiro, P. Stepp, R. B. Thompson, L. VanBuskirk, W. B. Ward

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. D. Krikorian.
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. 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 communication systems. Topics include the evolution of communication media, current knowledge about mediated communication, and the role of communication in contemporary social issues. Discussion sections relate the course topics to students' personal experience. Assignments include case studies, experiential learning exercises, and short papers.

COMM 121 Investigating Communication
Fall. 3 credits. Students must be enrolled concurrently in COMM 120. Lecs, T R 10:10–11:25, 11:40–12:55 or 1:25–2:40. R. Ostman.
An examination of research methods in communication, with particular emphasis on the mass communication process. Exercises in writing, speaking, and working in small groups focus on topics such as gender depictions, violence in the media, and social roles.

COMM 191 Topics in Communication
Summer. 1–3 credits. Hours to be arranged. Staff.
Study of topics in communication at lower-division level. Special emphasis on topics reflecting the expertise of visiting faculty available in summer session and on topics suitable for entry-level college students.

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, T. Russo, R. Thompson, 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 or summer. 3 credits. T R 10:10–11:25. P. Stepp.
The student will learn the principles of argumentation and the rules of debate. Classroom debates on the CEDA national topic will provide experience in critical thinking, rapid organization of thoughts, employment of research, and writing and speaking in a logical, persuasive manner.

COMM 204 Effective Listening
Fall, spring, or summer. 3 credits. Limited to 25 nonfreshman students per section. No students accepted or allowed to drop after the second week of classes. Lec, M 2:55–4:10; sec, W 1:25–2:40, 2:55–4:10; R 1:25–2:40, 2:55–4:10. R. Thompson.
Lecture and sections are used to present an analysis of the process of listening, to identify barriers to effective listening, and to develop students' listening skills. Topics include audiology, cultural contexts, intercultural communication, linguistics, therapeutic listening, and critical analysis of information. Students are involved in skill-building exercises and in writing self-analytical papers, as well as attending seminars.

COMM 230 Visual Communication
Fall. 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 or 2:30–4:25. C. Scherer.
An introduction to visual communication theory. 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 Communication Systems and Technologies
Spring. 3 credits. Lec T R 11:40–12:55. A. P. Chan.
An exploration of the nature of communication systems and technologies. Topics include a brief history of communication and information technologies, descriptions of the uses, and impacts of technologies within the social system, and an introduction to electronic message design and construction.

COMM 250 Newswriting for Newspapers
Fall. 3 credits. Limited to 25 students. Keyboarding ability essential. Students missing first two classes without university excuse will be dropped. Lecs, M W 9:05–9:55; labs, R 2:30–4:25 or F 9:05–11:00. Staff.
Writing and analyzing news stories. A study of the elements that make news, sources of news, interviewing, writing style and structure, press problems, and press-society relations. Concentration on newswriting as it is practiced by newspapers in the United States. Two writing assignments each week, one done in class, one done out of class.

COMM 253 Information Gathering and Presentation
Spring. 3 credits. Prerequisite: COMM 117, COMM 121. Lec, M W 11:15; lab R 9:05–9:55, F 11:15–12:05 or F 2:30–3:20. L. Cowdery.
Students learn how to locate information from data bases, interviews, and printed materials, to evaluate it, and to present it in written, tabular, and graphic form. Formats include media stories, research reports, and materials for public information. Experience in industry research methods helpful; concurrent enrollment in COMM 282 recommended.

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. L. Cowdery.
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 will be 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. Lec 01, M W F 10:10–11:00, Lec 02, M W F 11:15–12:05. L. Van Buskirk and staff.
Students write as members of different organizations, and as representatives of business, government, community, and other interests. Emphasis is on adapting tone to the audience and to the purpose of the message. Writing assignments include reports, memoranda, proposals, and letters. Assignments are based on cases developed from current websites.

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 273 Communication Institutions
Spring. 3 credits. Letter only. T R 11:40–12:55. Not offered 1999–2000. J. Shanahan.
A survey of the history, organization, and social importance of communication institutions. Institutions to be analyzed include advertising/PR, media industries, propaganda and political communication, news/journalism, and new technologies. Cases and examples will be drawn from areas relevant to CALS programs, including environment, agricultural policy and land use. Communication 116 or 120 are suggested but not required.]

COMM 282 Communication Industry Research
Spring. 3 credits. Prerequisite: COMM 116, 120, 121. Lec, M W 12:20–1:10; labs, F 9:05–11:00, F 12:20–2:15, or R 9:05–11:00. 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. Van Buskirk.
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 Science and Technology Studies 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 World Wide 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, spring, or summer. 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 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 one-year trial basis. Hours to be arranged. P. Stepp.
Students will learn preparation for practice in CEDA (Cross Examination Debate Association) debate, Lincoln Douglas debate, or individual speaking events. The class will be divided into four groups according to level of experience; therefore it may be repeated to a maximum of 8 credits.

[COMM 315 Introduction to Health Communication
Fall. 3 credits. COMM 116 or COMM 120 or permission of instructor. Juniors and seniors only. T R 11:40–12:55. Not offered 1999–2000. Staff.
An overview of health communication, examining topics such as physician-patient relationships, the role of support groups, communication in health care organizations, cultural differences in health beliefs and communication, and public health campaigns. Instruction techniques include class discussion, presentations, and group projects.]

COMM 330 Communication Technologies and Management of Information
Fall. 3 credits. Prerequisite: COMM 240. T R 10:10–11:25. A. P. Chan.
Appropriate use of communication and information technologies can facilitate the coordination, control, and management of information. This course surveys existing theories and practice of information management, integrating insights cutting across communication, economics, management science, and sociology.

COMM 350 Writing for Magazines
Fall, spring, or summer. 3 credits. 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. W. Ward; spring: lec, T R 8:40–9:55; lab, R 1:25–2:15. Staff.
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
Fall. 3 credits. Not open to freshmen. Limited to 24 students. Prerequisite: one college-level writing course. Lecs, M W 9:05; 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. Hours TBA. Offered even-numbered years. B. Lewenstein.
Students will cover the annual meeting of the American Association for the Advancement of Science, held in February each year. Before the meeting, students will review science writing techniques and issues. At the meeting, students will meet with science writers and attend press conferences and scientific sessions. Students will write at least two stories. Students responsible for all costs of travel, lodging, and meals.

COMM 368 Text Editing and Management
Fall. 3 credits. Limited to 25 junior, senior, or graduate students. Prerequisite: COMM 250, 260, 263, 350 or 352. M W F 12:20–1:10. L. Cowdery.
How to guide a manuscript from draft to presentation. Topics include production, copy editing and design, document management, and editorial decision making. Publications include books, magazines, newsletters, and promotional and educational materials for internal and external use. Appropriate for those who will oversee publications as part of their work.

COMM 376 Planning Communication Campaigns
Spring. 3 credits. Prerequisites: COMM 282 or equivalent social research course (may be taken concurrently). T R 10:10–11:25. R. D. Colle.
Overviews theories that guide and influence social change efforts. Research techniques and communication tools used in communication planning and campaign design are reviewed. Class discussion focuses on social change efforts in nutrition and health, rural development, marketing, and the environment. Students work closely with a client in designing a communication campaign.

COMM 380 Independent Honors Research in Social Science
Fall or spring. 1–6 credits. Limited to undergraduates who have met the requirements for the honors program. R. D. Colle.

[COMM 382 Communication Research Design
Spring. 3 credits. Lec, T R 3:35; lab, W 2:30–4:25. Prerequisite: COMM 282 or equivalent; one course in statistics (may be concurrent). Not offered 1999–2000. C. Scherer.
Discussion of advanced communication research methods. Emphasis on research design and measurement techniques. Final paper will be a complete research proposal for a senior or Honors thesis in Communication.]

COMM 398 Issues in Teaching Communication
Fall. 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, we will 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. Hours to be arranged. P. Stepp.
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 Behavior and Communication

Fall. 3 credits. Labs limited to 15 junior, senior, or graduate students. Prerequisite: COMM 116 or equivalent. Lec, M W 11:15–12:05; Sec 01, W 2:30–4:25; Sec 02, F 10:10–12:05; Sec 03, F 10:10–12:05; Sec 04, 12:20–2:15; Sec 05, 12:20–2:15. D. Krikorian.

Study of management and leadership in formal organizations with emphasis on the psychology of communication between supervisor and employee; examination of formal and informal communication networks, and interpersonal communication in an organizational context. Case studies analyzed in lab.

COMM 411 Leadership from a Communication Perspective

Spring. 3 credits. Limited to 30 students. Lec, T R 1:25–2:40. P. Stepp.

Leadership is a product of human communication. Leadership competence can be increased by increasing communication competence. Leadership theories, particularly transformational leadership, will be studied, and gender/minority responsive leadership will be stressed. Practical application will include leadership exercises and observation of leaders.

COMM 412 Communication Leadership Lab

Spring. 1 credit. Concurrent enrollment in COMM 411 required. Hours TBA. P. Stepp.

This course will provide laboratory experience in leadership and the methods used to analyze leadership in an organization. Students will take turns serving as a group leader of six to eight students in applying leadership theories to study leadership styles, leader-follower relations, organizational culture, and leadership competencies in an organization.

COMM 418 Communication and Persuasion

Spring. 3 credits. Prerequisite: COMM 116 and 120 or introductory psychology or social psychology. M W 2:55–4:10 (one evening mid-semester prelim). M. Campo.

The course focuses on theories of communication's influence on persuasion and attitude change. Students will become familiar with a variety of social-psychological theories of attitude change and persuasion. Those theories also will be 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. Lec, 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, communication 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.

COMM 421 Communication and the Environment

Spring. 3 credits. Lec, T R 11:40–12:55. J. Shanahan.

Students will investigate how values, attitudes, social structure, and communication affect public perceptions of environmental risk and public opinion about the environment. A primary focus will be mass media's impact in 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

Fall. 3 credits. Prerequisites: introductory psychology or COMM 120. M W F 12:20–1:10 (one evening mid-semester prelim). M. Shapiro.

A survey of knowledge about the psychological influence of television and other audio-visual communication technologies. Topics may include: the history of concerns about television and movies, who watches television and why, how people understand and mentally process television, how television influences thinking and emotions, the effects of various forms (including entertainment, news, and advertising), the future forms of mass media including multimedia and virtual reality. Lectures concurrent with COMM 622; graduate students should enroll in COMM 622.

COMM 424 Communication in the Developing Nations

Fall. 3 credits. Limited to juniors and seniors. T R 2:55–4:10. 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 426 Impact of Communication Technologies

Spring. 3 credits. M W 2:55–4:10. B. Lewenstein.

Examine emerging technologies of communication, such as computer-based information systems and satellites and their potential for influencing communication processes and social systems. Also examines the impacts of previous communication innovations from cave painting to television. Lectures concurrent with COMM 626; graduate students should enroll in COMM 626.

COMM 428 Communication Law

Spring. 3 credits. Offered even-numbered years. Limited to junior, senior, and graduate students; others by permission of the instructor. Lec, M W F 11:15–12:05. D. Grossman.

A practical survey of the law governing mass media, primarily for those working in the field. Coverage includes restraints on news gathering and publication, privacy, defamation, copyright, broadcast and cable regulation, access, electronic media and other issues of current interest.

COMM 429 Legal Issues in Business and Electronic Communication

Spring. 3 credits. Prerequisite: COMM 428. Offered odd-numbered years. M W F 11:15–12:05. D. Grossman.

The increase in commercial use of the Internet and new types of interactive electronic media in business create unique contexts for applying traditional principles of law. This course will examine the rights and responsibilities of parties involved in electronic commerce, including information security (guaranteeing confidentiality and effective record-keeping), electronic contracts and EDI, rights in information (copyrights, trade secrets, trademarks and patents), regulation of information content (pornography and advertising) and regulation of on-line conduct (criminal liability and civil exposure).

COMM 439 Interactive Multimedia: Design and Research Issues

Fall. 3 credits. Prerequisite: permission of instructor. Lec, T 11:40–12:55; lab 01, T 1:25–2:15, lab 02, R 1:25–2:15. G. Gay.

An overview of interactive multimedia technologies (videodisc, CD-ROM, digital video technologies, computer graphics, and text). Course will focus on theories and research applicable to interactive multimedia such as visualization, learner control, mental models, knowledge representations, and information processing. Course will also emphasize interactive multimedia design, application, and evaluation. Lectures concurrent with COMM 639; grad students should enroll in COMM 639.

COMM 440 Computer Mediated Communication: Theory and Practice

Spring. 3 credits. Permission of instructor. Letter grade only. Lec, T 12:20–2:15; lab 01, T 11:15–12:05; lab 02, R 11:15–12:05. G. Gay.

Course will focus 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 considerastions, and cultural and social issues. Lectures concurrent with COMM 640; graduate students should enroll in COMM 640.

COMM 466 Public Communication of Science and Technology

Fall. 3 credits. Limited to 15 students. Prerequisite: COMM 352 or 360, or Engineering 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, 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. M 2:55–4:10. Prerequisites: permission of instructor; limited to communication seniors selected based on goals and academic preparation. 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 policy makers. Fee charged.

COMM 486 Risk Communication
Spring. 3 credits. T R 2:55–4:10. C. Scherer.
An examination of theory and research related to the communication of scientific information about environmental, agricultural, food, health, and nutritional risks. Course will concentrate on social theories related to risk perception and behavior. Case studies involving pesticide residues, waste management, water quality, environmental hazards, and personal health behaviors will be examined. Emphasis will be placed on understanding, applying, and developing theories of risk communication. Lectures concurrent with COMM 686; graduate students should enroll in COMM 686.

COMM 490 Senior Thesis in Communication
Fall, spring. 3 credits; may be repeated for a maximum of 6 credits. Prerequisite: COMM 382. Staff.
Seniors conduct research based on a thesis proposal written in COMM 382. Supervision provided by a member of the Communication graduate faculty assisted by a Ph.D. candidate. Thesis will be reviewed by faculty readers before approval.

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 Internship
Fall, spring, summer, and intersession. 1–3 credits. Students must apply no later than the spring pre-course enrollment period for a fall internship or the fall pre-course enrollment period for a spring or summer internship. **Prerequisites: limited to communication juniors or seniors, 3.0 average in communication courses, and approval of academic advisor.** S-U grades only.
Structured, on-the-job learning experience under supervision of communication professionals in a cooperating organization. Maximum of 6 credits total may be earned; no more than 3 per internship but flexibility allows 6 for 1 credit each, 3 for 2 credits each, or 2 for 3 credits each. Internships must be approved in advance by the student's academic adviser and must be supervised by a communication professional in fields of public relations, advertising, publishing, or broadcasting. Minimum of 60 on-the-job hours per credit required.

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 Behavior and Communication
Fall. 3 credits. Lec, M W 11:15–12:05; sec, TBA. D. Krikorian.
Study of management and leadership in formal organizations with emphasis on the psychology of communication between supervisor and employee; examination of formal and informal communication networks, and interpersonal communciation in an organizational context. Case studies analyzed in lab. Lectures concurrent with COMM 410; graduate students should enroll in COMM 510.

[COMM 610 Seminar in Organizational Communication
Spring. 3 credits. Prerequisites: COMM 410/510 or one course in organizational behavior or permission of instructor. Not offered 1999–2000. Lec, M W 11:15–12:05; lab, F 10:10–12:05. D. Krikorian.
Examination of contemporary research on the social psychology of interpersonal communication in organizations including supervisor-employee relations, leadership style, work motivation, organizational socialization, and formal and informal communication networks.]

COMM 618 Communication and Persuasion
Spring. 3 credits. Prerequisite: introductory research methods course and introductory psychology or social psychology course. M W 2:55–4:10. M. Campo.
The course focuses on theories of communication influence on persuasion and attitude change. Students will become familiar with a variety of social-psychological theories of attitude change and persuasion. Those theories also will be 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.

COMM 622 Psychology of Television
Fall. 3 credits. Prerequisites: introductory psychology or social psychology and introductory research-methods course. M W F 12:20–1:10. M. Shapiro.
A survey of knowledge about the psychological influence of television and other audio-visual communication technologies. Topics may include: the history of concerns about television and movies, who watches television and why, how people understand and mentally process television, how television influences thinking and emotions, the effects of various forms (including entertainment, news, and advertising), the future forms of mass media including multimedia and virtual reality. Lectures concurrent with COMM 422; graduate students should enroll in COMM 622.

COMM 624 Communication in the Developing Nations
Fall. 3 credits. Open to juniors, seniors, and graduate students. T R 2:55–4:10. 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 626 Impact of Communication Technologies
Spring. 3 credits. Open to seniors. M W 2:55–4:10. B. Lewenstein.
Examines emerging technologies of communication, such as computer-based information systems and satellites and their potential for influencing communication processes and social systems. Also examines the impacts of

previous communication innovations from cave painting to television. Lectures concurrent with COMM 426; graduate students enroll in COMM 626.

COMM 639 Interactive Multimedia: Design and Research Issues
Fall. 3 credits. Prerequisite: permission of instructor. Lec, T 11:40–12:55; lab 01, T 1:25–2:15; lab 02, R 1:25–2:15. G. Gay.
An overview of multimedia technologies (videodisk, CD-ROM, digital video technologies, computer graphics, and text). Course will focus on theories and research applicable to interactive multimedia such as visualization, learner control, mental models, knowledge representations, and information processing. Course will also emphasize interactive multimedia design, application, and evaluation. Lectures concurrent with COMM 439; grad students should enroll in COMM 639.

COMM 640 Computer Mediated Communication: Theory and Practice
Spring. 3 credits. Prerequisite: permission of instructor. Lec, T 12:20–2:15; lab 01, T 11:15–12:05; lab 02, R 11:15–12:05. G. Gay.
Course will focus 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. Lectures concurrent with COMM 440; graduate students should enroll in COMM 640.

COMM 641 Human-Computer Interaction
Spring. 3 credits. Offered odd-numbered years. T R 8:40–9:55. G. Gay.
An examination of how people relate to, think about, and think with new communication technologies in schools, homes, and the workplace. Using assigned readings from multiple disciplines, class exercises, field studies, and case studies, students will study and critique aspects of human-computer interaction, social psychology, and other issues that shape the process and effectiveness of designing, implementing and using computer systems.

COMM 676 Communication Planning for Social and Behavioral Change
Spring. 3 credits. T R 10:10–11:25. R. D. Colle.
Overview theories that guide and influence social change efforts. Research techniques and communication tools used in communication planning and campaign techniques and communication tools used in communication planning and campaign design are reviewed. Class discussion focuses on social change efforts in nutrition and health, rural development, marketing, and the environment. Course seeks to integrate theory, data-based generalizations, and planning processes into an integrated communication plan.

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. Prerequisite: COMM 680 or graduate standing and permission of instructor. T R 2:30–4:25. M. A. Shapiro.
Development of, and contemporary issues in, communication theory. Discussion will include the interaction between communication and society, social groupings, and mental processing.

COMM 682 Methods of Communication Research
Spring. 3 credits. Lec, M W 12:20–1:10; sec, F 12:20–2:15. D. Scheufele.
An analysis of the methods used in communication research. Emphasis 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 Quantitative Research Methods in Communication
Spring. 3 credits. Prerequisite: COMM 682 or equivalent. Lec, M 6:00 p.m.–9:00 p.m. Not offered 1999–2000. Staff.
Experience in quantitative research techniques. The course provides an introduction to inter- and multi-disciplinary research through examination of the procedures, techniques and assumptions associated with particular techniques of design and measurement, data collection, data preparation, data analysis, and hypothesis testing. Readings include a variety of fields and disciplines in the social and natural sciences.]

[COMM 685 Training and Development: Theory and Practice (also International Agriculture 685 and EDUC 685)
Spring. 4 credits. S-U grades optional. Charge for materials, $45. F 9:05–12:05; lab to be arranged. Not offered 1999–2000. Staff.
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. Design for scientists, administrators, eductor-trainers, and social organizers in rural and agricultural development programs in the U.S. and abroad.]

COMM 686 Risk Communication
Spring. 3 credits. T R 2:55–4:10. C. Scherer.
An examination of theory and research related to the communication of scientific information about environmental, agricultural, food, health, and nutritional risks. Course will concentrate on social theories related to risk perception and behavior. Case studies involving pesticide residues, waste management, water quality, environmental hazards, and personal health behaviors will be examined. Emphasis will be 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. Hours to be arranged. G. Gay and R. Colle.
Some weeks scholars from a wide variety of fields will present varied topics in theory or research as it relates to communication; other weeks graduate students will 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. Hours to be arranged. Staff.
Study of topics in communication not otherwise provided by a department course and determined by the interest of the faculty and students.

COMM 700 MPS Project 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.
Project research for Master of Professional Studies (Communication) students.

COMM 781 Seminar in Psychology of Communication
Spring. 3 credits. Letter grade. Offered odd-numbered years. Prerequisite: COMM 680 and 681 or equivalent graduate level theory in psychology or social psychology. Hours to be arranged. M. Shapiro.
Discussion and analysis of selected current issues in the psychology of communication. Students will 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.

EDUCATION

D. H. Monk, chair; G. J. Applebee, W. S. Carlsen, C. A. Conroy, J. D. Deshler, J. A. Dunn, D. M. Ewert, D. E. Hedlund, S. C. Piliero, G. J. Posner, R. E. Ripple, V. N. Rockcastle, D. E. Schrader, J. W. Sipple, R. E. Steele, K. A. Strike, H. D. Sutphin, D. J. Trumbull, D. G. Way

EDUC 005 Basic Review Mathematics
Fall. 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. C. 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 101 Introduction to Education
Fall. 3 credits. T R 11:40–12:55. G. J. Posner.
An introduction to the field of education that is structured around an examination of three contemporary policy issues. The issues are chosen to help students understand important aspects of formal schooling systems (e.g., the public schools, colleges, and universities) as well as nonformal educational activities (e.g., adult education, extension education, and community education). The course is team-taught by two members of the faculty and is designed for students seeking a self-contained introduction to education that can also lead to additional study in the field.

EDUC 115 Introductory College Mathematics
Spring. 4 credits. M W F 11:15 or 12:20. S. C. 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 will use graphing calculators in a collaborative lab setting.

EDUC 120 Education for Empowerment
Spring. 3 credits. W 1:25–4:25. R. E. Steele.
Common themes running through the modules include human learning, teaching strategies, 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 210 Psychology of Learning and Memory
Fall. 3 credits. Prerequisite: introductory psychology. Not offered 1999–2000. J. A. Dunn.
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 will be emphasized. One or more experimental projects and the use of microcomputers will be required.]

EDUC 212 Psychological Foundations of Education
Spring and fall. 3 credits. S-U option available. Prerequisite: introductory psychology. W 2–4:25 plus times to be arranged. J. A. Dunn.
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. 4 credits. S-U grades optional. T R 2:55–4:10. Staff.
Students learn to be self-directed learners, to integrate theory, and to be critical observers of their own experiential learning, issues of diversity and empowerment, interpersonal communication, and critical analysis. Concepts and skills are learned through participation in a campus-based adult education program, the Community Learning and Service Partnership (CLASP). Students practice adult education facilitation techniques in lab.

EDUC 240 The Art of Teaching
Fall and spring. 3 credits. Fall: M 8–9:55 or T 10:10–12:05 or 2:30–4:25. Spring: M 8–9:55 or 12:20–2:15 or T 2:30–4:25 or W 12:20–2:15 or 2:30–4:25. G. J. Posner and 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 271 Sociology of Education
Fall. 3 credits. S-U grades optional. T R 10:10–11:25. J. W. Sipple.
An introduction to the sociological study of schooling and education. Topics include the effects of social factors on educational achievement, the norms and values learned as part of the process of schooling, the relations between students and teachers, and the school's relations to the economic and political systems. All levels of education, from elementary school to the university, are considered.

EDUC 311 Educational Psychology
Fall. 3 credits. Prerequisite: introductory psychology. S-U grades optional. M W F 11:15–12:05. D. E. Schrader.
This course applies psychological concepts to educational settings such as schools 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 with a focus on secondary education.

EDUC 317 Psychology of Adolescence
Spring. 3 credits. Prerequisite: introductory psychology. S-U grades optional. M W 11:15–12:05; Friday morning section to be arranged. 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 will be discussed for both formal and informal settings.

EDUC 331 Careers in Agriculture, Extension, and Adult Education
Fall. 1–3 credits. Letter grade only. M 2:00–4:25. J. D. Deshler, D. E. Foster, and G. J. Applebee.
This course will offer modules in three areas of teaching: Adult Education, Cooperative Extension, and Agricultural Education. Each module will offer one hour of credit, and students may take one or more of the modules. The course will provide a historical perspective and an introduction to the organization and scope of programs for each module. Students will 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 AgriScience Education
Spring. 1–3 credits. Prerequisite: enrolled in a Cornell teacher education program or permission of instructor. R 2:00–4:25. C. A. Conroy, R. E. Steele.
Selection, practice, and evaluation of methods in AgriScience education will be stressed. The course offers a modular approach to focus on teaching strategies and methodology unique to teaching in schools. Content will include program planning (Module I), experiential learning (Module II), and youth leadership (Module III). All students must enroll for one credit in Module I; students may be exempt from Modules II and III with permission of instructor. Participants will be required to participate in field experiences at arranged times.

[EDUC 335 Youth Organizations
Spring. 3 credits. T R 10:10–11:25; lab to be arranged. Not offered spring 1999–2000. 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 indepth learning-by-doing experience of how youth organizations function. Field experience with a recognized youth organization is required.]

EDUC 370 Issues in Educational Policy
Spring. 3 credits. T R 10:10–11:25. K. A. Strike.
An examination of selected policy issues in current education. Included are such topics as equality of educational opportunity; student, parent, and teacher rights; and educational politics. Issues are treated from legal, sociological, and economic perspectives. Meets group C requirements for College of Agriculture and Life Sciences.

EDUC 378 Political Economy of Education
Fall. 3 credits. S-U grades optional. T R 1:25–2:40. Staff.
A policy oriented examination of educational systems with an emphasis on political and economic perspectives. Attention will be paid to both external and internal aspects of educational activities. Specific topics will include the changing contributions of education to earnings, school-community relations, power within educational organizations, the impact of technology in the workplace and in classrooms, and the sources and impact of educational costs. A variety of education settings will be examined including higher education and non-formal education.

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 402 Knowing and Learning in Science, Mathematics, and Agriscience
Fall. 4 credits. Prerequisite: enrollment in a Cornell teacher education program or permission of instructor. M W 2:30–4:25. D. J. Trumbull and S. C. Piliero.
Students examine both current notions in the history and philosophy of science that explain how knowledge within a discipline develops and current theory and research that examines the individual's acquisition of knowledge. This material serves as a basis for students' individual research projects investigating neophytes' knowledge of science and mathematics concepts. All students enrolled must complete fieldwork. Fieldwork will comprise a minimum of three hours a week in an appropriate educational setting.

EDUC 403 Observing and Teaching Science, Mathematics, and Agriscience
Spring. 4 credits. Prerequisites: enrollment in a Cornell teacher education program or permission of the instructor. C. A. Conroy and S. C. Piliero.
Designed for prospective secondary teachers, this course provides a multiple-perspectives orientation to the culture of schools and the work of teaching science and mathematics. Students spend 6-8 hours each week observing in area schools. Students also plan and teach innovative lessons in the scheduled teaching laboratory. Readings and discussions planning, delivery and evaluation of instruction classroom management, and other issues such as equity, tracking, and classroom language.

EDUC 413 Psychology of Human Interaction
Fall. 3 credits. Enrollment limited. Prerequisite: permission of instructor. T R 10:10–12:05. 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 414 Counseling Psychology
Spring. 4 credits. Prerequisites: introductory psychology, social or personality psychology. T R 10:10–12:05. D. E. Hedlund.
The processes of counseling are examined from various theoretical perspectives. Typical counseling issues are examined, and implications are drawn for counseling strategies, including psychological assessment, establishing therapeutic goals, intervention strategies, and evaluation of outcomes.

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 430 Special Problems in Agricultural Education
Fall, spring, or summer. 1–3 credits. Letter grade only. W 12:20–1:10. C. A. Conroy and R. E. Steele.
An opportunity to study individually selected problems in agricultural education.

EDUC 445 Curriculum Design Workshop
Summer. 3 credits. G. J. Posner.
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 447 Curriculum Design Laboratory: A Technology-Intensive Course
Spring or summer. 3 credits. W. S. Carlsen.
A project-focused introduction to course design, from needs assessment, through materials development, to the evaluation of student outcomes. The course involves the creation and implementation of an actual curriculum, and the nature of the project will vary from year to year. Students are expected to make extensive use of computer software writing, design, management, and communications. The summer section of 447 will be smaller and we anticipate that, rather than working on a single class project, students will undertake curriculum development projects of their own design.

EDUC 472 Philosophy of Education
Fall. 3 credits. T 2:30–4:25. K. A. Strike.
A study of central issues in the philosophy of education. Questions of ethics, political philosophy, and the theory of knowledge are examined and linked to current educational issues.

EDUC 477 Law and Educational Policy
Fall. 3 credits. M 2:30–4:25. K. A. Strike.
A study of recent federal court decisions concerning education. Emphasis 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 483 Comparative Studies in Adult Education
Spring. 3 credits. S-U grades optional. T R 3:35–5:00. J. D. Deshler.
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. Hours to be arranged. Staff.
The department teaches "trial" courses under this number. Offerings vary by semester, and will be advertised by the department. Courses offered under the number will be approved by the department curriculum committee, and the same course will not be offered more than twice under this number.

EDUC 495 Senior Seminar
Spring. 2 credits. Education majors or permission of instructors. S-U only. To be arranged. Undergraduate coordinator for the department.
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 will be involved in selecting the issues and providing guidance for the seminar, students will be 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). Hours to be arranged. 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 grade-point averages of at least 2.7. S-U grades optional. Students must register with an Independent Study form (available in 140 Roberts Hall). Hours to be arranged. 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 grade-point averages of at least 2.7. Students must register with an Independent Study form (available in 140 Roberts Hall). Hours to be arranged. 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 501 Communication Workshop
Summer and intersession. 2 credits. S-U grades optional. M. D. Glock.
The course focuses on skills enabling individuals to cope with such concerns as motivation, dealing with difficult people, productive criticism, improving comprehension, adjusting to different learning styles, and communicating with the public. Practice is coordinated with theory and research findings. The ongoing dynamics of the course necessitate intense participation over a period of time, not provided by regularly scheduled fifty-minute class periods. Additional auto-tutorial lab time is scheduled. Appropriate for anyone who works with people.

EDUC 507 Science and Environment for Teachers
Summer. 3 credits. S-U option. Prerequisite: contact instructor for details. W. S. Carlsen.
This three-week inservice program for secondary and middle school science teachers focuses on biological, chemical, and hydrological methods of water monitoring and watershed dynamics. Participants also use remote sensing; work with computers; investigate topics in science, technology and society; learn pedagogical techniques that are consistent with science reform initiatives; and discuss and develop new types of assessment.

EDUC 513 Interpersonal Interaction
Summer. 1–2 credits. D. E. Hedlund.
Designed to develop skills for an understanding of effective interpersonal communication and interaction. Appropriate for students in the helping professions, education, and areas involving management of human resources. A workshop design is required for the second credit. Participants must bring a tape recorder to class.

EDUC 523 Food and Fiber Across the Curriculum
Summer. 0–3 credits. D. E. Foster and staff.
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 will examine the basic principle of learning, identify different learning styles, and explore a variety of teaching techniques, methods, and technologies. Participants will also learn how to design a course and improve their effectiveness as teachers.

EDUC 601 Secondary Agriculture, Science and Mathematics Teaching Practicum
Fall or spring. 6 credits. Prerequisite: permission of instructor. Letter grades only. For graduate students enrolled in the Teacher Education in Science and Mathematics Program. M T W R F 8:00–3:00. W. S. Carlsen, C. A. Conroy, S. C. Piliero, G. J. Posner, A. Solomon, M. S. Slack, and D. J. Trumbull.
Supervised student teaching in science or mathematics at the secondary level. Program includes teaching in a local school for ten 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. S. C. Piliero, M. S. Slack, and D. J. Trumbull.
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 will complete an extensive portfolio documenting their work.

EDUC 606 Seminar in Science and Mathematics Education
Fall. 1 credit. S-U grades only. T 4:30–5:30. W. S. Carlsen and S. C. Piliero.
Explores topics in science and mathematics education. The focus of the seminar changes each year.

EDUC 609 Methods for Interpretive Research
Spring. 3 credits. Prerequisite: course in research methods or measurement or permission of instructor. M W 2:30–4:00. Offered alternate years. 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 will 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. M W 11:15–12:05. R. E. Ripple.
A basic survey course for graduate students. Emphasis on psychological factors involved in human learning and the educational process. Set in a broad-based conceptual model of any behavioral setting for learning. A life span developmental approach is used, appropriate for those seeking an introduction to educational psychology or a refresher course in contemporary educational psychology.

EDUC 614 Epistemological Development and Reflective Thought
Fall. 3 credits. S-U grades optional. M 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
Spring. 3 credits. S-U grades optional. M 12:20–2:15. 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, 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. 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. 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. Hours to be announced. R. E. Steele.
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. Hours to be announced. C. A. Conroy.
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. Field trip. Lec, T R 10:10–11:25; lab, to be announced. Staff.
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. R. Steele.
Participants will 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 will be explored through readings and applied assignments. The instructor will introduce 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 644 Curriculum Theory and Analysis
Spring. 3 credits. M 1:25–4:25. G. J. Posner.
An examination of the basic elements involved in making curriculum decisions and an analysis of current approaches to curriculum. The course focuses on the assumptions underlying any curriculum. The major task of each student is to choose and conduct an in-depth analysis of a curriculum. This course is the basic graduate course in curriculum.

[EDUC 651 Developing a Research Proposal
Spring. 2 credits. Letter or S-U option. T R 3:35-4:25. Offered alternate years. Not offered 1999–2000. C. A. Conroy and D. J. Trumbull.
Study of procedures for developing and writing a research proposal. Emphasis will be given to identifying a significant topic, recognizing weaknesses in illustrative proposals, and clear and concise writing. Students will be provided with some assistance in constructing a brief proposal of their own.]

EDUC 661 Administration of Educational Organizations
Fall. 3 credits. R 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 664 Educational Finance
Fall. 3 credits. S-U grades optional. W 3:35–6:00. Staff.
An analysis of the distribution and utilization of public and private resources for educational purposes. The discussion will revolve around the issues of equity, efficiency, and freedom of choice. Alternative methods of financing schools will be evaluated, and the perplexing legal and moral issues raised by such questions as "Who pays?" and "Who benefits?" will be discussed. Specific attention will be given to budgeting, accountability, and productivity. An opportunity for individuals to focus on their own areas of interest, such as occupational education, the two-year college, or secondary or higher education.

EDUC 665 Administrative Decision Making
Spring. 3 credits. S-U grades optional. W 3:35–6:00. Staff.
An introduction to decision making theory and its relevance to the field of educational administration. Specific applications will be made to the study and improvement of productivity within educational systems. A wide variety of educational settings will be considered, including higher education and non-formal education.

EDUC 680 Foundations of Extension Adult Education
Fall. 3 credits. Limited to 20 students. S-U grades optional. F 9:05–12:05. J. D. Deshler.
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 will be examined through a seminar approach.

EDUC 682 Community Education and Development
Fall. 3 credits. Limited to 25 students. Letter grade only. M 1:25–4:25. Staff.
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 Communication 685, International Agriculture 685)
Spring. 4 credits. S-U grades optional. Charge for materials, $45. F 9:05–12:05; lab to be arranged. R. D. Colle and J. D. Deshler.
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 U.S. and abroad.

EDUC 694 Special Topics in Education
Fall, spring, or summer. 1–3 credits. Prerequisite: permission of instructor. S-U grades optional. Hours to be arranged. Staff.
Topics to be announced.

EDUC 711 Contemporary Issues in Educational Psychology
Fall and spring. Variable, 3 credits. S-U grades optional. Staff. Fall: hours to be announced. J. Dunn. Spring and fall: T 2:00–4:30.
This is a graduate-level seminar dealing with key issues in contemporary psychology having implications for educational practice and research. Topics will 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. M 12:20–2:15. Not offered 1999–2000. 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 will be 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. R. E. Ripple and J. D. Deshler.
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. 2 credits. S-U grades optional. R 8:00–9:55. Staff.
Emphasis on current problems and research in agricultural, extension, and adult education. Includes discussion and analysis of student and staff research.

[EDUC 745 Seminar in Curriculum Theory and Research
Fall. 3 credits. Prerequisite: EDUC 644, or permission of instructor. Not offered 1999–2000. T 2:30–5:00. G. J. Posner.
Theoretical issues in curriculum and appropriate areas for curriculum research are discussed. Two current topics of interest are the hidden curriculum and school reform. Both topics serve to uncover the relation between ideology and research.]

EDUC 760 Practicum Seminar in Educational Administration
Fall, spring and summer. 2 credits. S-U only. Hours to be arranged. J. W. Sipple and K. A. Strike.
The practicum seminar is taken in conjunction with the administrative internship and serves to tie together previous coursework, current policy issues, and the concurrent internship. It involves two elements. First, current interns will meet regularly during the semester to bring their knowledge base (developed in the program) to bear on their current duties and problems and will collaboratively problem solve with faculty and other interns. Second, interns will participate in special topics seminars as needed in order to supplement coursework in critical areas. Examples of special topics are AIDS, sexual harrassment in the workplace, child abuse, and substance abuse recognition.

EDUC 761 Internship in Educational Administration
Fall, spring and summer. 9 credits. S-U only. Hours to be arranged. G. Posner, J. W. Sipple and K. A. Strike.
The internship experience will provide aspiring administrators with supervised professional activities in a public school district. Students undertaking an internship in Educational Administration will (1) learn the practical day-to-day skills of school administration under the supervision of an on-site administrator, and (2) conceptualize and execute a research project dealing with an issue of interest to the participating school district and the student's special committee. Students will work in collaboration with their special committee and on-site supervisor to integrate educational theory and the field experience. A minimum of 20 hrs per week will be devoted to on-site internship duties. Students will enroll concurrently in EDUC 760 (practicum seminar) to complete additional degree and certification requirements.

EDUC 772 Seminar in Philosophy of Education
Spring. 3 credits. Prerequisite: permission of instructor. S-U grades optional. W 9:00–11:00. K. A. Strike.
Topics to be announced.

EDUC 783 Comparative Extension Education Systems
Summer. 3 credits. S–U option. R. E. Steele.
Extension education in the developing nations is studied using, as an analytical frame of reference, a hypothetical model comprising such components as community organization, community-based learning, indigenous facilitators and leaders, extension generalists and specialists, training and research-extension linkages. Case materials on alternative extension models and intercountry experiences provide an empirical base.

EDUC 800 Master's-Level Thesis Research
Fall or spring. Credit to be arranged. 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 to be arranged. Staff.

EDUC 900 Doctoral-Level Thesis Research
Fall or spring. Credit to be arranged. 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 to be arranged. Staff.

ENTOMOLOGY

D. A. Rutz, chair; M. C. Caillaud, N. W. Calderone, B. N. Danforth, J. Ewer, P. P. Feeny, C. Gilbert, A. E. Hajek, M. P. Hoffmann, J. K. Liebherr, J. E. Losey, R. A. Morse, B. L. Peckarsky, D. Pimentel, L. S. Rayor, R. B. Root, J. P. Sanderson, J. G. Scott, A. M. Shelton, E. J. Shields, M. J. Tauber, W. M. Tingey, Q. D. Wheeler

Courses by Subject

Apiculture: 260, 264
Behavior: 215, 325, 471, 662
Ecology: 452, 455, 456, 470, 471, 672
Introductory courses: 201, 212, 215
Medical entomology and veterinary entomology: 352
Morphology: 322
Pathology: 463
Pest management: 241, 277, 441, 444, 477, 644
Physiology and toxicology: 370, 483, 490, 685
Systematics: 331, 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 will explore 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 will provide hands-on opportunities for examining these amazing animals.

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 $35. 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 215 Spider Biology: Life on a Silken Thread
Fall. 2 credits. Prerequisite: introductory biology or permission of instructor. S-U grades optional. Lecs, M W 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 will be 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. Prerequisites: BIO G 101–102 or equivalent. Lecs, T R 10:10; lab/disc, T or W 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. R. A. Morse.
Introduces the fundamentals of practical beekeeping, including the life history, physiology, and behavior of honey bees. The classical experiments on the dance language and the role of pheromones are reviewed. Some lectures are devoted to pollination of agricultural crops and the production of honey and beeswax.

ENTOM 264 Practical Beekeeping
Fall. 1 credit. Limited to 20 students. Prerequisite: ENTOM 260 (may be taken concurrently). Lab, R 2–4:25. R. A. Morse.
This course consists of fourteen laboratory sessions to acquaint students with practical methods of colony management. Laboratories involve actual work with honey bee colonies and equipment. Some of the topics covered are management of bees for apple pollination, honey harvesting and processing, and disease identification and control.

[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 2000; next offered spring 2001. 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 to vertebrates. This presentation is intended for students curious about controlling pests without using synthetic chemicals.]

[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 2000; next offered spring 2001. 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. Prerequisites: introductory biology or introductory entomology or permission of instructor. Lecs, M W F 12:20. Offered alternate years. Not offered spring 2000; next offered spring 2001. L. S. Rayor.

Insects are the most diverse organisms on earth, with equally diverse behavior. This course will explore 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

Fall. 4 credits. Prerequisite: ENTOM 212. Lecs, T R 12:20; labs, T R 1:25–4:25. Offered alternate years. Q. D. Wheeler.

An introduction to the classification, evolutionary history, and distribution of the 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 352 Medical and Veterinary Entomology

Fall. 3 credits. Prerequisites: BIO G 101–102 or equivalent. S–U grades optional. Lecs, T R 10:10; lab, R 1:25–4:25. Offered alternate years. Not offered fall 1999; next offered fall 2000. Staff.

The ecology of arthropods of medical and veterinary importance in temperate and tropical regions of the world with emphasis on the role they play in causation or transmission of disease. The laboratory involves 2 field trips, techniques of collection and identification, dissections, methods of transmission, means of identification of a blood pathogen and the source of a blood meal.]

[ENTOM 370 Pesticides, the Environment, and Human Health (also Toxicology 370)

Fall. 2 credits. Prerequisites: BIO G 101–102 or equivalent. Lecs, T R 9:05. Offered alternate years. Not offered fall 1999; next offered fall 2000. 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.]

ENTOM 441 Seminar in Insect Pest Management

Spring. 1 credit. Limited to 15 students. Prerequisite: ENTOM 241 or 444 or permission of instructor. S-U grades only. Hours to be arranged. Offered alternate years. M. P. Hoffmann and A. M. Shelton.

Discussion and analysis of current topics in insect pest management.

ENTOM 444 Integrated Pest Management (also Plant Pathology 444)

Fall. 4 credits. Prerequisites: BIOES 261, ENTOM 212 or 241, and PL PA 241 or their equivalents or permission of instructor. Lecs, M W F 9:05; labs M or T 1:25–4:25. P. Arneson and J. Losey.

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 BIOES 452)

Spring. 3 credits. Prerequisites: one year of introductory biology; BIOES 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 2000; next offered spring 2001. 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 instructors. S-U grades optional. Lecs, T R 10:10; lab T 1:25–4:30. 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 will be presented, and large-scale biogeographic patterns discussed. Laboratories will focus on computer applications and discussion of controversial issues.

ENTOM 455 Insect Ecology (also BIOES 455)

Fall. 3 credits. Prerequisites: BIOES 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. R. B. Root.

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 BIOES 456 and NTRES 456)

Spring. 4 credits. Limited to 60 students. Recommended: BIOES 261. S-U grades optional. Lecs, T R 9:05; labs, T W or R 1:25–4:25. Offered alternate years. Not offered spring 2000; next offered spring 2001. 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:** a field project includes descriptive and experimental techniques and hypothesis testing 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 non-infectious 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

Spring. 3 credits. Prerequisites: BIOES 278 or permission of instructor. S-U grades optional. Lecs, T R 10:10; disc, 1 hr/wk to be arranged. Offered alternate years. C. M. Caillaud.

A study of the genetic basis and evolution of ecologically important traits. Blending theory with an experimental approach to study evolution in nature, the course includes methods for measuring genetic variation and natural selection; biometrical and molecular analysis of genetic architecture; constraints and limits on evolution in natural populations; genetic aspects of coevolution, phenotypic plasticity, and conservation of endangered species. Examples are taken from studies of animals and plants.

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. B. L. Peckarsky.

The 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. The laboratory involves field collections and laboratory identification of invertebrates and stresses the use of keys. Students will 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, BIOES 261, and permission of instructor. Lecs, T R 9:05; lab T 1:25–4:15. Offered alternate years. M. J. Tauber.
Approach and procedures in biological control of arthropod pests and weeds. Demonstrations focus on living parasitoids and predators. Discussions focus on case histories.

[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, to be announced. Offered alternate years. Not offered fall 1999; next offered fall 2000. 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. The student will also be introduced to some common methods used in physiological research and to the critical reading of scientific literature.]

[ENTOM 490 Toxicology of Insecticides (also Toxicology 490)
Spring. 4 credits. Prerequisites: general chemistry. S-U grades optional. Lecs, M W F 9:05; disc 1:25–2:15, day to be arranged. Offered alternate years. Not offered spring 2000; next offered spring 2001. J. G. Scott.
The history, metabolism, and mechanism of action of synthetic and naturally occurring insecticides. Mechanisms of insecticide resistance, evaluation of insecticide toxicity, and new approaches to insect control with biotechnology will be discussed.]

ENTOM 494 Special Topics in Entomology
Fall or spring. 4 credits maximum. S-U grades optional. Hours to be arranged. Staff.
The department teaches "trial" courses under this number. Offerings vary by semester, and will be advertised by the department. Courses offered under the number will be approved by the department curriculum committee, and the same course will not be offered more than twice under this number.

ENTOM 497 Individual Study in Entomology
Fall or spring. Credit to be arranged. 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 to be arranged. 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
Summer. 3 credits. Limited to 18 students. 3 week summer session. Prerequisites: an introductory course in insect taxonomy and permission of instructor. Labs, M T W R F 9–4; Saturday field trips. Offered alternate years. Q. D. Wheeler.
A comprehensive review of the comparative morphology, phylogenetic relationships, classification, natural history, and distribution of the Coleoptera, including adult and immature stages. Laboratory practice in identification and methods for collection and study of beetles. A collection is required.

ENTOM 632 Advanced Coleopterology
Summer. 1–3 credits. Prerequisite: permission of instructor. S-U grades optional. Offered alternate years. Not offered summer 2001; next offered summer 2000. Lab, to be arranged. Q. D. Wheeler.
An advanced course on the phylogeny and classification of selected subclades of Coleoptera. Laboratory exercises in identification of beetles, generally to the level of genus or beyond. Taught by authority on taxon of interest, frequently including a visiting scholar. Can be repeated for credit.

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
Winter session, 2000. 2 credits. Prerequisites: permission of instructor. Offered alternate years. Lectures/labs M-F 9:00 am.-1:00 pm. Limited to 6 students. 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 will introduce students to the basic methods of insect molecular systematics, including DNA extraction, gel electrophoresis, PCR, DNA purification, and DNA sequencing (manual and automated). Results will be 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) will be comprised of a rotating series of four-week intensive modules on specialized topics. Topics will 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 will be 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); Economics of pest management—Staff: ARME; Greenhouse and Floriculture IPM—J. Sanderson: Entomology (Ithaca); IPM in fruit systems—A. Agnello, G. English-Loeb: Entomology (Geneva); Genetics in managed ecosystems—C.M. Caillaud: Entomology (Ithaca); Turf-grass insect IPM—M. Villani: Entomology (Geneva); Insect vectors of plant pathogens—Staff; IPM of soil-dwelling arthropods—M. Villani: Entomology (Geneva); Integrated weed and insect pest management—C. Mohler: Ecology & Systematics; IPM implementation and extension—M. Hoffmann, J. Sanderson: Entomology (Ithaca); Plant resistance—Staff: Entomology, Plant Breeding; Integrated Pest Management in Tropical Agriculture—P. Arneson: Plant Pathology (also PL PA 655); IPM of natural systems—B. Blossey: Natural Resources; Sustainable strategies for pest management—Staff.

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 to be arranged. M. J. Tauber.

ENTOM 672 Seminar in Aquatic Ecology
Spring. 1 credit. Prerequisites: permission of instructor or either ENTOM 456, 471 or BIOES 261, 462. S-U grades optional. Hours to be arranged. 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.

ENTOM 685 Seminar in Insect Physiology
Spring. 1 credit. S-U grades optional. Prerequisite: permission of instructor. Offered alternate years. Hours to be arranged. C. Gilbert.

ENTOM 707 Individual Study for Graduate Students
Fall or spring. Credit to be arranged. Prerequisite: permission of instructor. Not for thesis research. Staff.

ENTOM 709 Teaching Entomology
Credit to be arranged. Staff.
Teaching entomology or for extension training.

ENTOM 800 Master's-Level Thesis Research
Credit to be arranged. Prerequisite: permission of instructor. S-U grades optional. Staff.

ENTOM 900 Doctoral-Level Thesis Research
Credit to be arranged. 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

Floriculture and Ornamental Horticulture courses are listed under Horticultural Sciences.

Freehand Drawing and Scientific Illustration

Freehand Drawing and Scientific Illustration courses are offered through the Department of Floriculture and Ornamental Horticulture and are described in the section "Freehand Drawing and Scientific Illustration."

FOOD SCIENCE

D. D. Miller, chair; T. E. Acree, D. K. Bandler, D. M. Barbano, C. A. Batt, M. C. Bourne, J. W. Brady, D.P. Brown, J. M. Brown, R. B. Gravani, T. Henick-Kling, J. H. Hotchkiss, H. T. Lawless, C. Y. Lee, R. H. Liu, S. J. Mulvaney, J. M. Regenstein, S. S. H. Rizvi, S. K. Sharma, K. J. Siebert.

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 will be given.

FOOD 102 Exploring Food Processing
Spring. 1 credit. S-U grades only. F 12:20. Five field trips, one on F 12:30–2:30 and 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 four commercial food manufacturing/processing plants and one food research organization will be used to illustrate the application of current technologies. A course project, using the Food Science Alumni Network, will be required.

FOOD 150 Food Choices and Issues
Spring. 2 credits. S-U grades optional. T R 12:20. R. B. Gravani and D. D. Miller.
This course provides Cornell students with the knowledge needed to make healthy food choices. A systematic approach to food production, processing, distribution, and consumption will be presented. Each student will analyze the nutritional quality of his or her personal diet using a computer diet analysis program. Topics include relationships between diet and health; food processing; food safety; and discussions of contemporary issues relating to food quality, safety, and nutrition.

FOOD 200 Introductory Food Science
Fall. 3 credits. Prerequisite: college level courses in chemistry and biology. 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. Lecs, W F 12:20; lab, M 12:20–3:20. R. H. Liu.
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 spectometry are discussed.

FOOD 250 Kosher and Halal Food Regulations
Spring. 2 credits. Sophomore standing and above. 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 will be examined. The nature of the kosher supervision industry in America will be described. Halal laws will also be examined and the interactions between the two communities explored. Current food-related issues in both communities will be reviewed, including recent court decisions. Some aspects of ethnic foods will also be considered.

FOOD 290 Meat Science (also Animal Science 290)
Fall. 2 or 3 credits. Lecs, T R 11:15–12:05 p.m.; 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, preservation, 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 is taken.

[FOOD 311 Milk and Frozen Desserts
Fall. 2 credits. Prerequisite: FOOD 322 or permission of instructor. R 12:20–4:25. Offered alternate years. Next offered fall 2000. D. K. Bandler and D. P. Brown.
Deals with the principles and practices of processing fluid milk products and frozen desserts. The chemical, microbiological, and technological aspects of processing these dairy products are considered. Emphasis will be upon product quality and recognition of factors affecting consumer acceptance.]

FOOD 321 Food Engineering Principles
Fall. 3 credits. Prerequisites: FOOD 200 and introductory physics. 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, and heat and mass transport.

FOOD 322 Food Engineering Laboratory
Spring. 2 credits. Prerequisite: FOOD 321. Lab, T or R 1:25–4:10; lec, T 12:20. S. K. Sharma and S. S. H. Rizvi. Limited to 10 students in each lab session.
Provides hands-on experience with food engineering processes and measurements. Topics covered include mass and energy balances, rheology, fluid mechanics, heat transfer, refrigeration and psychrometry.

FOOD 351 Milk Quality
Fall. 1 credit. Prerequisite: AN SCI 250 or equivalent or permission of instructor. F 12:20. D. K. Bandler and D. P. Brown.
Focuses on the important aspects of farm sanitation and milk handling as they affect milk flavor and quality. The course is an overview of quality control tests, basic microbiology, cleaning and sanitizing, and special problems in manufacturing and marketing fresh and storable dairy products.

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 will present 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 will be reviewed. A 2 credit core section on food microbiology is complemented by a 1 credit section on industrial/biotechnology applications.

FOOD 395 Food Microbiology Laboratory
Fall. 2 credits. Prerequisite: BIOMI 291 or equivalent. 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 special methods for microbiological testing and control of food products, and practice in the application of a systematic approach to controlling the safety of foods.

[FOOD 396 Food Safety Assurance
Spring. 2 credits. Prerequisite: MICRO 290 or permission of instructor. T R 9:05–9:55. Offered alternate years. Not offered spring 2000. 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 will be used to demonstrate and apply the key principles that are discussed.]

FOOD 400 Senior Seminar in Food Science and Technology
Fall. 1 credit. Limited to seniors. M 4:30–5:20. D. K. Bandler.
Students prepare and present a seminar on a topic of current interest in food science and technology.

[FOOD 401 Concepts of Product Development
Spring. 2 credits. Prerequisite: FOOD 200 or equivalent. M W 11:15–12:05. Offered alternate years. Next offered 2001. 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. Lec, 12:30–2:15; lab, M 2:30–4:25. Offered alternate years. Not offered spring 2000 or 2002. 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 will serve 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 Cheese and Other Fermented Dairy Foods
Fall. 2 credits. Prerequisite: background in microbiology. R 12:20–4:25. Offered alternate years. Next offered fall 1999. D. K. Bandler and D. P. Brown.
Principles and practices of fermentation and processing techniques as they apply to cheeses, cultured dairy foods, beer, and related products. Labs will feature unit processes and tastings.

FOOD 409 Food Chemistry
Spring. 3 credits. Prerequisite: BIOBM 330 or 331. M W F 9:05–9:55. J. W. Brady.
The chemistry of foods and food ingredients. Chemical and physical properties of water, proteins, lipids, carbohydrates, and other food components/additives are discussed in the context of their interactions and functional roles in foods. The effects of chemical changes during processing and storage on quality and nutritional aspects of several food commodity groups (milk, meat, fruits and vegetables, cereals and legumes) are described.

FOOD 410 Sensory Evaluation of Food
Fall. 2–3 credits (one lab credit). Prerequisite: statistics. 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. M W F 9:05–9:55. Offered alternate years. Next offered spring 2000; not offered spring 2001. 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 419 Food Chemistry Laboratory
Spring. 2 credits. Prerequisites: BIOBM 330 or 331 and concurrent registration in FOOD 409. W 12:20–4:25. D. D. Miller and J. M. Brown.
A laboratory course emphasizing fundamental chemical principles and laboratory techniques necessary for an understanding of the chemistry of foods. Relationships between chemical composition and functional, nutritional, and organoleptic properties of foods are stressed. Many of the laboratory techniques involved are common to those used in biochemistry laboratories (e.g., electrophoresis, chromatography, enzyme assays) but are applied to specific foods or beverages.

FOOD 423 Unit Operations in Food Manufacturing
Fall. 4 credits. Intended for seniors and food science majors. Lec, T R 11:15–12:05; recitation, T 12:20; lab, 1:25–4:25 T or to be arranged. S. J. Mulvaney and S. K. Sharma.
An integrated approach to understanding food manufacturing operations. Topics include major unit operations used for thermalization, freezing and dehydration of foods. Emphasis is placed on the interplay between engineering design of processes and the physical and chemical transformations that occur as food is produced from various commodities. The impact of process conditions on product safety, overall quality, and storage stability are also considered.

FOOD 430 Understanding Wine
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. 25, 2000) to enroll. S-U grades optional. T R 2:30–4:25. T. Henick-Kling, T. E. Acree, and H. T. Lawless.
An introduction to wine appreciation through the study of fermentation biology, wine composition, and sensory perception. Samples of wines will be used to illustrate the sensory properties, microbiological processes, and chemical components that determine wine quality. Students will learn to recognize the major features of wine that determine sensory quality and know the processes that produced them. Topics will include the psychology and chemistry of bouquet, taste, and aroma; the microbiology of fermentation and spoilage; and the sensory properties of wines from different grape varieties, viticultural practices, and wine making techniques.

FOOD 447 International Postharvest Food Systems
Fall. 2 or 3 credits. Prerequisite: freshman chemistry. S-U grades optional. T R 10:10–11:00. M. C. Bourne and staff.
An interdisciplinary course designed for all undergraduate and graduate students in CALS. 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. Offered alternate years. Next offered spring 2000; not offered spring 2001 or 2003. 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 will be on the Food and Drug Administration and U.S. Department of Agriculture regulations, but the course also will refer to other regulatory agencies. Emphasis will be 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. Next offered spring 2001. 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.
The department teaches "trial" courses under this number. Offerings vary by semester, and will be advertised by the department. Courses offered under the number will be approved by the department curriculum committee, and the same course will not be 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.
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. As topics may be changed, 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.
Students assist in teaching a course appropriate to their previous training and experience. Students will meet with a discussion or laboratory section and will 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.
Students conduct original research directed by a food science faculty member.

FOOD 600 Seminar in Food Science
Fall and spring. 1 credit. S-U grades only. Required of all food science graduate students. T 4:30–5:30.
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: organic chemistry, biochemistry, knowledge of dairy-product manufacturing procedures, and permission of instructor. F 1:25–3:30. Offered alternate years. Not offered fall 1999. D. M. Barbano.
A detailed study of milk constituents and their properties. Properties of various milk constituents are related to observed physical and chemical changes that occur in dairy products during and after processing. This course will emphasize current research in dairy chemistry.]

[FOOD 605 Physical Chemistry of Food Components
Fall. 3 credits. Prerequisite: an undergraduate course in physical chemistry. M W F 10:10. Offered alternate years. Not offered fall 1999. J. W. Brady.
This course will cover the physical properties of food molecules. Emphasis will be placed on the molecular basis of structural characteristics; colloidal properties; molecular interactions; foams, gels; and water binding of foods.]

FOOD 607 Advanced Food Microbiology
Spring. 2 credits. Prerequisites: food microbiology, genetics (preferred). M W 11:15. Offered alternate years. Next offered spring 2000; not offered spring 2001. C. A. Batt.
There have been great advances in applying the modern tools of molecular biology to the detection of microorganisms and their metabolites. The primary emphasis of this course will be to review the recent developments in the theory and application of nucleic acid and antibody-based detection systems, especially as they concern food safety. In addition, other approaches, including measurement of impedence, ATP, and endotoxins, will be discussed.

FOOD 608 Chemometric Methods in Food Science
Fall. 2 credits. Prerequisite: basic statistics and chemistry or permission of instructor. S-U grades optional. W 1:25–3:20. Offered alternate years. Next offered in 2000. 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. Next offered spring 2000; not offered spring 2001. 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 will survey 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 Nutritional Sciences 620)
Spring. 2 credits. Limited to qualified seniors and graduate students. Prerequisite: BIOBM 330 or equivalent. T R 10:10. Offered alternate years. Next offered spring 2000; not offered spring 2001. 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
Fall. 2 credits. Letter grade. Prerequisites: FOOD 409 and a Biochemistry course.
An advanced course in food lipids. Describes the physical, chemical and biochemical properities of lipids, interactions and changes in food processing and storage, food technology and applications, and modern analytical methodology of lipids.

FOOD 665 Engineering Properties of Foods
Spring. 2 credits. Prerequisite: course in transport processes or unit operations as applied to foods; or permission of instructor. T R 12:20–1:10. Offered alternate years. Next offered spring 2000; not offered spring 2001. S. S. H. Rizvi, S. J. Mulvaney, and S. K. Sharma.
Theories and methods of measurement and prediction of rheological, thermal, and mass transport properties of foods and biomaterial systems. Emphasis is on physical-mathematical basis of measurement as well as the prediction processes. Examples of appropriate use of these properties in engineering design and analysis of food processes will also be provided.

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 will be advertised by the department. Courses offered under the number will be approved by the department curriculum committee, and the same course will not be offered more than twice under this number.

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. There will be assigned readings and discussion sessions on educational theory and practice throughout the term.

FOOD 800 Masters-Level Thesis Research
Fall or spring. Credit to be arranged. 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 to be arranged. 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 to be arranged. 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.

Related Courses in Other Departments

Introduction to Computing (ABEN 151)

Introduction to Business Management (ARME 220)

Marketing (ARME 240)

Food Industry Management (ARME 443)

Biological and Environmental Transport Processes (ABEN 350)

Computer-Aided Engineering: Applications to Biomaterials and Food Processing (ABEN 453)

Practical Aspects of Postharvest Handling of Horticultural Crops (HORT 325)

FREEHAND DRAWING AND SCIENTIFIC ILLUSTRATION

Freehand Drawing is a program within the Department of Floriculture and Ornamental Horticulture. Other courses offered by the department are listed under Horticultural Sciences.

[FR DR 109 Nature Drawing
Fall. 3 credits. Limited to 25 students. S-U grades optional. Permission of instructor required. M W F 10:10–12:05. Not offered fall 1999. R. J. Lambert.
A beginning course with emphasis on the drawing of natural forms: plants, animals, and landscapes. Of particular interest to students in floriculture and ornamental horticulture, landscape architecture, biological sciences, nature education, or similar fields. Outside field notebook assignments.]

[FR DR 211 Freehand Drawing and Illustration
Fall. 2 credits. Prerequisite: FR DR 109 or equivalent. S-U grades optional. 6 studio hours scheduled in 2 or 3 hour units between 9:05 and 12:05 M T W R. Not offered 1999. R. J. Lambert.
Progression to the organization of complete illustrations. Subject matter largely from sketchbooks, still life, and imagination. Composition, perspective, and ways of rendering in different media are considered.]

FR DR 214 Watercolor
Spring. 2 credits. S-U grades optional. 4 studio hours scheduled in 2 hour units between 9:05 and 12:05 and 2 hours outside sketching. M T W R. R. J. Lambert.
A survey of watercolor techniques. Subject matter largely still life, sketchbook, and on-the-spot outdoor painting.

FR DR 316 Advanced Drawing
Fall. 2 credits. Prerequisite: FR DR 109, 211 or permission of instructor. S-U grades optional. 4 hours to be arranged. M R 9:05–12:05, 2 hours outside sketching. R. J. Lambert.
For students who want to attain proficiency in a particular type of illustration or technique.

[FR DR 417 Scientific Illustration
Fall. 2 credits. Prerequisite: FR DR 211 or 316 or equivalent. S-U grades optional for graduate students only. Not offered 1999–2000. R. J. Lambert.
A survey of methods of illustration. Training in techniques of accurate representation in media suitable for reproduction processes, including pen and ink, scratchboard, wash, and mixed media.]

FRUIT AND VEGETABLE SCIENCE: HORTICULTURAL SCIENCE

See Horticultural Sciences.

HORTICULTURAL SCIENCES

Horticultural science courses at Cornell are taught by the faculty of the Department of Floriculture and Ornamental Horticulture and the Department of Fruit and Vegetable Science (Pomology and Vegetable Crops).

Floriculture and Ornamental Horticulture

T. C. Weiler, chair; N. L. Bassuk, G. L. Good, C. F. Gortzig, J. Gruttadaurio, R. J. Lambert, R. W. Langhans, C. P. Mazza, W. B. Miller, R. G. Mower, K. W. Mudge, A. M. Petrovic, D. A. Rakow, F. S. Rossi, L. A. Weston, T. H. Whitlow

Fruit and Vegetable Science

H. C. Wien, chair; R. R. Bellinder, L. A. Ellerbrock, D. E. Halseth, I. A. Merwin, M. P. Pritts, A. Rangarajan, J. Sieczka, L. D. Topoleski, C. B. Watkins, D. W. Wolfe

Courses by Subject:

General horticulture: 100, 101, 102
Public garden management: 485
Crop production:
- Agroforestry: 415
- Fruit: 200, 442, 444, 445, 450
- Greenhouse and controlled environments: 400, 410
- Nursery: 400, 420
- Turfgrass: 330, 475
- Vegetable: 225, 456, 460

Extension education: 476, 629
Horticultural physiology: 400, 450, 455, 456, 460, 462, 615, 620
Independent study, research, and teaching: 470, 495, 496, 497, 498, 499, 500, 605, 700, 800, 900
Internships: 496
Landscape horticulture: 301, 435, 440, 485, 491
Plant materials: 230, 243, 300, 301, 335, 430
Plant propagation: 400
Postharvest physiology: 325, 625, 630
Seminars: 602, 630
Special topics: 470, 494, 629, 630, 635, 694
Turfgrass management: 330, 475
Vegetable types and varieties: 220, 465

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.

HORT 100 History of Horticulture
Fall. 2 credits. Lec, T 2:00–4:30. C. F. Gortzig.
A survey of the history and development of horticulture as a science, art and profession. Discussions cover from pre-history to the present with emphasis on the 1700's to present. A field trip to historic sites for which there may be a charge of $30–$50.

HORT 101 Introduction to Floriculture and Ornamental Horticulture
Fall. 2 credits. Lec, W 10:10; lab W 1:25–4:25. T. C. Weiler and staff.
Introduction to the technology and career opportunities in floriculture and ornamental horticulture. Exploration of private and/or public sector activities: production (greenhouse, nursery, and sod), sales (retail and wholesale), landscape management (landscape management, recreational turfgrass management, urban horticulture) related professional and commercial fields. The role of science and technology in the continuing development of horticultural practice. Field trips to horticultural firms and demonstration sites.

HORT 102 General Horticulture
Spring. 4 credits. Each lab limited to 25 students. Lecs, M W F 10:10; lab M T or W 2–4:25. L. D. Topoleski.
This course acquaints the student with applied and basic horticulture. Open to all students who want a general knowledge of the subject or who want to specialize in horticulture but have a limited background in practical experience or training in plant science. Includes flower, fruit, and vegetable growing and gardening techniques.

HORT 200 Introductory Pomology
Fall. 3 credits. S-U grades optional. Lec, T R 10:10; lab, T 1:25–4:25. I. A. Merwin.
A general introduction to pomology—the science and art of fruit growing. Lectures and discussion emphasize the natural history, ecology, botany, physiology, integrated pest management, and diverse production systems for fruits grown in temperate climate areas. Lab sessions and field-trips involve fruit anatomy and morphology, clonal selection and propagation, planting and pruning techniques, fruit harvesting and storage, environmental and sustainability issues, WWWeb-based information on fruit growing, and hands-on practice in local orchards and vineyards.

HORT 220 Vegetable Types and Identification
Fall. 2 credits. T 2–4:25. L. Topoleski.
This course acquaints students with the vegetable species grown in the Northeast and the pests and disorders encountered in their production. Subjects covered include identification of economically destructive weeds, diseases and insects of vegetables, identification of vegetable and weed seeds, seedlings, nutrient deficiencies, vegetable judging, grading, and grade defects.

HORT 225 Vegetable Production
Fall. 4 credits. Lecs, M W F 11:15; lab, W 2–4:25; 1 S fieldtrip and 3 fieldtrips (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 laboratory are included.

HORT 230 Woody Plant Materials
Spring. 4 credits. Fee for lecture-laboratory manual: $35. Lecs, T R 9:05; lab T 2–4:25 **required** and **either** W **or** F 2–4:25. Staff.
A study of the trees, shrubs, ground covers, and vines used in landscape plantings. Emphasis is on winter identification and values for use as landscape material.

[HORT 243 Taxonomy of Cultivated Plants (also BIOPL 243)
Fall. 3 credits. Prerequisite: one year of introductory biology or written permission of instructor. May not be taken for credit after BIOPL 248. Lec, M W 10:10–11:00; lab, W 1:25–4:25. Offered even years. Not offered fall 1999, next offered fall 2000. 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 lecture-laboratory manual: $35. Lecs, T R 10:10; lab, T 2–4:25. 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. Garden planting design is not a component of the course.

HORT 301 Plants for Interiors
Spring. 3 credits. Prerequisite: HORT 300 or permission of instructor. Fee for lecture-laboratory manual: $35. Lecs, M W 11:15; lab, R 2–4:25. Offered even years. T. C. Weiler and staff.
Study of plants for interiors: identification, design characteristics, and cultural requirements; the interior landscape industry (organization, bidding, installation, maintenance); use of plants as elements of planting design (trees, shrubs, groundcovers, and accent plants (including potted flowering plants and cut flowers). Required 3-day field trip, estimated cost, $130.

[HORT 325 Practical Aspects of Postharvest Handling of Horticultural Crops
Spring. 3 credits. Not offered spring 2000. Lecs, M W 9:05; lab T 1:25–4:25. Staff.
A study of changes that occur in horticultural crops between harvest and consumer. Practices that affect the rate of change and the final effect on quality of the commodity are discussed. Maturity/quality indices, preharvest treatments, and harvesting/handling practices and storage/transportation requirements of selected horticulture crops are covered.]

[HORT 330 Turfgrass Management
Fall. 3 credits. Prerequisite: SCAS 260. Lec, M W 11:15; lab, F 11:15–1:10. Offered even years. Not offered fall 1999, next offered fall 2000. 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, nutrition in the management of turfgrass sites, and integrated pest management.]

HORT 335 Woody Plant Materials for Landscape Use
Fall. 3 credits. Limited to 30 students. Primarily for landscape architecture majors. Fee for lecture-laboratory manual, $35. Lecs, M W 9:05; lab R 1:25–4:25. R. G. Mower.
A study of the trees, shrubs, vines, and ground covers used in landscape plantings in the northeastern United States. Emphasis is on leaf identification and on characteristics that determine the usefulness of each as landscape subjects.

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 are stressed in lecture and hands-on skills in laboratories. Examples include both temperate as well as 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, cd); Lab: greenhouse/autotutorial; Discussion: email. K. W. Mudge.
A four week autotutorial approach to the principles and practices of grafting and budding as applied to plant propagation. Emphasis will be on the role of grafting in modern horticultural practice and on student development of hands on grafting skills. Instruction will involve microcomputer presentation of lecture materials (world wide web, cd-rom) asynchronous discussion (email), and hands on greenhouse laboratory exercises.

[HORT 410 Production and Marketing of Crops Grown in Controlled Environments
Spring. 4 credits. Letter grade only. Offered odd years; 2001. Lecs, T R 10:10; lab 2–4:25. T. C. Weiler and staff.
Basics of establishing and managing agricultural production in environmentally optimized facilities; technology basics, systems and practices, structures, systems and equipment, materials handling, heating and cooling, lighting, fertilizing and irrigation, environmental stewardship, integrated pest management, business management; world centers of production; production of cut, pot, bedding, vegetable, and fruit crops in controlled environments, emphasizing predictive harvesting through environmental, physical, and chemical management of growth and development. Each student will grow one or more crops. Required 3-day field trip, estimated cost, $130.]

HORT 415 Principles and Practices of Agroforestry (also NTRES 415)
Spring. 3 credits. Prerequisites: senior or graduate standing or permission of instructor. S-U option. Lecs, M W 10:10; lab, W 1:25–4:25. K. W. Mudge, J. P. Lassoie.
An introduction to modern and traditional agroforestry systems involving the 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 non-woody components of agroforestry systems will be considered from the standpoint of above and below ground resource capture. The sustainability of agroforestry systems will be critically examined from both a biophysical and socioeconomic perspective. Laboratory sessions will include field trips, case studies, use of computer-based sources of information, and practical skills involved in woody plant management (identification, propagation, planting, pruning, measurement.)

HORT 420 Principles of Nursery-Crop Production
Fall. 4 credits. Prerequisite: HORT 400. Lecs, M W F 9:05; lab, M 2–4:25. Field trips. Offered odd years; 1999, 2001. 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 430 Special Topics in Ornamental Plants
Fall or spring. Credit and hours to be arranged. Primarily for upperclass floriculture and ornamental horticulture majors. Prerequisites: HORT 230, 300, 301, 335, or the equivalent, and permission of instructor. R. G. Mower.
Topical subjects in plant materials. Independent and group study of important groups of woody and herbaceous plant materials not considered in other courses. The topic is given in the supplementary announcement.

[HORT 435 Landscape Management
Fall. 4 credits. Prerequisites: HORT 230 or 335. Lecs, M W F 9:05; lab, M 2:00–4:25. Offered even years. Not offered fall 1999, next offered 2000. G. L. Good.
A study of the practices involved in the maintenance of woody ornamental plants in the landscape. The major emphasis will be 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: 1999, 2001. 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. Not offered 1999–2000. 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 will be considered, and alternative production practices for both commercial and home gardeners will be discussed. Frequent field trips enhance classroom activities.]

HORT 444 Applied Viticulture
Fall. 3 credits. Lecs, T R 9:05; lab, R 2–4:25. Not offered 2000. R. M. Pool.
Grape production and post-production practices with emphasis on the Great Lakes and Finger Lakes regions. We will examine grape varieties, site selection, and vine management as affected by geography, meteorology and vine anatomy/physiology. Protection of vines and grapes from injury by cultural, chemical, and natural means will also be explored. Laboratory exercises and field trips offer hands-on experience in vineyard practices, marketing and processing.

HORT 445 Orchard Management
Spring. 3 credits. S-U grades optional. Lec T R 10:10; lab, T 1:25–4:25. Offered even years. Not offered in 2001. I. A. Merwin.
The science 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 utilization of orchard equipment. Emphasis is on the agroecology of perennial crop systems, with labs providing hands-on experience in orchard management. Previous coursework in pomology and other plant sciences is suggested, but not a prerequisite.

[HORT 450 Soil Management and Nutrition of Perennial Crops
Fall. 3 credits. Fee for course materials $35. Lecs, M W 8; lab, M 1:25–4:25. Not offered 1999–2000.
Fundamentals of mineral nutrition and soil management for perennial horticultural crops. Soil management effects on crop performance, nutrient relationships, and interaction with other components of crop production systems are emphasized. Mineral nutrition aspects deal with diagnostic techniques, interpretation of tissue and soil analyses, and nutrient requirements for optimizing crop performance.]

[HORT 455 Fertility Management and Nutrition of Vegetable Crops
Fall. 3 credits. Prerequisite: any college-level chemistry course. Lecs, M W 10:10; lab/disc, M 2–4:25. Not offered 1999–2000.
The course deals with both major, secondary and minor elements including fertilization programs, interpretation of tissue and soil analyses, nutrient interactions, induced deficiencies, toxicities as well as the effects of organic matter, crop residues, and specific crop sequences. The course emphasizes hands-on field and greenhouse experiments and small group discussions.]

HORT 460 Plant-Plant Interactions
Spring. 3 credits. Prerequisite: any crop production on plant ecology course or permission of instructor. Lecs, T R 9:05; lab/disc, M 2–4:25. Not offered spring 2001. D. W. Wolfe.
Mechanisms by which plants interfere or positively interact within the context of environmental conditions such as light, temperature, and fertility. Competitive and chemical interactions are considered between weeds and crops, among crops in polyculture, and between individuals in monoculture. Most examples will be taken from temperate and tropical monoculture and intercropping systems, but implications for natural ecosystems will also be considered.

[HORT 462 Vegetable Crop Physiology
Spring. 3 credits. Prerequisites: HORT 225 and BIOPL 242. Lecs, T R 9:05; lab/disc, M 2–4:25. Offered alternate years. Next offered spring 2001. H. C. Wien.
Study of the physiological processes that determine the timing, quantity, and quality of vegetable crop yields. Processes of flower induction, fruit set, fruit growth, and the relations between vegetative and reproductive growth are covered. The course emphasizes practical hands-on greenhouse experiments and small group discussions.]

HORT 465 Vegetable Varieties and Their Evaluation
Fall, weeks 1–7. 2 credits. Prerequisites: HORT 225 or permission of instructor. S-U grades only. Lecs, W F 8; lab, F 1:25–4:25. Offered alternate years. Not offered fall 2000. D. W. Wolfe and A. Rangarajan.
Principles of vegetable variety evaluation and selection of techniques in relation to program objectives. Morphology, yield, and quality of selected crops will be studied in the field. The seed industry will be briefly discussed.

HORT 470 Special Topics in Pomology
Spring. 3 credits. Open to undergraduates by permission. Hours to be arranged. Staff.
Selected topics are considered with respect to the current literature, experimental techniques, or applied technologies. Topics change from one year to another and reflect the expertise and research interests of the professors who participate. Topics selected for each term will be announced several months before the term begins.

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 will provide the basis for discussion.

HORT 476 Practical Problem-Solving in Horticulture
Fall. 2 credits. Lec, M 12:20–1:10; lab W 2–4:25. C. P. Mazza.
Foundation for extension or similar career oriented students. Application of horticultural science principles to practical situations. Techniques of synthesizing information from various scientific disciplines. 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 p.m. 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-one-half-day field trip to visit other botanical gardens and arboreta. Offered odd years; 2001. Not offered spring 2000. D. A. Rakow.
The course will explore the history of public gardens, types of contemporary public gardens, and the operation of botanical gardens and arboreta. Included will be 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 Design and Plant Establishment in the Urban Environment (also LA 491)
Fall. 3 credits. Prerequisites: HORT 230 or 335 or permission of instructor. Lecs, T R 12:20; lab, T 1:25–4:25. N. L. Bassuk and P. J. Trowbridge.
This course will focus on the establishment of woody and herbaceous plants in urban and garden settings. By understanding the environmental constraints placed on plants, we will be able to critically assess and modify potential planting sites, select appropriate trees, shrubs, and ground covers, and learn about the principles and practices of plant establishment both in the ground and in contained environments. Design, followed by specifications and graphic details, will be produced to implement these practices. Field work includes chemical and physical analysis of soils, vegetation, and site assessment.

HORT 494 Special Topics in Horticulture
Fall or spring. 4 credits maximum. S-U grades optional.

In **Sections 01 and 02,** the departments teach "trial" courses under this number. Offerings may vary by semester, and will be advertised by the departments. Courses offered under the number will be approved by the department curriculum committees, and the same course will not be offered more than twice under this number.

Section 01, Fruit and Vegetable Science

Section 02, Horticultural Practicum. Fall. 3 credits. Lab, R 1:25–4:25. D. A. Rakow and staff.
In Section 02, students will gain practice in developing specific manual skills under the direction of experienced plantations' staff. Applied theory and practice for a variety of horticultural topics: integrated pest management, water, bog, and marsh gardening, bed preparation and planting perennials, tree planting, pruning techniques, small engine maintenance, stone patio and path construction, and dry stone wall construction.

HORT 495 Undergraduate Seminar
Fall or spring. 1 credit. Fruit and Vegetable Science. Undergraduate participation in weekly departmental seminar series. Graduate students should enroll in HORT 602. May be taken four times for one credit per semester. S-U grades only. R 4. C. B. Watkins and A. Rangarajan.
Current topics in Fruit and Vegetable Science (see HORT 602).

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. Hours to be arranged. 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. Hours to be arranged. 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). Hours to be arranged. 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.) Hours to be arranged. 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 MPS [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 Floriculture and Ornamental Horticulture

Fall or spring. 1 credit. Prerequisite: permission of instructor. Lec, M 12:20. Staff.

Graduate students join distinguished visitors and Cornell staff members for weekly professional seminars on current teaching, research, and extension in floriculture and ornamental horticulture. Students will present a seminar based on their work. Often students use the presentations as part of their thesis defense and in preparation for job interviews.

HORT 602 Seminar in Fruit and Vegetable Science

Fall or spring. 1 credit. S-U grades only. R 4:00. A. Rangarajan and C. B. Watkins.

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 pomology or vegetable crops. Undergraduate students register under HORT 495 Sec 1.

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. T R 2:30–4:25. Offered alternate years. Not offered spring 2001. D. W. Wolfe.

Advantages and limitations of conventional experimental designs and analyses of greenhouse and field (including-on-farm) experiments. Use and interpretation of plant growth analysis techniques. Discussions will include critical analysis of published data and research in progress.

[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. Offered odd years; 2001. 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 Physiology of Horticultural Crops

Spring. 3 credits. Prerequisite: BIOPL 242 and/or HORT 325. Lecs, T R 10:10; disc, to be arranged. Not offered spring 2000.

Physiological and biochemical aspects of growth and maturation, ripening, and senescence of harvested horticultural plant parts. Topics include morphological and compositional changes during ripening and storage life, some physiological disorders, aspects of hormone action and interactions, and a consideration of control.]

HORT 629 Special Topics in Plant Science Extension (also Plant Breeding 629)

Spring. 2 credits. Offered alternate years. F 1:25–4:25. W. D. Pardee.

Designed for graduate students and advanced undergraduates to provide a broader knowledge of cooperative extension philosophy and methods. Developed for students interested in extension and research in public and commercial organizations. Topics relate to extension in other countries as well as in the United States.

HORT 630 Current Topics in Postharvest Horticulture

Spring. 1 credit. Prerequisite: permission of instructor. Hours to be arranged. Staff.

Graduate students and staff report and discuss current topics in postharvest biology and technology of horticultural crops.

HORT 635 Tools for Thought

Fall. 1 credit. Open to graduate students only. S-U grade only. 1 hour per week, to be arranged. T. H. Whitlow.

A discussion of readings from Kuhn, Popper, Waddington 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. 1 hour per week, to be arranged. Staff.

Fruit and Vegetable Science. 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. Hours to be arranged. Sec 01, Floriculture. Sec 02, Fruit and Vegetable Science. Staff.

The department teaches "trial" courses under this number. Offerings vary by semester, and will be advertised by the department. Courses offered under the number will be approved by the department curriculum committees, and the same course will not be 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 to be arranged. 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 to be arranged. S-U grades only.

HORT 900 Thesis Research, Doctor of Philosophy

Fall or spring. Credit to be arranged. S-U grades only.

INTERNATIONAL AGRICULTURE

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.

INTAG 300 Perspectives in International Agriculture and Rural Development

Fall. 2 credits. F 1:25–3:20. 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 402 Agriculture in the Developing Nations I

Fall. 2 credits. Prerequisite: International Agriculture 300. F 1:25–3:20. P. A. Arneson and staff.

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 in the tropics, using case studies of agricultural development in Latin America, especially Ecuador. 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 (International Agriculture 602), which includes a trip to Ecuador during the intersession.

INTAG 403 Traditional Agriculture in Developing Countries

Fall. 1 credit. S-U only. T 8–8:50. H. D. Thurston, D. Bates, R. Blake, J. Lassoie, A. Power, E. Fernandez, T. Steenhuis.

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 will examine traditional systems from several disciplinary points of view.

INTAG 599 International Agriculture and Rural Development Project Paper
Fall and spring. 1–6 credits. Limited to M.P.S. candidates in the fields of International Agriculture and Rural Development (IARD) and International Development (ID). S-U grades only. Staff.

INTAG 602 Agriculture in the Developing Nations II
Spring. 3 credits. Prerequisites: INTAG 300 or equivalent, INTAG 402, and permission of instructors. Cost of field-study trip includes air fare and approximately $450 for lodging, meals, and personal expenses. T R 2:30–4:25 until midterm only. R. W. Blake and staff.
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 field-study trip during January to Latin American countries is followed by discussions and assignments dealing with problems in agriculture and livestock production in the context of social and economic conditions.

INTAG 603 Administration of Agricultural and Rural Development (also Government 692)
Spring. 4 credits. M 2:30–5:30. 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 650 Special Topics in International Agricultural and Rural Development
Fall or spring. 1 credit. Staff.
A seminar for new themes of agricultural and rural development. Offered occasionally. Specific content varies.

INTAG 685 Training and Development: Theory and Practice (also Communication 685, Education 685 and Industrial and Labor Relations 658)
Spring and summer. 4 credits. S-U grades optional. Charge for materials $45. Lec, F 9:05–12:05; lab, 1 hour per week, to be arranged. At Communication Graduate Center. R. Colle and D. Deshler.
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 U.S. 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 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 694.1 Tropical Fallow Management
Fall and spring. 1–2 credits. Prerequisite: permission of instructor required. Letter or S-U grades. E. Fernandes and L. Fisher.
This discussion course is linked to the CIFFAD initiative on Fallow Management in the Tropics, which is supported by several CIIFAD programs. The course, which is coordinated by the Management of Organic Inputs in Soils of the Tropics (MOIST) group, will build upon the outputs from discussions in previous semesters and continue to refine the analytical framework and guidelines for the characterization, evaluation and synthesis of managed tropical fallow systems. Material for the course will be drawn from papers and syntheses presented by participants in the 1997 Workshop on the Intensification of Shifting Cultivation in Southeast Asia and case studies developed by Cornell students in 1998 field studies in Asia, Africa and Latin America.

INTAG 694.2 Farmer Centered Research and Extension
Fall. 3 credits. Letter or S-U grades. R 2:20–4:25. D. Deshler 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 will provide a focus for analysis. Appropriate roles of researchers and extensionists as partners with farmers will be 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 and research their own problems, and to empower them to take direct action to solve them.

INTAG 703 Seminar for Special Projects in Agricultural and Rural Development
Fall and spring. 1 credit. Required for graduate students enrolled in the M.P.S. (Agr.) degree program and majoring in international agricultural and rural development; others with permission of the director of graduate field studies in IARD. S-U grades only. M 12:20–2:15. R. W. Blake and staff.
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.

Related Courses in Other Departments

How to Manage a Watershed (ABEN 754 and GOVT 644)
Economics for Business in a Global Economy (ARME 100)
International Trade Policy (ARME 430)
Economics of Agricultural Development (ARME 464)
Seminar on Agricultural Trade Policy (ARME 730)
[Macro Policy in Developing Countries (ARME 763) Not offered 1999–2000.]
Tropical Livestock Production (AN SC 400)
[Tropical Forages (AN SC 403) Next offered spring 2001.]
Southeast Asia Seminar: Country Seminar (ASIAN 601)
Southeast Asia Seminar: Country Seminar (ASIAN 602)
Food, Agriculture, and Society (B&SOC 469, BIO G 469, S&TS 469)
Seminar in International Planning (CRP 671)
Seminar in Project Planning in Developing Countries (CRP 675)
Communication in the Developing Nations (COMM 624)
Comparative Studies in Adult Education (EDUC 483)
International Postharvest Food Systems (FOOD 447)
International Environmental Issues (NTRES 400)
Religion, Ethics, and the Environment (NTRES 407)
National and International Food Economics (NS 457)
International Nutrition Problems, Policy, and Programs (NS 680)
International Nutrition Seminar (NS 698)
Special Topics in International Nutrition (NS 699)
Plants, Genes, and Global Food Production (PL BR 201)
Plant Diseases in Tropical Agriculture (PL PA 655)
International Development (R SOC 205)
Comparative Issues in Social Stratification (R SOC 370)
[Gender Relations, Gender Ideologies, and Social Change (R SOC 425) Not offered 1999–2000.]
Social Demography (R SOC 438)
Population, Environment, and Development in Sub-Saharan Africa (R SOC 495)
[Contemporary Sociological Theories of Development (R SOC 606) Not offered 1999–2000.]
[Land Reform, Old and New (R SOC 643) Not offered 1999–2000.]
[The Sociology of Third World States (R SOC 725) Not offered 1999–2000.]
Properties and Appraisal of Soils of the Tropics (SCAS 471)
[Ecology of Agricultural Systems (SCAS 473 and BIOES 473) Not offered fall 1999.]
Comparative Extension Education Systems (EDUC 783)
Tropical Cropping Systems: Biodiversity, Social and Environmental Impacts (SCAS 314)

LANDSCAPE ARCHITECTURE

H. W. Gottfried, chair; M. I. Adleman, S. Baugher, K. L. Gleason, P. H. Horrigan, R. Jaenson, D. W. Krall, L. J. Mirin, R. T. Trancik, P. J. Trowbridge, K. A. Wolf

LA 141 Grounding in Landscape Architecture
Fall. 4 credits. Limited to 15 students. Letter grade only. Cost of drafting supplies, about $200.
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, fees and 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 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 will focus upon the role of materials in design, design theory, and design vocabulary associated with landscape architectural projects.

[LA 261 Urban Archaeology (also CRP 261)
Fall. 3 credits. Not offered fall 1999.
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 will participate in a local archaeological excavation.]

[LA 262 Laboratory in Landscape Archaeology (also ARKEO 262)
Spring. 3 credits. Prerequisites: LA 261 or CRP 261 or permission of instructor. Not offered spring 2000.
Various American Indian civilizations and European cultures have all altered the landscape to meet the needs of their cultures. Students will 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 282 The American Landscape
Fall. 3 credits. Next offered 2000.
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 292 Creating a Second Nature
Spring. 3 credits. Prerequisites: none, but ARKEO 100, ANTHR 100 or CLASSICS/ HISTORY OF ART 220 recommended. Offered alternate years. Not offered 1999–2000.
What can archaeological investigation tell us about the landscape of cultures that spent much of their civic and private lives out of doors? This course introduces the evidence for the markets, parks, gardens, fields and burial places central to daily life in the ancient Near East and Classical world.]

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 will be engaged in the art and science of site-scaled design. This includes relating construction and planting details to concepts and program.

LA 302 Community Design Studio: Integrating Theory and Practice
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.
The studio will engage course participants in service-oriented community design projects. Theories of place-making, community and participatory design and planning, and sustainability will be explored through practice-based learning. Students will be expected to work independently and collaboratively on team projects in the community. One class period per week will be designated for community field work. Studio theme for 1999-2000: to be announced.

LA 315 Site Engineering I
Spring. 2 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 (2nd seven weeks of semester). 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 317 Site Construction I
Fall (1st seven weeks of semester). 2 credits. Prerequisite: permission of instructor.
The detail design and use of landscape materials, used by landscape architects in project implementation is the focus of this course. The course format includes lectures, field trips, studio problems, and development of technical drawings leading to construction documentation for a wide variety of projects. Students will fabricate detail material prototypes and models and have the option of developing computer-generated drawings.

LA 318 Site Construction II
Spring (2nd seven weeks of semester). 2 credits. Prerequisite: LA 317 or permission of instructor.
Exploration of construction materials, including specifications, cost estimates, and methods used by landscape architects in project implementation is the focus for this course. The course includes lectures, studio problems, and development of drawings leading to construction documentation for a comprehensive project. Students will develop a process of self criticism related to measured drawings specific to the comprehensive project. Course participants will fabricate material prototypes in wood and metal.

LA 360 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. Each culture has altered the landscape in their own unique way as they created their own built environments.

LA 363/547 American Indians, Planners, and Public Policy (also CRP 363/547)
Spring. 3 credits..
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 the course is how to address urban and regional problems without imperiling the cultural survival of minorities.

LA 402 Urban Design in Virtual Space
Spring. 5 credits. Cost of supplies and fees, about $250; basic expenses for field trip, about $250.
A sequence of projects introducing students to advanced skills in large-scale urban design, including 3-d computer modeling and digital design media as tools for shaping the form of the city.

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 will explore 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 other professional situations. Topics discussed include practice diversity, marketing professional services, office and project management, construction management, computers in the profession, and ethics.

[LA 480 Principles of Spatial Design and Aesthetics (also City and Regional Planning 481 and 581)
Fall. 3 credits. Not offered 1999–2000.
A lecture course that introduces the spatial and visual design vocabularies of cities. Aesthetic principles and theories of design are investigated for different types of urban spaces drawn from a variety of international examples, historic and modern. Included in the course are design methods and applications in the contemporary urban context of Europe and North America.]

LA 483 Design Criticism
Fall. 3 credits.
Writing design criticism. Emphasis on analytical descriptions and interpretations or works and on the role of criticism in design discourse.

[LA 486 Community Design Workshop
Spring. 3 credits. Permission of instructor. S-U grades optional. Not offered 1999–2000.
This class will offer hands-on learning of the design process through the designing and building of service-oriented community projects (parks, public spaces, school gardens, downtown revitalization). This course will enable students to both study and experience design and implementation skills at all levels of the design process. Students will learn and practice skills related to community design primarily through work on the participating design and planning phase of the project.]

[LA 487 Experiential Community Design
Fall. 3 credits. Permission of instructor. S-U grades optional. Not offered 1999–2000.
This class will offer the opportunity to learn, hands-on, the design process through the designing and building of service-oriented community projects (parks, public spaces, school gardens, downtown revitalization). This course will enable students to both study and experience design and implementation skills at all levels of the design process. Students will be engaged in the community-build phase of a community design project initiated the previous spring semester.]

LA 490 Rome Wasn't Built in a Day
Spring. 3 credits.
In this electronic course, students will 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 will engage 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 will be 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 Design and Plant Establishment in the Urban Environment (also HORT 491)
Fall. 3 credits. Prerequisites: HORT 230 or permission of instructor. Cost of supplies, about $50; expenses for field trips, about $50.
This course will focus on the establishment of woody and herbaceous plants in urban and garden settings. By understanding the special constraints placed on plants, we will be able to critically assess and modify potential planting sites, select appropriate trees, shrubs, and ground covers and learn about the principles and practices of plant establishment both in the ground and in contained environments. Design, followed by specifications and graphic details, will be produced to implement these practices. Field work includes chemical and physical analysis of soils, vegetation, and site assessment. A comprehensive project allows students to put into practice many technical and design aspects of the 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 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 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 within contemporary design applied to the practice of landscape architecture. Projects focus on 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 will focus on the spatial design of project-scale site development. Students will develop their expertise in applying the design theory, vocabulary, and graphic expression introduced in LA 501.

LA 505 Landscape Representation I
Fall. 3 credits. Prerequisites: concurrent enrollment in LA 501 or permission of instructor.
This class introduces students to both conventional and unconventional modes of landscape architectural design representation. Drafting, orthographic drawing, axonometric project, lettering, analysis and concept drawing will be 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. Not offered 1999–2000.
Course will focus on modes of landscape representation from ideation to presentation. Projects will in many cases correspond with LA 502 design projects. Representation modes will include for example: freehand, analysis and orthographic drawing; concept modelling; composite drawings; visual books.]

LANAR 524 History of European Landscape Architecture*
Spring. 3 credits.
*Offered through the College of Architecture, Art, and Planning.

LANAR 525 History of American Landscape Architecture*
Fall. 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, or by permission of the instructor. Offered alternate years. Not offered spring 2000.
This advanced seminar is seeking students in classics, art history, archaeology, landscape architecture, 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.]

LA 569 Archaeology in Preservation Planning and Site Design (also CRP 569)
Spring. 3 credits. Offered alternate years. Next offered spring 2000.
In response to federal, state, and local legislation, 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 590 Theory Seminar
Spring. 3 credits.
Seminar in contemporary 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 will be 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; expenses for field trip, about $250.
The studio will focus on site-scaled projects that engage cultural and natural systems. Theories of place-making, sustainable design and landscape representation will be critically explored through design projects that derive from and affirm a sense of site and place. The integration of site knowledge and site construction aims to support a deepening level of correspondence 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 will build upon your prior course work with an expectation that course participants can creatively manipulate the program and conditions of a site with increased emphasis placed on how things are constructed and contemporary technology. This course will focus 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 will be critically explored through theory and practice in this studio.

LA 615 Site Engineering I
Spring. 2 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. (2nd seven weeks of semester). 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 617 Site Construction I
Fall (1st seven weeks of semester). 2 credits. Prerequisite: permission of instructor.
The detail design and use of landscape materials, used by landscape architects in project implementation is the focus of this course. The course format includes lectures, field trips, studio problems, and development of technical drawings leading to construction documentation for a wide variety of projects. Students will fabricate detail material prototypes and models and have the option of developing computer-generated drawings.

LA 618 Site Construction II
Spring. (2nd seven weeks of semester). 2 credits. Prerequisite: LA 617 or permission of instructor.
Exploration of materials, including specifications, cost estimates, and methods used by landscape architects in project implementation is the focus for this course. The course includes lectures, short studio problems, and the development of drawings leading to construction documentation for a comprehensive project. Students will develop a process of self-criticism related to measured drawings specific to the comprehensive project. Course participants will fabricate material prototypes in wood and metal.

[LA 619 Advanced Site Grading
Spring (2nd seven weeks of semester). 2 credits. Limited to 10 students. Prerequisite: LA 315 or LA 615. Not offered 1999–2000.
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. Each culture altered the landscape in their own unique 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. 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. 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.
This advanced studio provides the opportunity to explore issues of contemporary landscape architecture and integrate related fields. Topics examined 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

J. P. Lassoie, chair; R. A. Baer, M. B. Bain, B. L. Bedford, T. Brown, L. E. Buck, P. Curtis, D. J. Decker, T. J. Fahey, T. A. Gavin, J. W. Gillett, B. A. Knuth, C. Kraft, M. E. Krasny, C. C. Krueger, R. A. Malecki, R. J. McNeil, E. Mills, M. H. Olson, M. E. Richmond, L. Rudstam, J. Schelhas, R. Schneider, P. J. Smallidge, C. R. Smith, P. Sullivan, 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 100 Principles of Conservation
Fall. 3 credits. Limited to first-year students specializing in natural resources. Letter grade only. M W F 9:05; 1 hr disc to be arranged. R. J. McNeil.
The nature of natural resources, how they are managed, and their interactions with individuals and societies are considered. Case histories are used to illustrate both principles and practices. Emphasis will be on management of renewable resources based on ecological and cultural perspectives.

NTRES 201 Environmental Conservation
Spring. 3 credits. M W F 12:20; 1 hr disc sec to be arranged. Staff.
As the end of the 20th century approaches, our lives are increasingly touched by questions about environmental degradation at local, regional, and global scales. Business as usual is being challenged. This course will stimulate you to go beyond the often simplistic portraits of the environmental dilemma offered by the mass media so that you will have 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. Lec, W 9:05; labs, M W 1:25–4:25 or T R 1:25–4:25. T. Gavin and 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 253 Applied Ecology and Ecosystem Management
Spring. 3 credits. Prerequisites: introductory courses in biology and ecology. Lec M W 10:10–11:00; lab, T W or R 2:30–4:25.
The application of ecological principles to renewable resource and environmental problems. The perspective is the interactions of species within the ecosystem, which is the basic unit of study. Topics include fisheries, forests, the conservation and management of wild species, invaders and pests, and pollution. The discussion section emphasizes quantitative analysis and the use of microcomputers.

NTRES 270 Conservation of Birds
Spring or summer. 2 credits. Not offered every year. Check with department for availability. 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 will be 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 271 Conservation of Birds Laboratory
Spring or summer. 1 credit. Concurrent enrollment in NTRES 270 required. Not offered every year. Check with department for availability. 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 will 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 301 Forest Ecology
Fall. 3 credits. Prerequisite: introductory biology. M W F 11:15. 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. M 1:25–4:25. 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 White Mountains, New Hampshire. Group research projects in local forests.

NTRES 303 Woodlot Management and Maple Syrup Production
Spring. 3 credits. Letter grades only. Lec, T R 10:10–11:00; lab R 12:20–4:25. T. J. Fahey.
A practical, field-oriented course emphasizing principles and practices of multiple purpose management of small nonindustrial private forest land in the northeastern United States, including the production of maple syrup.

NTRES 304/305 Wildlife Ecology Concepts/Applications
These courses are currently under revision. Please contact the Department for information on availability.

NTRES 306 Coastal and Oceanic Law and Policy
Summer. 2 credits. July 19–26. 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. Estimated cost (includes tuition, room and board, and ferry transportation), $1,000.
Intended for persons 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 Management
Fall. 3 credits. Prerequisite: junior standing. M W F 10:10. B. A. Knuth.
Focus is on fish, wildlife, forest, and water 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 309 Resource Management in American Indian Nations
Summer. 1 credit. Prerequisite: none; recommended: one course each in Natural Resources and American Indian Program. Consult Cornell University Summer Session Catalog for scheduling information. S. M. Penningroth.
This course examines resource management in territories belonging to American Indian nations. Topics include history, sovereignty, religious significance of the environment, and intellectual property. Case examples of traditional Indian management techniques as well as contemporary resource management issues are presented.

NTRES 321 Introduction to Biogeochemistry (also GEOL 321, SES 321)
Fall. 4 credits. Prerequisites: college-level chemistry, plus a course in biology and/or geology. Lec, T R 12:20–1:10; lab, to be announced. J. B. Yavitt and L. A. Derry.
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.

NTRES 340 Quantitative Population Analysis
Fall. 3 credits. Letter grade only. Prerequisites: Math 111, Math 171, BTRY 215 or permission of instructor. M W F 9:05–9:55. P. J. Sullivan.
The dynamics and demographics of aquatic and terrestrial populations are examined using statistical techniques and computer modeling. The course will emphasize (1) estimation of population abundance using statistical surveys, mark-recapture methods, cohort analysis, and other sampling techniques; and (2) characterization of population dynamics through mathematical and statistical models representing the fundamental processes of birth, death, growth and movement. Topics will include applications to aquatic and terrestrial organisms of resource and conservation interest.

NTRES 350 Ecological Dimensions of Global Change
Fall. 3 credits. Prerequisites: college-level courses in biology and chemistry. M W 12:20–1:10, disc sec, M or W 1:25–2:15. J. B. Yavitt.
Human accelerated environmental changes threaten the integrity of nature. This course explains the ecological principles that comprise this threat. Topics include increasing air temperature, atmospheric carbon dioxide and other gases, and pollution. Discussions explore the likely future behavior of nature given different global change scenarios.

NTRES 400 International Environmental Issues
Fall. 4 credits. Prerequisite: junior standing or above. T R 10:10–12:05.
Current international environmental issues are analyzed from an interdisciplinary perspective, with an emphasis on understanding the complex relationships between humans and the environment that underlie environmental problems and solutions. Topics covered include conceptualization of environmental issues, population, property rights, human behavior, environmental values, environmental education, international policies, international organizations, globalization, conservation and development projects, participation and community-based conservation, and social conflict and unrest. Environmental issues covered include endangered species, biodiversity, tropical forests, global climate change, protected areas, indigenous people, and ocean fisheries. Emphasis on systematic analysis of environmental issues; written and oral presentations.

NTRES 402 Natural Resources Policy, Planning, and Politics
Spring. 3 credits. Prerequisites: junior standing; special application process, and course fee (approx. $350). Lec, January two-week intersession; two 2 hr orientation sessions in fall semester and four 2 hr sessions in February and March. Completed applications due by October 14. Applications are available in 122D Fernow Hall or by contacting map10@cornell.edu.
An introduction to the environmental policy process and its conceptual framework. Recognition of phenomena identified as natural resources or environmental problems and issues; steps leading to legislation or regulations to solve problems; implementation and evaluation stages; role of the legal system; roles of citizens, lobbyists, government actors. Case studies; presentations by and discussions with about twenty prominent Washington policy makers appearing as guest lecturers. Required interviews, term paper, oral reports. Several meetings in Ithaca before and after intensive January session in Washington.

NTRES 404/405 Wildlife Populations Ecology/Applications
These courses are currently under revision. Please contact the Department for information on availability.

[NTRES 406 Ecology Risk Assessment (also Toxicology 406)
Spring. 3 credits. Prerequisites: BIOES 261 or equivalent; permission of instructor if not an advanced student in natural sciences of engineering. M W F 11:15–12:05. Offered alternate odd years. Next offered spring 2001. J. W. Gillett.
This course strives to develop understanding of and competence in the different types of ecological (non human health) risk assessments. Focus is on cases for chemical, physical, and biological stressors in a variety of circumstances. The proposed USEPA approach under development will serve as the working model.]

NTRES 407 Religion, Ethics, and the Environment
Spring. 4 credits. For juniors, seniors, and graduate students; others by permission only. S-U grades optional. T R 10:10–11:00; a hr disc to be arranged. R. A. Baer.
How religion, 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, animals rights vs. ecosystem concerns, responsibility to future generations, the limitations of rationalism in ethics, and discussion of whether women approach moral issues differently from men.

[NTRES 408 Resource Management and Environmental Law
Fall. 3 credits. For juniors, seniors, and graduate students. S-U grades optional. M W F 9:05–9:55. Not offered fall 1999. Staff.
A senior-level course that introduces the use of legal concepts, doctrines, and remedies in

natural resource and environmental management. For a variety of living resources and their habitats, it explores the common law and regulatory processes available for resolving conflicts between exploitation and protection and stresses a practical understanding of how public and private values, economic considerations, and constitutional limitations affect management techniques and objectives.]

NTRES 410 Wildlife Management Concepts and Applications

Spring. 3 credits. Prerequisites: senior standing or permission of instructor. NTRES 210 required and a broad background in biology or ecology is strongly recommended. Lecs, T R 11:15–12:05; lab, W 1:25–4:25.

An in-depth analysis of ecological and human dimensions for decision making in integrated wildlife management. This includes population and system modeling for evaluation of management decisions, adaptive management, and design of wildlife management plans. Afternoon labs and field trips are required to investigate areas of interest in wildlife management.

NTRES 411 Seminar in Environmental Ethics

Fall. 3 credits. For seniors, juniors and graduate students. S-U grades optional. W 1:25–3:50.

Moral concerns relative to the natural environment and agriculture. In successive years, the seminar will focus on such topics as (1) animal rights vs. ecosystem concerns, (2) natural resource management and the concept of the public interest, (3) applying environmental ethics in a democratic and pluralistic society, and, (4) land use ethics.

NTRES 415 Principles and Practices of Agroforestry (also Hort 415)

Spring. 3 credits. Prerequisites: senior or graduate standing or permission of instructor. S-U option. Lec, M W 10:10–11:00; lab, W 1:25–4:25. K. Mudge and J. Lassoie.

An introduction to modern and traditional agroforestry systems involving the 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 non-woody components of agroforestry systems will be considered from the standpoint of above and below ground resource capture. The sustainability of agroforestry systems will be critically examined from both a biophysical and socioeconomic perspective. Laboratory sessions will include field trips, case studies, use of computer-based sources of information, and practical skills involved in woody plant management (identification, propagation, planting, pruning, measurement).

NTRES 417 Wetland Resources

Summer. 2 credits. Prerequisite: one year of college biology. July 12–19. 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. Estimated cost (includes tuition, room and board, and ferry transportation), $1,000.

An examination of coastal and adjacent freshwater wetlands from historical, disturbance, and preservation perspectives, including fresh and salt water-marsh ecology and management. Field trips to selected examples of the wetlands under discussion and follow-up laboratories emphasize successional features, plant identification and classification, and examination of the dominant insect and vertebrate associations.

NTRES 418 Wetland Ecology and Management-Lecture

Fall. 3 credits. (Students may not receive credit for NTRES 418 *and* NTRES 417 Wetland Resources, Shoals Marine Laboratory summer course.) T R 1:25–2:40. 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. W or F 12:20–4:25. One weekend fieldtrip required.

An integrated set of laboratory field exercises designed to expose students to: (a) the diversity of wetland ecosystems; (b) the flora, fauna, soils, and hydrology of wetlands within the region; (c) methods of sampling wetlands vegetation, soils, and water; and (d) methods of wetland identification and delineation. Some exercises will require written reports.

NTRES 420 Ecological Management of Water Resources

Spring. 3 credits. Prerequisites: introductory ecology and introductory chemistry or permission of instructor. M W F 9:05–9:55. 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 will 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: one introductory course in ecology or equivalent and junior standing; one advanced course in ecology or equivalent. T R 1:25–2:40. B. Bedford.

The course explores environmental impact assessment (EIA) from the perspective of the watershed, landscape, or region rather than the individual development project. It provides an overview of the EIA process and landscape analysis as they are implemented within various governmental and development agencies; examines diverse conceptual frameworks for landscape impact analysis; and exposes students to modern tools for evaluating landscapes.

NTRES 438 Fishery Management

Spring. 3 credits. Lec, T R 10:10; disc, T or R 11:15. Offered alternate years. Next offered spring 2000. C. C. Krueger.

Introduction to management as an adaptive process that focuses on achievement of goals. Coverage includes sport and commercial fisheries and species restoration. Topics include setting goals and objectives, regulations, habitat management, population control, stocking, and management of trout, reservoirs, the Great Lakes and Pacific halibut. Ecological, social, political, and economic aspects of those topics are discussed.

[NTRES 442 Techniques in Fishery Science

Fall. 5 credits. Limited to 15 upperclass and graduate fishery students. Cost of field trips, no more than $30. Offered alternate odd years. Next offered fall 2000. T R 1:25–4:25; 2 or more weekend field trips and 1 mid-week field trip. C. C. Krueger.

Emphasis is on methods for collecting and analyzing data from fish populations and their habitats. Topics include passive and active fish-capture methods, tagging and marking, and physical and chemical habitat measurements. Assumptions and limitations inherent in data sets, research planning, and scientific report writing are also discussed. Several field trips provide hands-on experience in data collection on streams and lakes.]

NTRES 450 Conservation Biology

Fall. 3 credits. Prerequisite: a reasonable biology background. Limited to first 30 seniors, plus graduate students. Lec, T 10:10–12:05; disc, R 10:10 or 11:15. T. A. Gavin.

Emphasis will be on biological topics that are important to the maintenance of biological diversity. Examples include population viability analysis, and the analysis of the demography and genetics of small populations as they are affected by habitat fragmentation and isolation. Students will gain thorough familiarity with these concepts and their potential application through lectures, discussion, and use of computer models. This course is intended primarily for students with a background in college biology. Students with no college biology background should enroll in BIOES 257.

NTRES 456 Stream Ecology (also ENTOM 456, BIOES 456)

Spring. 4 credits. Limited to 45 students. Prerequisites: none; BIOES 261 recommended. Offered alternate years. Lec T R 9:05–9:55; lab T W or R 1:25–4:25. B. 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**: A field project includes descriptive and experimental techniques and hypothesis testing related to environmental assessments.

NTRES 460 Quantitative Ecology of Fisheries Resources

Spring. 3 credits. S-U grades optional. Prerequisites: NTRES 304 recommended or permission of instructor. M W F 10:10–11:00. 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 Management of Terrestrial Habitats

Spring or summer. 2 credits. Prerequisites: NTRES 210, 304; statistics recommended; junior standing or above. Lec/lab, W 1:25–4:25. Not offered every year. Check with department for availability. C. R. Smith.

A landscape ecological approach will be used to introduce students to habitat concepts and to methods of inventorying, measuring, monitoring, describing, classifying, and restoring terrestrial habitats at a variety of temporal and spatial scales. Field trips will be taken to areas managed by both public and private land management organizations. An introduction to use of the Global Positioning System (GPS) is included.

NTRES 493 Individual Study in Resource Policy, Management, and Human Dimensions

Fall, spring or winter. Credit to be arranged. S-U grades optional. Prerequisite: permission of instructor. R. A. Baer, T. Brown, L. E. Buck, D. J. Decker, J. Gillett, B. Knuth, R. McNeil, J. Schelhas.

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 will be advertised by the department. Courses offered under the number will be approved by the department curriculum committee, and the same course will not be offered more than twice under this number.

NTRES 495 Individual Study in Fish and Wildlife Biology and Management

Fall or spring. Credit to be arranged. S-U grades optional. Prerequisite: permission of instructor. M. Bain, P. Curtis, T. Gavin, C. Kraft, C. Krueger, R. Malecki, E. Mills, A. Moen, M. Olson, 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 to be arranged. S-U grades optional. Prerequisite: permission of instructor. B. Bedford, T. Fahey, M. Krasny, J. Lassoie, R. Schneider, 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 will 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 to be arranged. Limited to graduate students working on professional master's projects. S-U grades only.

NTRES 601 Seminar on Selected Topics in Fishery Biology and Aquatic Science

Fall or spring. 1 credit. S-U grades only. T 3:35–4:25; disc sec, T 4:30–5:00.

Selected readings and discussions of research and/or current problems in fishery and aquatic sciences.

NTRES 604 Seminar on Selected Topics in Resource Policy and Management

Fall. 2 credits. S-U grades only. M 3:00–4:30.

Primarily for graduate students with a major or minor in resource policy and management and upper level undergraduates with a strong interest in resource policy analysis. Topics include the policy process, actors and stakeholders, ethical dimensions, and evaluation. Emphasis is placed on discussion, faculty-student interaction, communication skills, and current resource policy issues.

NTRES 607 Ecotoxicology (also Toxicology 607)

Spring. 3 credits. Prerequisites: graduate or senior status and two 300-level courses in chemistry, biological science, or toxicology. M W F 11:15–12:05. Offered alternate even years. Next offered spring 2000. 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 610 Introduction to Chemical and Environmental Toxicology (also Toxicology 610)

Fall. 3 credits. Prerequisites: biochemistry and animal physiology. Letter grade only. M W F 11:15–12:05. J. W. Gillett.

Introduction to the basic concepts of toxicology, exposure and biological responses to toxicants, methods of assessing toxicity; factors affecting outcomes, specific sources of toxicants (including air pollution, agriculture, industrial and commercial processes, natural occurring toxicants, and social poisons), risk assessment and regulation of toxic materials.

NTRES 612 Wildlife Science Seminar

Fall and spring. 1 credit. Prerequisite: permission of instructor. S-U grades only. Check with department for availability.

Discussion of individual research or current problems in wildlife science.

NTRES 615 Case Studies and Special Topics in Agroforestry

Fall. 2 credits. Prerequisites: NTRES/HORT 415 or permission of instructor. S-U only. Hours to be arranged. L. E. Buck, J. P. Lassoie.

Interdisciplinary groups of students examine case study examples of agroforestry practices in developed and developing countries. Specific topical areas are examined in depth, leading to development of a team-written report and a class presentation. Extensive library research and participation in small group discussions are required.

NTRES 616 Forest Science and Management Seminar

Fall and spring. 1 credit. Permission of instructor. S-U grades only. Check with department for availability.

Selected readings and discussions of research and/or current problems in forest science and management.

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. J. Schelhas.

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 619 Field Practicum in Conservation and Sustainable Development

Spring. 3 credits. Prerequisites: NTRES 618; preference given to graduate students with minor in conservation and sustainable development; permission of instructor. Limited to 12 students. Includes two-week field study trip to a Latin American country in January. J. Schelhas.

An interdisciplinary study of a conservation and development problem in Latin America. The course will use an interdisciplinary research methodology that includes group problem identification, individual or rapid appraisal projects, and synthesis of group work to identify key conservation and development issues and research priorities for a selected site.

NTRES 660 Quantitative Ecology of Fisheries Resources

Spring. 3 credits. S-U grades optional. Prerequisites: NTRES 304 recommended or permission of instructor. M W F 10:10–11:00. Offered alternate even years. P. J. Sullivan.

This course is taught in conjunction with NTRES 460 (see description above). Students taking the course for graduate credit will be 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 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 will be advertised by the department. Courses offered under the number will be approved by the department curriculum committee, and the same course will not be offered more than twice under this number.

NTRES 698 Current Topics: Environmental Toxicology (Toxicology 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 to be arranged. 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 to be arranged. Limited to graduate students working on master's thesis research. S-U grades only.

NTRES 900 Graduate-Level Thesis Research
Fall and spring. Credit to be arranged. 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 to be arranged. 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 456, 470, 471; BIOES 263, 274, 278, 452, 457, 461, 462, 463, 471, 472, 475, 476, 478)

Environmental Law, Ethics, and Philosophy (S&TS 206; CRP 451; PHIL 241, 246, 247, 381)

Human Systems and Communication (COMM 260, 285, 352, 421)

Physical Sciences (ABEN 435, 475; SCAS 260, 321, 365, 371, 483; GEOL 103, 104; CEE 432)

Public Policy and Politics (GOVT 427, 428; BIO & SOC 461; CEE 529)

Resource Economics (ARME 100, 250, 450, 451; ECON 309)

Spatial Data Interpretation (SCAS 420, 461, 620, 660)

PLANT BREEDING

E. D. Earle, chair; W. R. Coffman, S. Kresovich, M. M. Kyle Jahn, S. R. McCouch, M. A. Mutschler, W. D. Pardee, K. V. Raman, M. E. Smith, M. E. Sorrells, S. D. Tanksley, D. R. Viands

Emeritus Professors: R. E. Anderson, H. L. Everett, C. C. Lowe, H. M. Munger, R. P. Murphy, R. L. Plaisted and D. H. Wallace

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
Spring. 2 credits. Prerequisite: one 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 401 Plant Cell and Tissue Culture
Fall. 3 credits. Prerequisites: a course in plant biology, cell 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. Methods for plant improvement via manipulations of cultured cells will be discussed.

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 R 1:25–4:25 (alternate weeks) plus 1 hr to be arranged. E. D. Earle.
Laboratory exercises complementing Plant Breeding 401. Techniques for establishing, evaluating, and utilizing plant organ, tissue and cell cultures will be covered. Experiments use a broad range of plant materials and include *Agrobacterium*-mediated gene transfer.

PL BR 403 Genetic Improvement of Crop Plants
Fall. 3 credits. Prerequisites: genetics (BIOGD 281 or other standard genetics course), and a course in crops, horticulture or floriculture. M W F 9:05–9:55.
M. E. Smith.
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 Genetic Diversity
Spring. 2 credits. S-U option. Prerequisites: a course in genetics, plant breeding or permission of instructor. T R 9:05–9:55.
S. Kresovich.
This course explores the structure of genetic variation through time and space and how it ultimately may be maintained and utilized. Case studies representing organisms of biological interest and agricultural importance are employed to highlight biological and genetic theories, technologies, and approaches essential to conservation genetics and the improvement of crop and animal species. In complement, underlying ethical, legal, and social issues affecting conservation and use of genetic diversity 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 two-week module at a time to be arranged in Spring 2000. 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. In 2000 the module will deal with applied techniques and molecular cytogenetics. In 2001 it will cover basic techniques for examination of plant chromosomes.

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 will be advertised by the department. Courses offered under the number will be approved by the department curriculum committee, and the same course will not be 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, 603 or equivalent (may be taken concurrently). 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. Lecs, T R 1:25–2:40. M. M. Kyle.
This course provides an advanced survey of genetics in higher plants. Topics include genetic analysis of developmental and metabolic processes, cytogenetics, mating behavior and barriers, and aspects of population and quantitative genetics.

PL BR 607 Electronic Information Resources and Bioinformatics
Fall. 1 credit. Enrollment limited. S-U or letter grades optional. Prerequisites: basic biology, basic genetics, familiarity with PC working environment. Permission of instructor required. Times to be arranged—three times/week for one month. E. Paul and S. McCouch.
This course will focus on how to access information in public data bases such as GenBank, GRIN, and SWISSPROT, and on tasks such as BLAST searching, sequence alignment, primer design, and phylogeny analysis. The biological background of issues will be presented in lectures, and extensive on-line exercises will provide students with experience in accessing and analyzing diverse information in the computer environment.

PL BR 608 Comparative Genomics
Fall. 1 credit. Enrollment limited. S-U or Letter grades optional. Prerequisites: PL BR 607 or equivalent experience. Permission of instructor required. Times to be arranged—three times/week for one month. E. Paul, S. McCouch and M. Sorrells.
This course will emphasize how to access and integrate different types and sources of data using computer databases and a variety of querying mechanisms. Students will learn to integrate information derived from analysis of phenotypes, biochemical and metabolic pathways, DNA sequences and genetic and physical maps using plant genome databases, and a variety of software packages.

PL BR 610 Advanced Plant Breeding Methods
Spring. 3 credits. Prerequisites: PL BR 403, (603), or equivalent, BIOGD 281, or equivalent. M W F 12:20–1:10. M. Mutschler.
This is a capstone course that integrates information from a variety of disciplines to provide a current comprehensive examination of modern plant breeding. Plant breeding methods used for a variety of crops are considered, including selection techniques, strategies for self- and cross-pollinated crops, population improvement, and utilization of wild germplasm for crop improvement in private or public programs. The effect of crop and breeding objectives on the success of breeding strategies will be considered. Integration of biochemical and molecular techniques into an applied breeding program will be addressed.

PL BR 622 Seminar
Fall or spring. 1 credit. S-U grades only. T 12:20. 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 653.2 Plant Biotechnology (also Plant Pathology 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) Sept. 29-Oct. 27. 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. Prerequisites: BIO PL 653.1. M W F 10:10–11:00. Offered alternate years. Next offered fall 2000. 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 and Genetic Diversity (also BIO PL 653.6)
Fall. 1 credit. S-U grade or letter option. Lecs, M W F 10:10–11:00. (12 lecs) Sept. 29–Oct. 27. Offered alternate years. S. Kresovich and S. Tanksley.
Application of DNA markers to the evaluation of genetic diversity in natural populations and germplasm collection as well as the identification, manipulation and isolation of genes important to plant and animal productivity using molecular genetic techniques. Students will 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. Strategies for the use of DNA polymorphisms in the management of genetic resources will also be taught.

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 will be advertised by the department. Courses offered under the number will be approved by the department curriculum committee, and the same course will not be 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 or 603. W 3:35–5:15, F 3:35–4:25. Offered odd years. Not offered 1999–2000. M. E. Sorrells.
Emphasis is on 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.]

PL BR 717 Quantitative Genetics in Plant Breeding
Spring. 3 credits. S-U grades only. Prerequisites: PL BR 403, (603), and BTRY 601 or equivalent. M W F 2:30–3:20. Offered even years. D. R. Viands and M. E. Sorrells.
Discussion about 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 will be evaluated to provide data for computing quantitative genetic parameters.

[PL BR 718 Breeding for Pest Resistance
Spring. 3 credits. Prerequisites: BIOGD 281 and PL BR 403, (603). An introductory course in Plant Pathology and/or Entomology also highly recommended. Lec, T R 10:10–11:30. Not offered 1999–2000. M. A. Mutschler.
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/molecular tools in breeding for pest resistance.]

PL BR 800 Master's-Level Thesis Research
Fall or spring. Credit to be arranged. 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 to be arranged. 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 to be arranged. Prerequisite: permission of instructor. S-U grades optional. Graduate faculty.
For students admitted to candidacy **after** the "A" exam has been passed.

PLANT PATHOLOGY

S. A. Slack, chair; J. R. Aist, P. A. Arneson, S. V. Beer, G. C. Bergstrom, B. B. Brodie, A. R. Collmer, T. P. Delaney, W. E. Fry, S. M. Gray, K. T. Hodge, R. K. Horst, G. W. Hudler, R. P. Korf, J. A. Laurence, S. G. Lazarowitz, J. W. Lorbeer, R. Loria, G. B. Martin, M. T. McGrath, M. G. Milgroom, E. B. Nelson, W. A. Sinclair, H. D. Thurston, B. G. Turgeon, O. C. Yoder, 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 101 Freshman Writing Seminar: Pests, Pesticides, People, and Politics
Spring. 3 credits. Limited to 17 students. Lecs, M W F 8:00. Offered spring 2000. P. A. Arneson.
This seminar examines the use of pesticides, their impact on human health and the environment, and their regulation. Beginning with Rachael Carson's classic *Silent Spring*, we will examine many facets of the pesticide controversy through readings in current popular literature, technical journals, government documents, industry propaganda, and publications of various so-called "public interest groups." We will emphasize the need for critical thinking as we explore the power of the written word to persuade.

[PL PA 102 Freshman Writing Seminar: Environmental Issues and the Changing Global Climate
Fall. 3 credits. Limited to 17 students. Lecs, T R 8:40. Not offered fall 1999.
This seminar provides an opportunity to learn more about the biological, social, and political impact of environmental issues on scales ranging from local to global. Readings, discussions, and some hands-on experience will provide subjects for a seminar designed to teach writing at levels of single sentences to term papers.]

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
Spring. 4 credits. Prerequisite: one year of biology. Lecs, M W F 11:15; lab, T or W 1:25. W. E. Fry.
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. It is not an adequate prerequisite for plant pathology courses numbered 600 and above.

PL PA 309 Introductory Mycology
Fall. 3 credits. Prerequisite: a year of biology or equivalent. Concurrent registration in PL PA 319 is recommended. Lecs, T R 9:05–9:55; labs, R 1:25–4:25. J. R. Aist.
An introduction to fungi, emphasizing biology, comparative morphology, and taxonomy.

PL PA 319 Field Mycology
Fall. 1 credit. Prerequisite: permission of instructor. Offered fall 1999. K. T. Hodge.
Study of mushrooms and other fungi on 7 field excursions followed by 7 evening labs devoted to lectures and identification and study of collections under the microscope. Emphasis on ecology, biology, and means of identification. Grades are determined on basis of laboratory final.

PL PA 401 Basic Plant Pathology
Fall. 4 credits. Prerequisite: one year of biology and BIO PL 241 or equivalent. Recommended: general microbiology, plant physiology. Lecs, T R 11:15, F 12:20; lab, T or W 1:25. W. A. Sinclair.
Principles and practice of plant pathology. Lectures and labs are coordinated to consider types of plant pathogens and their population dynamics, disease cycles, diagnostic criteria and procedures, mechanisms of pathogen attack and plant defense, vector relationships, epidemiology, disease forecasting, loss assessment, and disease control. This course prepares students for graduate-level work in plant pathology.

PL PA 407 Nature of Sensing and Response (Also BIO G 407)
Spring. 3 credits. Prerequisites: BIO BM 330 or 333 or 331 and previous or concurrent registration in 332. Recommended: BIO GD 281. Lec, T R 10:10–11:25. T. P. Delaney.
The responses of organisms and cells to their surroundings are examined to illustrate how biological systems: sense their biotic and abiotic environment and communicate sensing into appropriate responses. A wide variety of response systems will be explored to identify their unique features and to illustrate how similar processes are utilized by widely divergent organisms. Examples are drawn from prokaryote, plant and animal systems for environmental sensing, control of development and responses during disease. Discussion will also examine the role of genetics and biochemistry in understanding signal transduction pathways, as well as the way these systems are perturbed by mutation and disease.

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. Offered fall 1999. 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 7 weeks of formal lecture and laboratory sessions, students will 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 of Trees and Shrubs
Fall. 3 credits. Prerequisites: PL PA 241 or equivalents. Lecs, M W 11:15; labs, F 1:25–4:25. Not offered fall 1999. Next offered fall 2000 and alternate years. G. W. Hudler.
For students preparing for careers in horticulture, urban forestry, and pest management. Deals with the nature, diagnosis, assessment, and treatment of diseases of trees and shrubs. Forest, shade, and ornamental plants are considered.]

PL PA 444 Integrated Pest Management
Fall. 4 credits. Prerequisites: BIO ES 261, ENTOM 212 or 241, or PL PA 241 or their equivalents or permission of instructor. P. A. Arneson and J. Losey.
Lectures integrate the principles of pest control, ecology, and economics in the management 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.

PL PA 472 Microbial Control of Plant Diseases
Spring. 3 credits. Limited to 20 students. Prerequisites: PL PA 241 or PL PA 401, BIOMI 290, or equivalent. Lecs, M W 9:05; disc F 9:05–9:55. E. B. Nelson.
This course is intended to provide students with a broad exposure to the field of biological disease control. The basic ecological concepts and principles underlying microbial interactions with plants, as well as plant pathogens, and the role of these interactions in the suppression of fungal and bacterial diseases will be discussed. Emphases will be placed equally on biological control processes in rhizosphere and phylloplane habitats. Topics will address aspects of root and leaf microbial ecology, plant pathogen ecology and behavior, ecological and molecular mechanisms of biological disease control, and manipulation and enhancement of biological control processes. Applied aspects such as delivery approaches, commercialization and registration of biological control organisms, and implementation of biological disease control practices in agriculture will also be covered. One student-driven discussion session per week will provide opportunities to explore timely topics related to biological control that may fall beyond the central focus of the course.

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. 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.

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 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 Plant Disease Epidemiology
Fall. TBA. M. G. Milgroom.

PL PA 644 Ecology of Soil-Borne Pathogens
Fall. R 12:20. E. B. Nelson.

PL PA 645 Plant Virology
Fall. F 12:20. S. M. Gray.

PL PA 647 Bacterial Plant Diseases
Fall and spring. M 9:05. S. V. Beer.
Emphasizes current research in phytobacteriology undertaken in laboratories at Cornell.

PL PA 648 Molecular Plant Pathology
Fall. R 12:20. T. P. Delaney.

[PL PA 649 Mycology Conferences
Fall. 1 credit. Not offered 1999–2000. K. T. Hodge.]

PL PA 650 Diseases of Vegetable Crops
Fall. TBA. Hours to be arranged. J. W. Lorbeer and T. A. Zitter.

PL PA 652 Field Crop Pathology
Spring. W 8:00. G. C. Bergstom.

PL PA 654 Diseases of Florist Crops
Spring. F 12:20. R. K. Horst.

PL PA 655 Plant Diseases in Tropical Agriculture (also ENTOM 644)
Spring. T 12:20. P. A. Arneson.

PL PA 661 Diagnostic Lab Experience
Summer and fall. 1 or 2 credits. S-U grades only. Requires 3 hrs/wk per credit hour. Hours to be arranged. 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 will be given to graduate students in plant pathology and plant protection.

PL PA 662 Molecular Plant-Pathogen Interactions
Spring. 1 credit. Prerequisites: BIOGD 281, BIOBM 330 or 331, and BIOMI 653.1. Lecs, M W F 10:10 (12 lecs) Jan. 26–Feb. 21. T. P. Delaney, A. R. Collmer.
An examination of the molecular properties that control the development of host-parasitic interactions in both microorganisms (bacteria and fungi) and higher plants. Contemporary theories describing the genetic mechanisms of pathogenesis and resistance are discussed.

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)
1 credit. Lecs, M W F 10:10 (12 lecs) Sept. 1-Sept. 27. T. Delaney, G. B. Martin.
A review and update on molecular biology concepts relevant to plant sciences including DNA synthesis, RNA transcription and processing, and protein structure and translation.

Methods applicable to plant molecular biology are described, including isolation of nucleic acids, gel electrophoresis, recombinant DNA techniques, plant transformation, mutant production, and use of sequence databases.

Section 02 Plant Biotechnology (BIO PL 653.2 and PL BR 653.2)
1 credit. Lecs, M W F 1:25 (12 lecs) Sept. 29-Oct. 27. 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 681 Plant Pathology Seminar
Fall and spring. 1 credit. Required of all plant pathology majors. S-U grades only. W 12:20–1:10.

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. 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.

PL PA 701 Concepts of Plant Pathology: Organismal Aspects
Spring. 3 credits. For graduate students with majors or minors in plant pathology; others by permission. Prerequisites: PL PA 401 or equivalent and permission of instructor. Lecs, T R 9:05; lab/disc, R 2–4:25. A. R. Collmer.
Concepts in host-pathogen relationships with emphasis on roles of molecules and cells in determining the outcome of an interaction. Genetic, molecular biological, physiological, and cell biological approaches to experimental analysis of exemplary host-pathogen systems are considered. Historical perspectives and recent research are reviewed and analyzed. Students prepare and review mock grant proposals.

PL PA 702 Concepts of Plant Pathology: Population Aspects
Fall. 3 credits. For graduate students with a major or minor in plant pathology; others by permission. Prerequisite: PL PA 401 or permission of instructor. Some background in statistics is recommended. Lab=discussion section. Lec, T R 10:10; disc, T 2–4:25. M. G. Milgroom.
Theory and concepts in plant disease epidemiology and population biology of plant pathogens. Topics include: population dynamics of pathogens in time and space, interactions of pathogen and plant populations, and population genetics of pathogens. The discussion section is used for examining current plant pathology literature and other exercises complementary to lecture material.

[PL PA 705 Phytovirology
Spring. 2 credits. For graduate students with a major or minor in plant pathology; others by permission. Prerequisite: PL PA 401 or equivalent. Not offered spring 2000. S. G. Lazarowitz.
This course considers plant viruses and the diseases they cause. Consideration is given to virus structure and composition, classification, replication, effects on hosts, modes of transmission, and the relationships of these aspects to principles of diagnosis and control.]

PL PA 706 Phytonematology
Fall. 2 credits. For graduate students with a major or minor in plant pathology; others by permission. Prerequisite: PL PA 401 or equivalent or permission of instructor. J. Esnard.
The course deals with plant-parasitic and plant-associated nematodes, their biology, morphology and systematics; ecology and role in ecosystem health; physiology and molecular aspects of nematode-plant interactions; population dynamics; interactions with other plant pathogens; and management options. Bioengineering, breeding for resistance, genetic mechanisms of host resistance, biological control, and technical methods of handling nematodes will also be covered. Emphasis will be placed on the nematode as an animal system.

[PL PA 707 Phytobacteriology
Fall. 2 credits. Prerequisites: general microbiology, lectures and laboratory; introductory plant pathology. Offered alternate years. Not offered fall 1999. S. V. Beer.
A consideration of the prokaryotes that cause disease in plants and examples of the diseases they cause. The course emphasizes properties of bacterial pathogens that affect disease, methods for manipulation of the pathogens,

and recent developments in phytobacteriology. The current state of knowledge of important phytopathogenic genera including their genetics and mechanisms of pathogenesis is reviewed. Laboratory practice in isolation, inoculation, identification, genetics, and physiology is included.]

PL PA 709 Phytomycology
Spring. 2 credits. For graduate students with a major or minor in plant pathology or mycology; others by permission. Prerequisites: PL PA 401 and 309 or equivalents, or permission of instructor. Lec, F 1:25–2:30; lab, 2:30–4:30. J. W. Lorbeer.
Provides basic information on the biology of plant pathogenic fungi with emphasis on the structure, ecology, genetics, life cycles, and disease cycles of representative genera and species.

[PL PA 715 Phytovirology Laboratory
Spring. 2 credits. Limited to 12 students. Prerequisite: permission of instructor. S-U grades only. Not offered spring 2000. S. G. Lazarowitz.]

[PL PA 735 Advanced Plant Virology
Spring. 3 credits. Prerequisite: permission of instructor. 3 lecs, hours to be arranged. Not offered spring 2000. S. G. Lazarowitz.
Topics in plant virology, with an emphasis placed on student discussion of current literature. Topics included are viral infection process, viral and viroid replication, viral recombination, viral movement, viral genes and their products, cross protection, detection of viruses, molecular approaches to resistance and the use of viruses as vectors for introducing genetic material into plants.]

[PL PA 738 Genetics and Development of Filamentous Fungi
Fall. 2 credits. Prerequisite: BIOGD 281 or equivalent. Hours to be arranged. Next Offered 2000–2001. B. G. Turgeon, O. C. Yoder.
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 739 Advanced Mycology
Fall. 4 credits. Prerequisites: PL PA 309 or equivalent, a course in genetics, and permission of instructor. Offered odd-year fall semesters. Not offered 1999–2000. K. T. Hodge.
A detailed study of the taxonomy, nomenclature, and biology of four major groups of fungi (rusts, smuts, peronosporales, and fungi imperfecti).]

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. Hours to be arranged. 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. S-U grades optional. Credit to be arranged. Prerequisite: permission of adviser. Graduate faculty.
For students working on a master's degree.

PL PA 900 Graduate-Level Thesis Research
Fall or spring. S-U grades optional. Credit to be arranged. 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. S-U grades optional. Credit to be arranged. Prerequisite: permission of adviser. Graduate faculty.
For doctoral candidates who have passed the "A" exam.

POMOLOGY (FRUIT SCIENCE)

See Horticultural Sciences.

RURAL SOCIOLOGY

D. L. Brown, chair; P. R. Eberts, S. Feldman, J. D. Francis, C. C. Geisler, P. K. Gellert, D. T. Gurak, T. A. Hirschl, W. B. Lacy, T. A. Lyson, P. D. McMichael, M. J. Pfeffer, J. M. Stycos, 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 100 Indian America to 1890 (also American Indian Studies 100)
Fall. 3 credits. S-U optional. Enrollment limited to 550. W 7:30–10 p.m. R. W. Venables.
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 which marks the end of the conquest of Indian America. Guest lecturers, including American Indian leaders, provide additional perspectives.

R SOC 101 Introduction to Sociology (also Sociology 101)
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. Staff.
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 will provide "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 Introduction to Sociology: Microsociology (also Sociology 103)
Fall. 3 credits. S-U optional. Lec, T R 8:40–9:55. W. Burkhard.
An introduction to microsociology, focusing on social processes within small groups, including the family. Emphasis is on leadership, conformity, social influence, cooperation and competition, distributive justice, and micro analyses of interaction.

R SOC 105 Economic Sociology (also Sociology 105)
Fall. 3 credits. S-U optional. T R 11:30–12:45. C. Leuenberger.
Modern social thought arose out of attempts to explain the relationship between economic development and the social transformations that gave rise to the contemporary world. Classical theorists from Karl Marx and Max Weber to Karl Polanyi focus their writings on emergent capitalist economies and societies. Contemporary social theorists likewise have sought to understand the interaction between capitalism and the social forces reacting against and emerging from modern economic development. From exchange and rational choice theories to network analysis and institutional theory, a central theme in contemporary social thought has been the relationship between the economy and society, economic action and social structure, rationality and fundamental social processes. This course provides an introduction to social thought and research seeking to understand and explain the relationship between economy and society in the modern era.

R SOC 175 Issues in Contemporary American Indian Societies (also American Indian Studies 175)
Spring. 3 credits. S-U grades optional. Lecs, W 7:30–9:30 p.m.; sec, various times. Staff.
American Indian cultural and political history from 1890 to the present will be the primary focus of this course, with a review of important earlier events in U.S./Native American national relations. Emphasis will be on Native American perspectives, with guest lectures and media presentations.

R SOC 200 Social Problems (also Sociology 200)
Fall. 3 credits. S-U grades optional. Enrollment limited to 100. T R 10:10–11:25. T. A. Hirschl.
This course investigates a variety of current social problems from a sociological perspective. The course begins with an overview of sociological theories that may account for social problems and identifies common as well as competing elements of these theories. The theoretical framework is then applied to analyze a variety of social problems, which may vary semester to semester. Examples of social problems are homelessness, teenage pregnancy, deindustrialization, and homicide, among others. Emphasis in the course will be given to how social problems are measured, and students will be given an opportunity to test theories with data analysis.

R SOC 201 Population Dynamics (also Sociology 202)
Spring. 3 credits. S-U grades optional. Enrollment limited to 35. ALS students must register for this course as R SOC 201. T R 2:55–4:10 or 8:40–9:55 (depending on instructor). J. M. Stycos or L. B. Williams.
This course provides an introduction to population studies. The primary focus is on the relationships between demographic processes (fertility, mortality, and migration) and social and economic ones. Discussion will cover special topics related to population growth and distribution, including marriage and family formation, labor force participation, urban growth and urbanization, resource allocation, and the environment.

[R SOC 202 Religion and Family in the U.S. (also Sociology 201)
Fall. 3 credits. S-U optional. Lec, M W 2:55–4:10. Not offered 1999–2000. P. Becker.
This course will examine how two fundamental social institutions—religion and the family—are interlined in American society. As recently as the 1950s, religious institutions were organized around the needs of one dominant family form, the male-breadwinner family with a stay-at-home mother. But since the 1950s, that family form is no longer statistically dominant or culturally normative. How have religious institutions adapted to new family forms? How do religious beliefs influence behavior within families, for example, the raising of children? How do religious groups foster ideals of family life, or influence our beliefs about what are "good" families? How do people's family experiences and family values influence their participation in organized religion? What models of family life are religious groups organized around? We will begin to answer these questions by drawing on readings that explore the religion-family link in a variety of religious, ethnic, and social class contexts within the contemporary United States.]

R SOC 205 International Development (also Sociology 206)
Spring. 3 credits. Enrollment limited to 74. M W F 10:10–11:00. P. D. 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. We will also examine the new social movements, such as environmentalism, feminism, and grassroots activism.

R SOC 206 Gender and Society (also Women's Studies 206)
Spring. 3 credits. Enrollment limited to 100. Lecs, M W 11:15–12:05; sec, various times. B. Wejnert.
Course will familiarize students with origin of gender hierarchies, social and behavioral similarities/differences between females and males, and 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 will be a major focus of the course. Objectives will be met through lectures, readings, films, participant observation and personal experiences.

R SOC 208 Technology and Society
Fall. 3 credits. Offered odd years. M W F 10:10–11:00. C. C. Geisler.
The relationship between technology and society is among the most pervasive concerns of our time. Ultimately, what makes a technology useful or "appropriate" is a sociological question. Lectures and readings review classical debates regarding technology and society. Herein, students compare high technologies and appropriate technologies, identify problems associated with technology transfer to other societies, and create a list of important criteria by which technologies are judged appropriate or inappropriate using numerous case studies.

[R SOC 209 Social Inequality (also Sociology 208)
Spring. 3 credits. S-U optional. Not offered 1999–2000. M. Brinton.
This course examines the nature and processes of social inequality in industrial societies. The principal focus is on the contemporary United States, with some comparisons to other industrial societies with different educational and class structures. Readings include theoretical and empirical materials on urban inequality and stratification along race, class, and gender lines. The course includes ethnographies of schools and workplaces as well as more quantitative research.]

R SOC 213 Social Indicators, Data Management, and Analysis
Fall. 3 credits. Offered alternate years (opposite of R SOC 214). T R 11:40–12:55. P. R. Eberts.
A survey of definitions of social indicators and general principles of social indicators research will be 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, etc., based on census data, household surveys, and key-informant and other low-cost techniques, will be examined using personal computers.

[R SOC 214 Research Methods for the Social Sciences
Fall. Offered even years (opposite of R SOC 213). 3 credits. Enrollment limited to 25. T R 11:40–12:55. Not offered fall 1999 and 2001; next offered fall 2000. L. B. Williams.
A survey of approaches to conducting research in the social sciences will be presented. These include observation techniques, unstructured, semi-structured, and structured interviews, experiments, and focus groups. Some statistical techniques for data analysis will be discussed. A background in elementary statistics, although not required, is preferred.]

R SOC 215 Organizations: An Introduction (also Sociology 215)
Fall. 3 credits. S-U optional. Lec T R 10:10–11:25. S. Han.
This is an introductory course in the study of organizations. We will start by taking a look at various examples of organizing, including a street gang in a Boston neighborhood, General Moltke's Prussian Army, a government agency, and an industrial corporation. These brief glimpses serve as exercises in looking behind and beyond diverse rhetoric for common patterns in organizational phenomena. We will consider these both from inside and outside perspectives. The focus of the course is upon research scholarship, not the training of managers. Nonetheless, the analytical skills you will acquire are applicable to work in firms, government agencies, and nonprofit organizations.

R SOC 220 Sociology of Health of Latinos and Ethnic Minorities (also Latino Studies Program 220)
Fall. 3 credits. S-U grades optional. Enrollment is limited to 40. 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 301 Theories of Society
Spring. 3 credits. Prerequisites: rural sociology or sociology course. S-U grades optional. Enrollment is limited to 30. M W F 11:15–12:05. P. K. Gellert.
An introduction to the "classical" sociological theorists for juniors, seniors, and beginning graduate students. Emphasis on (1) the central concepts of the sociological tradition, (2) major classical theorists (Marx, Durkheim, Weber) and contemporary counterparts. The relevance of these theories of society to current events and social problems will be stressed.

R SOC 302 Evaluating Statistical Evidence (also Sociology 301)
Fall. 3 credits. S-U optional. Lec, M W 10:10–11:00. R. L. Breiger.
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 318 Ethnohistory of the Northern Iroquois (also American Indian Studies 318)
Spring. 3 credits. S-U grades optional. Enrollment limited to 20. M 7:30–10:30 p.m. R. W. Venables.
The development of Iroquois (Houdenosaunee) history and culture is traced to the present day.

R SOC 324 Environment and Society (also Science and Technology Studies 324 and Sociology 324)
Spring or summer. 3 credits. Enrollment limited to 100. M W F 1:25–2:15. M. J. Pfeffer.
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, ecofeminism, social ecology, NIMBYism, risk assessment, 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 Demographic Analysis in Business and Government (also Agricultural, Resource, and Managerial Economics 416)
Fall. 3 credits. S-U with permission of instructor. Prerequisite: R SOC 213 or a statistics course. Enrollment limited to 50 students (10 R SOC students, 40 ARME students). Lec, W F 1:25–2:15. Sec, M 1:25, 2:30. W. Brown.
An overview of the way demographic analysis is used in business and government. Through the use of case study and problem solving methods of learning, students come to understand how demographic concepts, methods, and data are used by demographers to solve problems in business and government. The course is designed for upper-level undergraduates from a variety of academic disciplines and career orientations. Students will work on problems drawn from consumer marketing, education, housing and real estate development, human resources, and health services.

R SOC 336 Rural Areas in Metropolitan Society
Fall. 3 credits. S-U grades optional. Prerequisite: a social science course. T R 11:40–12:55. Offered alternate years. D. L. Brown.
This course analyzes the changing structure and role of small towns and rural areas in developed nations. The focus is on adaptation of rural communities and populations to major trends including increased societal differentiation and complexity; increased societal interdependence, and rapid social, economic, technological, and ecological change. Alternative policies to ameliorate rural problems and/or enhance rural contributions to national development are considered. Students participate in group research projects in rural communities.

R SOC 340 Food and Agriculture in Modern Society
Spring. 3 credits. Prerequisite: one course in social science (CALS Group C). S-U optional. Enrollment limited to 30. T R 8:40–9:55. G. W. Gillespie.
Our changing food and agriculture system will be examined from a sociological perspective. What are its major trends as we enter the twenty-first century? What are its social, human health, and environmental issues? What are its potential development strategies and what do these imply for rural communities, urban areas, and the environment?

[R SOC 360 Sociology of American Indians (also American Indian Studies 361)
Spring. 3 credits. Prerequisite: R SOC 101/SOC 101 or approval of the instructor. Enrollment limited to 20. T R 10:10–11:25. Offered odd years. Not offered spring 2000. B. Baker.
This course is designed to emphasize the role of theory and research in our understanding of American Indians. Towards that end, the relationship between the nation-state and indigenous populations will be emphasized. Students will be exposed to the following theoretical perspectives; world systems and dependency, internal colonialism, social disintegration, the social construction of reality, political mobilization, and ethnic reorganizations. The course is also historical and comparative as students will study different Indian tribes located in the United States and Canada.]

R SOC 367 American Indian Tribal Governments (also American Indian Studies 367)
Fall. 3 credits. S-U option. Enrollment limited to 20. Lecs, W 2:00–4:25. B. Baker.
This course focuses on the structure of contemporary tribal governments and the ways in which these governments approach the issues confronting their constituents. The effects of European contact on traditional political organizations are detailed, as are the present day relationships of tribal governments to federal and state governments.

R SOC 370 Comparative Issues in Social Stratification (also Sociology 371)
Fall. 3 credits. Prerequisite: an introductory social science course. T R 1:25–2:40 or T R 8:40–9:55 (depending on professor). T. A. Lyson or S. Feldman.
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 we will give special attention 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 408 Human Fertility in Developing Nations (also Biology and Society 404)
Spring. 3 credits. Enrollment limited to 15. T R 2:55–4:10. Offered alternate years. Not offered 1999–2000. Staff.
A review of the major literature dealing with the social causation of variation in human fertility. Emphasis will be on international comparisons and on the methodology of field research.]

R SOC 410 Population and Environment
Spring. 3 credits. Enrollment limited to 15. T R 10:10–11:25. Offered alternate years. J. M. Stycos.
A voluminous new literature is emerging, attempting to trace the connections between population dynamics and environmental change. The seminars will be devoted to a critical examination of this literature, stressing population change both as cause and consequence of environmental factors. In addition, the social and economic forces that mediate the population-environment relation will be examined.

[R SOC 418 Population Policy (also Biology and Society 414)
Spring. 3 credits. Prerequisite: R SOC 201 or permission of instructor. Enrollment limited to 15. T R 10:10–11:25. Offered alternate years. Not offered 1999–2000. Staff.
The ways in which societies try to affect demographic trends. Special focus is on government policies and programs to reduce fertility.]

[R SOC 425 Gender Relations, Gender Ideologies, and Social Change
Spring. 3 credits. R 1:25–4:25. Offered alternate years. Not offered 1999–2000. S. Feldman.
Drawing on feminist and sociological theory and methods, and employing a comparative and global analytic framework, this course examines how gender ideologies, work-family linkages and the transformation of work and the labor process are based on and help transform gender relations. The course gives attention to the particularity of place and time as these help to situate gender relations in the different state, regional, and global configurations that contextualize and configure everyday life.]

[R SOC 430 Migration and Population Redistribution
Fall. 3 credits. Prerequisite: undergraduates, one demography course or permission of instructor. T R 8:40–9:55. Offered even years. Not offered fall 1999 and 2001; next offered 2000. D. L. Brown.
This course analyzes the determinants and consequences of internal migration in urban and rural areas of developed and developing nations. Economic and demographic interrelationships are emphasized as are implications of changes in local and regional population size and composition for labor supply, the demand for goods and services, and infrastructure. Public policy implications of the inter-relations are investigated. Techniques and measurement issues associated with the analysis of migration and population distribution are discussed.]

[R SOC 431 Social Demography of Minorities
Spring. 3 credits. S-U option. Enrollment limited to 30. M W 8:40–9:55. Not offered 1999–2000. D. T. Gurak.
Ethnic conflict and accomodation is examined in diverse settings (societies and historical periods). Demographic indicators (such as residential segregation, marital patterns, mortality and fertility differentials, and occupational mobility) of underlying social conditions serve as the principal vehicle for evaluating the status of ethnic relations.]

R SOC 434 Sociology of Health and Human Behavior (also Policy Analysis & Management 430)
Summer 3-week session. 3 credits. S-U optional. Prerequisite: RS 103 or Soc 103, permission of instructor. Limited to 30. M-F 2–4:40 p.m. L. Morton.
This course examines the socially constructed meanings of health, illness, and death by the application and comparison of theoretical perspectives: biomedical vs. community; personal vs. population; public vs. privatized; and economic efficiency vs. distributive justice. It will focus on structural determinates of health inequality with attention to gender, age, ethnicity and race, culture, geographic location, and income.

[R SOC 436 Successful Aging: Issues and Social Policy in the 1990s
6-week summer session. 3 credits. M-F 10:00–11:15. Not offered summer 2000. P. Taietz.
This course aims to correct the misconceptions about aging and to free ourselves of the stereotypic viewpoint that older persons are members of a single, homogeneous category. Successful aging in the 1990s and beyond is the central focus of the course. The response of the public and private sectors to the rapidly growing older population is examined in view of the imbalance between the strengths and capacities of older persons and the lack of roles and opportunities in society to utilize and reward their talents and abilities. Films and fieldtrips.]

[R SOC 437 Aging and Aging Social Policy in the 1990s
Fall. 3 credits. Prerequisite: R SOC 101 or its equivalent. Enrollment limited to 30. T R 11:40–12:55. Not offered 1999–2000. Staff.
An analysis of the "graying" of America and the responses of the public and private sectors to this demographic revolution. Examines the interplay between basic and applied knowledge in social gerontology. Explores the formal and informal networks of services, in both rural and urban environments, that help maintain independent living arrangements for the elderly.]

R SOC 438 Social Demography (also Sociology 437)
Fall. 3 credits. Enrollment limited to 30. M W 8:40–9:55. D. T. Gurak.
This course surveys the methods, theories, and problems of population studies. Attention is directed to the social, economic, and cultural determinants and consequences of population growth, distribution, and change. The core areas of demography, fertility, mortality, and migration are studied. Comparisons are made between developed and developing areas and between Africa, Asia, and Latin America.

[R SOC 440 The Social Impact of Resource Development
Spring. 3 credits. S-U grades optional. Offered alternate years. Not offered 1999–2000. C. C. Geisler.
Social impact assessment (SIA) is a method of anticipating unwanted side-effects of projects, policies, and new technologies before they happen and a decision tool for mitigation. The seminar explores SIA applications in different parts of the world and pays particular attention to impacts on native and indigenous peoples. Students learn practical SIA skills and related theoretical/conceptual debates.]

R SOC 442 American Indian Philosophies: Selected Topics (also American Indian Studies 442)
Spring. 3 credits. S-U grades optional. Prerequisite: permission of instructor. Enrollment limited to 15. W 7:30–10:30. R. W. Venables.
This course provides an opportunity for students to read and discuss a wide range of American Indian philosophies.

[R SOC 490 Society and Survival
Fall. 3 credits. Prerequisite: introductory sociology course or permission of instructor. Enrollment limited to 30. T R 2:55–4:10. Not offered 1999–2000. D. T. Gurak.
Course surveys existing theories, methodological techniques, and research results relating to how social, economic and cultural structures and processes affect survival chances in diverse societies. A comparative framework is presented, and the utility of existing knowledge for policy-related applications in different societies is assessed. Attention is given to the problems associated with imputing causality in morbidity and mortality data.]

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 will be advertised by the department. Courses offered under the number will be approved by the department curriculum committee, and the same course will not be offered more than twice under this number.

R SOC 495 Population, Environment, and Development in Sub-Saharan Africa
Fall. 3 credits. Offered alternative years. Enrollment limited to 30. M W 2:55–4:10. D. T. Gurak.
In the past three decades, countries in sub-Saharan Africa have experienced rapid population growth, weak economic growth, and growing environmental problems. This course examines how these problems are interrelated and looks at possible solutions. After reviewing trends in population, environment and development within the region, the course focuses on specific problems, including: urbanization, health and survival, population pressure and sustainable agriculture, refugees, and gender/family/community structures.

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
Fall. 3 credits. S-U optional. Enrollment limited to 15. W 1:25–4:25. J. D. Francis.
Course is for students with diverse backgrounds: undergrads, grads, people in professional careers, others with interest in environmental issue identification, resolution and management. Course discussions include ecological, social, economic and local government perspectives. Via lab exercises throughout the semester, student will have opportunities to apply the concepts and principles of these perspectives to analysis of specific local environmental management problems. Readings, lectures, and a course project are mandatory.

R SOC 599 MPS 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, R 7:00–10:00 p.m. P. R. 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
Spring. 1 credit. Prerequisite: R SOC 601. M 6:30–9:30 p.m. (Meets triweekly.) P. R. Eberts.
A participatory seminar for feedback, collective learning, and guidance as MPS students apply community and rural development theory and methods in thesis project work with local and regional communities.

R SOC 603 Classical Sociological Theory
Fall. 4 credits. S-U grades optional. Prerequisites: open to graduate students only. T R 2:55–4:10. M. J. Pfeffer.
Students will review the main streams of classical sociological thought, focusing on the work of Weber, Durkheim, and Marx. 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 will be 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 604 Theories of Social Change
Spring. 3 credits. S-U grades optional. T R 2:55–4:10. Not offered 1999–2000. P. D. McMichael.
This course surveys major twentieth-century social theories, focusing on lineages from classical theory and on theories relevant to understanding the processes of social change. Major topics covered will include mid-century functionalism, conflict theories, neo-Marxism, neo-Weberianism, substantive economic sociology, and world-systems theory. Other topics, such as the "new sociology of culture,"

critical theory, structuration theory, neofunctionalism, the new methodological individualism, and the macro-micro link, will be covered briefly.]

R SOC 606 Sociological Theories of Development
Spring. 3 credits. T 2:30–5:30. P. K. Gellert.
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
Fall. 3 credits. S-U optional. Offered odd years. R 1:25–4:25. P. Gellert.
Building on theories in the sociology of development, this seminar will examine the role of natural resource extraction, processing, and exports to global markets in the developmental trajectories of nations in Asia, Africa and Latin America. Engages students in both theoretical debates and practical implications of resource access, control, and conflict amongst various social actors ('stakeholders'). Detailed historical cases will be examined, primarily from Southeast Asia (Indonesia, Malaysia, Philippines).

[R SOC 612 Population and Development in Asia (also WMNS 612)
Spring. 3 credits. Offered odd years. Not offered spring 2000 and 2003; next offered spring 2001. W 10:10–1:10. L. B. Williams.
This graduate seminar considers population and development issues in Asia. Case studies pertaining to Southeast Asia will be highlighted. We will discuss the linkages between population and development and consider both from a historical perspective. Recent social, economic, and demographic change in the region will be considered in depth. Evolving gender roles in the family, labor force, and broader social context will also be examined.]

R SOC 618 Research Design I
Fall. 4 credits. Prerequisite: a statistics course. T R 12:20–2:15. J. D. Francis.
First of a two-semester sequence (may be taken individually) in introductory graduate methods. Discusses problems of measurement, the design of instruments, and problems of reliability and validity. Common forms of measuring instruments are discussed. Concludes with an introduction to factor analysis. Students apply principles to development of several common types of scales. Computers will be used extensively.

R SOC 619 Research Design II
Spring. 4 credits. Prerequisite: an introductory methods course and a statistics course. T R 12:20–2:15. J. D. Francis.
The second part of the two-semester sequence in introductory graduate methods, with emphasis on an intermediate-level treatment of the following topics: regression, analysis of variance, analysis of covariance. Special attention is given to use of categorical variables in regression. Students develop and examine several analytical models using actual data to familiarize themselves with data handling and processing. Extensive use of computers.

[R SOC 621 Foundations of Environmental Sociology
Fall. 3 credits. Open to graduate students only. S-U optional. Enrollment limited to 20. W 10:10–12:35. Offered even years. Not offered fall 1999 and 2001; next offered fall 2000. M. J. Pfeffer.
Foundations of Environmental Sociology provides graduate students with a broad survey of the literature in this disciplinary specialty area. Students will review the history of thought in environmental sociology as well as key literature in the various substantive foci of this specialty. The principle objective of this course is to provide graduate students specializing in environmental sociology with a firm grasp of the content, controversies, and trends in the area. Sessions are conducted in a seminar style, and discussions are focused on close review of assigned readings.]

R SOC 625 State, Economy, and Society
Spring. 3 credits. Enrollment limited to 25. W 1:25–4:25. Offered even years. P. D. McMichael.
Reviews major issues concerning the relations between political and economic institutions and the role of states, markets, firms, social movements, and cultural institutions in the process of social change. Theoretical perspectives are drawn from classical and modern social theory, including the application of comparative and historical methodologies. Substantive themes concern political-economic restructuring in world regions, and the interaction between national and global processes.

R SOC 630 Field Research Methods and Strategies
Fall. 3 credits. Enrollment limited to 20. T R 8:40–9:55. Offered odd years. L. B. Williams.
This course will cover a variety of methods: focus groups, in-depth interviews, participant observation, archival record analysis, structured surveys, among others. Frameworks by which research questions can be matched with appropriate field methodologies, choice of sample, data collection, approaches, etc. will be discussed and we will assess the strengths and weakness of various strategies of field research. We will also discuss practical matters such as fieldworker recruitment and training, data processing issues, and we will highlight the ethics of field work.

[R SOC 640 Community and Changing Property Institutions
Fall. 3 credits. R 1:25–4:25. Offered even years. Not offered fall 1999. C. C. Geisler.
The seminar acquaints students with the evolution of property rights, from antiquity to the present, and features a number of property debates (the biological basis of ownership; private versus public ownership; property and value; the so-called "tragedy of the commons"; the "new" property). Readings explore land use regulation and property rights, common property issues, opposing land ethics, and new property forms in the future.]

R SOC 641 Politics and Economics of Rural and Regional Development
Fall. 3 credits. Limited to upperclass or graduate students. S-U grades optional. M 12:20–2:50. Offered alternate years. T. A. Lyson.
A survey of social, political, and economic factors in local and regional development. Theories of community and regional development and underdevelopment are explored. Neoclassical, Marxist, and civil society theories are examined within local and global contexts.

[R SOC 643 Land Reform Old and New
Spring. 3 credits. S-U grades optional. R 1:25–4:25. Offered odd years. Not offered 1999–2000. C. C. Geisler.
Land reform continues to be a major cornerstone of development planning. Between 1980 and 2000 the number of landless and near-landless in the Third World will approach one billion. Though land reform is a principal source of hope for the landless, its meanings are many and its models are controversial. The seminar acquaints students with land reform in antiquity as well as in contemporary settings (among others, Japan, the Philippines, Israel, India, Brazil, Mexico, Russia, and the United States). Perennial issues of equity, efficiency, and sustainability will be discussed in each of these case study areas.]

[R SOC 645 Rural Economy and Society
Fall. 3 credits. W 1:25–4:25. Offered alternate years. Not offered 1999–2000. S. Feldman.
The structure and dynamics of rural communities are examined in a comparative historical framework focusing on continuities and divergences among imperialist and post colonial settings. Major topics include classical theories of rural social organization and their retheorization in contemporary peasant studies and agrarian political economy literatures, theorizations of locality, rurality and spatial complexity within the world economy, and critical issues framing the relationship between political and labor market restructuring and petty commodity and household production systems.]

[R SOC 655 Advanced Techniques of Demographic Analysis
Spring. 3 credits. Prerequisites: CEH 606, graduate standing or permission of instructor. Enrollment limited to 25. M 7:30–10:30 p.m. Offered alternate years. Not offered 1999–2000. D. T. Gurak.
An examination of analytical techniques that assumes a basic knowledge of demographic data and research methodology. Life tables, demographic estimates with incomplete data, survey techniques to supplement inadequate vital registration systems, data management, multi-level models, and other multivariate procedures are among the topics to be covered.]

R SOC 661 Sustainable Agriculture and Development
Spring. 3 credits. S-U grades optional. Prerequisites: graduate standing or instructor's permission. Offered alternate years. M 10:10–12:35. T. A. Lyson.
This course examines the relationship between local agriculture and development as these are embedded in a globalizing economy. Topics include an examination of the social scientific theoretical underpinnings of conventional agriculture, the social origins of sustainable agriculture, environmental and

community sustainability, agricultural diversification strategies, community agriculture development, and the political and policy contexts of more sustainable agricultural systems.

R SOC 671 Epistemological Challenges to Social Science Paradigms: A Feminist Inquiry (also Women's Studies 671)
Fall. 3 credits. W 1:25–4:25. Offered alternate years. S. Feldman.
This course will review and analyze contemporary themes in feminist epistemological critiques of sociological methods and knowledge systems. It identifies mainstream explanations within the social sciences, introduces early feminist challenges to androcentric paradigms, and explores philosophical assumptions of postmodern and poststructural analyses. Substantive foci assess various approaches to field, archival, and survey research, and the theoretical presuppositions of approaches from rationalism to postpositivism. We also address the linkages between theory and questions of political practice, individualism, and autonomy.

[R SOC 675 Global Patterns of International Migration
Fall. 3 credits. Enrollment limited to 20. M 7:30–10:30 p.m. Offered alternate years. Not offered 1999–2000. Staff.
International migration to the United States and other countries has increased in recent decades. What accounts for that trend in an era when large-scale international migration is supposed to have ended and what are the implications of immigration for receiving countries? Theories and research on these issues are examined in the course from a comparative and interdisciplinary perspectives. Several migration systems are examined, including those of North America and the European Community. Policies shaping immigration are also reviewed.]

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 will be advertised by the department. Courses offered under the number will be approved by the department curriculum committee, and the same course will not be offered more than twice under this number.

[R SOC 715 Comparative Research Methods
Spring. 3 credits. M 12:20–2:50. Offered odd years. Not offered spring 2000 and 2002; next offered spring 2001. T. A. Lyson.
This seminar focuses on the comparative method in the social sciences. The logic of comparative inquiry forms the substantive base of the course. Topics include cross-national and cross-regional research design and an analysis of the comparative case study approach. Illustrations of the comparative research approach will cover a range of data types and problems.]

[R SOC 718 Multidimensional Measurement and Classification
Fall. 4 credits. Prerequisite: previous course work in scaling and statistics. T R 12:20–2:15. Offered odd years. Next offered 2001–2002. J. D. Francis.
An advanced course in measurement and scaling, building from work by Thurstone, Guttman and Coombs to multidimensional measurements. Topics include philosophy of factor analysis, factor-analysis models, factoring design, factoring techniques, and comparison with factor-analysis models. Cluster analysis and multidimensional scaling are the other major techniques discussed. As matrix algebra is an integral part of these procedures, class time is devoted to this topic. Computers are used to analyze fit to models.]

[R SOC 719 Logistic and Log Linear Models
Spring. 4 credits. Prerequisites: two courses in statistics and one in methods. T R 12:20–2:15. Offered even years. Next offered 2001–2002. J. D. Francis.
The first part of the course reviews multiple regression theory and procedures, after which extensions of these models to categorical data are discussed. Consideration is given to violations of assumptions and their effects. Then more advanced regression concepts and estimation techniques are discussed. The main focus of the course is on logit and log linear models. Computerized labs are an integral part of the course.]

[R SOC 725 The Sociology of "Third World" States
Fall. 3 credits. W 1:25–4:25. Offered alternate years. Not offered 1999–2000. S. Feldman.
This course examines how processes of political and economic restructuring have reshaped state capacities and processes of state formation. Particular attention is paid to questions of class formation, corporatist alliances, transnational interests, and alternative development strategies with the emergence of austerity, privatization and trade liberalization and its neoliberalist ideology. Critical to this discussion are the contours of authoritarianism, nationalism, communalism and fundamentalism as these reconfigure national and regional alliances and practices and shape interpretations of current processes of resistance, change, and terms of intervention and exchange.]

[R SOC 730 Sociology of Global Change
Spring. 3 credits. S-U grades optional. Enrollment limited to 20. W 1:25–4:25. Offered odd years. Not offered spring 2000 and 2002; next offered spring 2001. P. D. McMichael.
Analyses of social change and development are increasingly sensitive to global context. They include the sociology of the world economy as a multi-layered entity anchored in an evolving international division of labor and the system of nation states, and the sociology of transnational political, economic, and cultural processes (e.g., food regimes, commodity chains, diasporas and transnational identities, the new regionalism, and transnational social movements). The seminar examines the substantive and methodological questions generated by research on these global processes, including questions of relevant units of analysis, situating global process in local events and subjectivities and vice versa, and examining the ways in which national structures and cultures interact with global structures and cultures.]

[R SOC 741 Community Development and Local Control
Spring. 3 credits. W 1:25–4:25. Offered alternate years. Not offered 1999–2000. C. C. Geisler.
Theories of community growth and decline and the current debate over the place of local control in community development in general are considered. Salient themes include the role of neopopulism in community development, changing institutions of property as community development occurs, and changing definitions of "community."]

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 to be arranged. 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 to be arranged. 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 to be arranged. 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 (WMNS 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

J. M. Duxbury, chair; M. Alexander, P. C. Baveye, D. R. Bouldin, R. B. Bryant, J. H. Cherney, S. J. Colucci, K. H. Cook, W. J. Cox, S. D. DeGloria, E. C. Fernandes, G. W. Fick, D. L. Grunes, R. R. Hahn, S. D. Klausner, W. W. Knapp, L. V. Kochian, T. A. LaRue, M. B. McBride, J. Mt. Pleasant, R. L. Obendorf, W. D. Pardee, W. S. Reid, S. J. Riha, T. W. Scott, T. L. Setter, P. L. Steponkus, H. M. van Es, A. Van Wambeke, R. M. Welch, D. S. Wilks, M. W. Wysocki

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

Atmospheric Science: 131, 250, 331, 332, 334, 341, 342, 352, 353, 435, 444, 447, 451, 456, 457, 635, 652, 692, 850, 950, 951

Crop Science: 311, 312, 314, 315, 317, 608, 610, 612, 613, 614, 642, 691, 820, 920, 921

Environmental Information and Analysis: 398, 411, 420, 620, 660, 675

Soil Science: 260, 321, 362, 363, 365, 371, 372, 373, 471, 473, 483, 663, 667, 669, 671, 693, 880, 980, 981

General Courses

SCAS 190 Sustainable Agriculture
Fall. Credits variable, 2 or 3. Limited to 60 students. S-U grades optional. Lec, R 10:10; labs, M 2:00–4:25, T 10:10–12:35. G. W. Fick.
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 non-majors 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 World Wide Web. An extra credit can be earned by participation in team preparation and delivery of a lesson in sustainable agriculture.

SCAS 494 Special Topics in Soil, Crop and Atmospheric 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 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.

SCAS 497 Individual Study in Soil, Crop, and Atmospheric 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 or crop science or atmospheric science are arranged at the beginning of the term for individual study or for group discussions.

SCAS 498 Teaching Experience in Soil Science, Crop Science, and Atmospheric Science
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 atmospheric science is obtained by assisting in the instruction of a departmental course.

SCAS 499 Undergraduate Research
Fall or spring. Credit to be arranged. Students must register with an Independent Study form (available in 140 Roberts Hall).
Independent research on current problems selected from any phase of crop science, atmospheric science, or soil science.

SCAS 695 Planning and Reporting Research
Spring. 2 credits. Prerequisite: graduate student status or permission of the instructor. Limited to 10 students. Lec to be announced. G. W. Fick.
This course is designed to prepare students in the SCAS Department and closely related fields for planning their research and reporting research results. Emphasis is given to literature reviews, scientific writing and reviewing (either thesis proposals, grant proposals, or manuscripts for publication), and slide and poster presentations. Students are expected to work closely with their major professor as well as the instructor of the course.

Atmospheric Science

SCAS 131 Basic Principles of Meteorology
Fall. 3 credits. Lecs, T R 11:15; lab, T W or R 1:25–4:25 and M W 7:00–9:30 p.m. 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.

SCAS 250 Meteorological Observations and Instruments
Spring. 3 credits. Prerequisite: SCAS 131. Lecs, M W 12:20; lab, R 1:25–3:20. M. W. Wysocki.
Methods and principles of meteorological measurements and observations, including surface, free-air, and remote systems. Instrument siting, mounting, and protection. Instrument response characteristics, calibration, and standardization. Recorders and data logging systems. Laboratory exercises in observation and data analysis. Intended to serve as preparation for Observers Examination. Lab fee, $50.

SCAS 331 Climate Dynamics (also ASTRO 331)
Fall. 4 credits. Prerequisites: MATH 112 or 192 or equivalent. Lecs, M W F 1:25–2:15; disc, W 2:30. K. H. Cook, 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.

SCAS 332 Evolution of the Earth System (also SES 302, GEOL 302)
Spring. 4 credits. Prerequisites: MATH 112 or 192 and CHEM 207 or equivalent. Lecs, to be announced; disc, to be announced. B. Isacks and others.
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.

SCAS 334 Microclimatology
Spring. 3 credits. Recommended: a course in physics. T R 10:10–11:25. D. S. Wilks.
This course treats relationships of radiant energy, temperature, wind, and moisture in the local environment. The interplay between physical processes of the atmosphere, plant canopies, and soil is examined, with emphasis on the energy balance.

SCAS 341 Atmospheric Thermodynamics and Hydrostatics
Fall. 3 credits. Prerequisites: one year of calculus and one semester of physics. M W F 9:05–9:55. 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.

SCAS 342 Atmospheric Dynamics
Spring. 3 credits. Prerequisites: one year each of calculus and physics. M W F 10:10. W. Knapp.
Introduction to atmospheric dynamics and to the methods of description and quantitative analysis used in meteorology. Topics considered include equations of atmospheric motion, motion in the free atmosphere, vertical variations of wind and pressure fields, mathematical representation and characteristics of fronts, mechanisms of pressure change, concepts of circulation and vorticity, and effects of friction on atmospheric motion.

SCAS 352 Synoptic Meteorology I
Spring. 3 credits. Prerequisites: SCAS 341 and concurrent enrollment in SCAS 342. Lecs, T R 9:05; lab, M 1:25–3:25. M. W. Wysocki.
Weather map analysis and forecasting techniques are studied by applying the principles of fluid and heat flow. This course will strengthen previously introduced meteorological concepts that will be applied to forecasting mid-latitude synoptic scale weather systems, such as cyclones, anticyclones, jet streams, fronts, and waves.

SCAS 353 Application of FORTRAN in Meteorology
Fall. 3 credits. Prerequisites: SCAS 131 plus one computer programming course. Lec, T R 12:20–1:10; lab, T 1:25–3:20. M. W. Wysocki.
An introduction to numerical techniques using FORTRAN to solve meteorological problems. No previous experience with FORTRAN is expected.

SCAS 435 Statistical Methods in Meteorology
Fall. 3 credits. Prerequisite: an introductory course in statistics (e.g., BTRY 215 or ARME 310) and calculus. T R 10:10–11:25. D. S. Wilks.
Statistical methods used in climatology, operational weather forecasting, and selected meteorological research applications. Some statistical characteristics of meteorological data, including probability distributions, intercorrelations, and persistence. Operational forecasts derived from multiple regression models, including the MOS system. Forecast verification techniques and scoring rules. Time series analysis, EOFs, and other research topics as time permits.

SCAS 444 Tropical Meteorology
Spring. 3 credits. Prerequisites: SCAS 342 or instructor's approval. M W F 11:15–12:05. Offered alternate years. Not offered spring 2001. K. H. Cook.
Structure and dynamics of the tropical atmosphere on a wide range of time and space scales ranging from meso-scale convective systems to planetary waves. Topics include hurricanes, monsoonal circulation, and El Nino.

SCAS 447 Physical Meteorology
Fall. 3 credits. Prerequisites: a year each of calculus and physics. M W F 10:10. Offered alternate years. Offered fall 1999. W. W. Knapp.
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, solar and terrestrial radiation, and principles of radar probing of the atmosphere.

SCAS 451 Synoptic Meteorology II
Fall. 3 credits. Prerequisites: SCAS 341 and SCAS 342. Lecs, T R 9:05; lab, M 1:25–3:20. S. J. Colucci.
Structure and dynamics of large-scale mid-latitude 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 the study of selected large-scale mid-latitude weather events.

SCAS 456 Mesoscale Meteorology
Spring. 3 credits. Prerequisites: SCAS 341 and SCAS 342 or permission of instructor. T R 11:40–12:55. Offered alternate years. Next offered spring 2000. S. J. Colucci.
Structure and dynamics of mid-latitude mesoscale weather systems such as fronts, jets, squall lines, convective complexes, precipitation bands, downslope windstorms, mountain breezes, sea breeze circulations, and lake effect snowstorms.

[SCAS 457 Atmospheric Air Pollution
Fall. 3 credits. Prerequisites: SCAS 341 or one course in thermodynamics and one semester of chemistry or permission of instructor. M W F 11:15–12:05. Offered alternate years. Next offered fall 2000. M. W. Wysocki.
Course will examine sources, effects, transport, measurement, and controls of air pollution. The basic principles in each area will be discussed with an emphasis on their local, regional, and global impacts.]

SCAS 635 Advanced Statistical Meteorology
Fall. 3 credits. Prerequisites: coursework in or elementary knowledge of statistics, calculus, matrix algebra, and computer programming. Lec, T R 10:10–11:25, R 11:35–12:05. D. S. Wilks.
Lectures and topics concurrent with SCAS 435, plus an extra 30-minute session per week in which selected topics from SCAS 435 are treated in more depth, and additional topics are covered which may vary from year to year according to student interest. Term project required.

[SCAS 652 Advanced Atmospheric Dynamics (also Astronomy 652)
Spring. 3 credits. Prerequisites: SCAS 341 and SCAS 342 or permission of instructor. T R 11:40–12:55. Offered alternate years. Offered spring 2001. S. J. Colucci.
Quasiqeostrophic theory, atmospheric waves, hydrodynamic instability, the general circulation of the atmosphere, and topics selected from among numerical weather prediction and tropical, mesoscale, and middle atmosphere processes according to student interest.]

SCAS 692 Special Topics in Atmospheric Sciences
Fall or spring. 1–6 credits. S-U grades optional.
Study of topics in atmospheric science that are more specialized or different from other courses. Special topics to be covered will depend on staff and student interests.

SCAS 850 Master's-Level Thesis Research in Atmospheric Sciences
Fall or spring. Credit by arrangement. S-U grades only. Hours by arrangement. Graduate faculty.
Limited to students specifically in a master's program.

SCAS 950 Graduate-Level Dissertation Research in Atmospheric Sciences
Fall or spring. Credit by arrangement. S-U grades optional. Hours by arrangement.
Limited to students in a Ph.D. program **only before** the "A" exam has been passed.

SCAS 951 Doctoral-Level Dissertation Research in Atmospheric Sciences
Fall or spring. Credit by arrangement. S-U grades optional. Hours by arrangement. Graduate faculty.
Limited to students admitted to candidacy **after** the "A" exam has been passed.

Crop Science

SCAS 311 Grain Crops
Fall. 4 credits. Prerequisite: SCAS 260 or BIOPL 241. Lecs, M W F 10:10; lab, M T 1:25–4:25. 1 or 2 field trips during lab periods (until 5 p.m. or on weekends). R. L. Obendorf.
Principles of field-crop growth, development and maturation, species recognition, soil and climatic adaptations, liming and mineral nutrition, weed control, cropping sequences, management systems, and crop improvement are considered. Grain, protein, oil, fiber, and sugar crops are emphasized in the context of food systems for improved health. Laboratory utilizes living plants, extensive crop garden, and computer simulation.

SCAS 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 T 1:25–4:25. 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.

SCAS 314 Tropical Cropping Systems: Biodiversity, Social & Environmental Impacts
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.

SCAS 315 Weed Science
Fall. 3 credits. Prerequisite: introductory course in biology or botany. Lecs, T R 9:05; lab, T W 2–4:25. Staff.
Principles of weed science are examined. Emphasis is on (a) weed ecology, (b) chemistry of herbicides in relation to effects on the environment and plant growth, and (c) control of weeds in crops. Laboratory covers weed identification and ecology, herbicide selectivity, symptomology, and behavior in soil.

SCAS 317 Seed Science and Technology
Fall. 3 credits. Prerequisite: BIOPL 241 or equivalent. Lecs, T R 11:15; lab, R 1:25–4:25. 2 all-day field trips will be scheduled during the semester. Offered alternate years. Offered fall 1999. Not offered fall 2000. 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.

[SCAS 608 Water Status in Plants and Soils
Fall. 1 credit. Prerequisite: permission of instructor. S-U grades only. Lec, 1 hour to be arranged; lab, first class meeting R 1:25–4:25. Offered alternate years. Not offered fall 1999. Offered fall 2000. T. L. Setter.
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.]

SCAS 610 Physiology of Environmental Stresses
Spring. 3 credits. Prerequisite: BIOPL 242 or 341. Lecs, T R 10:10–11:25. Offered alternate years. Offered spring 2000. P. L. Steponkus.
A study of the responses of plants to environmental stresses, with emphasis on thermal stresses including chilling, freezing, and high temperature injury. Emphasis is on the physiological and biochemical basis of injury and plant resistance mechanisms at the whole-plant, cellular, and molecular levels.

SCAS 612 Seed Physiology and Biotechnology
Spring. 3 credits. Prerequisite: plant physiology. 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.

SCAS 613 Physiology and Ecology of Yield
Spring. 3 credits. Prerequisite: plant physiology. M W F 12:20. T. L. Setter.
A study of environmental constraints on crop-plant productivity from a 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 on growth processes of vegetative plant organs.

SCAS 614 Research Methods in Weed Physiology
Spring. 2 credits. Prerequisite: SCAS 315 or equivalent. Offered alternate years. Next offered spring 2000. Staff.
Examination of a variety of modern techniques used to study herbicide absorption, translocation, metabolism, mode of action, and mechanism of resistance. Experiments will also be designed to study herbicide behavior and detection in soils. Laboratories will be accompanied by short lectures pertinent to experimental topics.

[SCAS 642 Plant Mineral Nutrition (ALSO BIO PL 642)
Spring. 3 credits. Prerequisite: BIO PL 341 or equivalent. Lecs, M W F 10:10–11. Offered alternate years. Not offered spring 2000. Next offered spring 2001. L. V. Kochian, R. M. Welch.
A detailed study of the processes by which plants acquire and utilize mineral nutrients from the soil. Topics will include the uptake, translocation, and compartmentation of mineral elements; rool-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 will be emphasized to illustrate the above topics.]

SCAS 691 Special Topics in Crop Science
Fall or spring. 1–6 credits. S-U grades optional. Hours to be arranged. Staff.
Study of topics in crop science that are more specialized or different from other courses. Special topics to be offered will depend on staff and student interests.

SCAS 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.

SCAS 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.

SCAS 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 and Analysis

SCAS 398 Environmental Microbiology
Spring. 3 credits. Prerequisite: BIOES 261 or BIOMI 290 or SCAS 260 or permission of instructor. Lecs, M W F 10:10. 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.

SCAS 411 Resource Inventory Methods (also Civil and Environmental Engineering 411)
Spring. 3 credits. Prerequisite: permission of instructor. S. D. DeGloria.
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.

SCAS 420 Geographic Information Systems
Fall. 4 credits. Prerequisite: SCAS 411 or instructor's approval. Lecs, T R 9:05–9:55; lab, M T W R 1:25–4:25. S. D. DeGloria.
Principles and applications of geographic information systems for the characterization and assessment of environmental process. 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.

SCAS 620 Spatial Modeling and Analysis
Spring. 3 credits. Prerequisites: SCAS 420, SCAS 461, or permission of instructor. Lecs, T R 9:05–9:55; lab, T W 1:25–4:25. S. D. DeGloria.
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.

[SCAS 660 Remote Sensing Fundamentals (also Civil and Environmental Engineering 610)
Fall. 3 credits. Prerequisite: permission of instructor. Lecs, M W 12:20–1:10; lab, T 2:30–4:25. Not offered 1999–2000. 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.]

SCAS 675 Modeling the Soil-Plant-Atmosphere System
Spring. 3 credits. Prerequisite: SCAS 483 or equivalent. Not offered spring 2001. Lecs, T R 8:40–9:55. S. J. Riha.
Introduction to the structure and use of soil-plant-atmosphere models. Topics covered will 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 will be discussed.

Soil Science

SCAS 260 Soil Science
Fall. 4 credits. S-U grades optional. Lecs, M W F 9:05; lab, M T W or R 1:25. 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 will initially be field-oriented with an emphasis on learning practical skills needed to evaluate and manage soils. Subsequent labs will focus on accessing, interpreting and applying soil information.

SCAS 321 Soil and Water Management
Fall. 4 credits. Prerequisites: SCAS 260. S-U grades optional. Lecs, T R 10:10–11:25; lab, R 2:30–4:30. H. M. van Es.
Course 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.

SCAS 362 Soil Morphology
Fall. 1 credit. Undergraduates only. Recommended for sophomores and juniors. R 1:25–4:25; all day field trip required. R. B. Bryant.
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.

SCAS 363 Soil Genesis, Classification, and Survey
Fall, weeks 1–7. 2 credits. Prerequisite: SCAS 260. Lecs, M W F 10:10; lab, W 1:25–4:25. One all day field trip is required. R. B. Bryant.
Factors and processes of soil formation. Principles of field identification, classification, survey, and interpretation. Laboratory exercises and field trips provide practical training in soil morphology and landscape relations. Course ends at mid-semester and is part of a sequence of three Intermediate Soil Science courses.

SCAS 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.

SCAS 371 Hydrology and the Environment (also ABEN 371 and GEOL 204)
Spring. 3 credits. Students enrolled in the statutory colleges must enroll in ABEN 371 or SCAS 371. Prerequisite: 1 course in calculus. Lecs, T R 9:05; lab, F 1:25–3:20. T. S. Steenhuis, L. M. Cathles, P. C. Baveye.
Introduction to hydrology as a description of the hydrologic cycle and the role of water and chemicals in the natural environment. Includes precipitation, infiltration, evapotranspiration, groundwater, surface runoff, river meandering floods, and droughts. Case studies, short field trips, computer programs, and laboratories are used to foster an understanding of concepts and principles of hydrologic processes.

SCAS 372 Soil Fertility Management
Fall. 3 credits. Prerequisite: SCAS 260 or permission of instructor. M W F 9:05. Staff.
An integrated discussion of soil crop yield relationships, with emphasis on the soil as a source of mineral nutrients for crops and the role of fertilizers and organic nutrient sources in crop production.

SCAS 471 Properties and Appraisal of Soils of the Tropics
Spring. 3 credits. Prerequisite: SCAS 260 or equivalent. S-U grades optional. No audits accepted. Lecs, T R 12:20; disc, W 1:25–3:25. 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 the preservation of the environment 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.

[SCAS 473 Ecology of Agricultural Systems (also BIOES 473)
Fall. 3 credits. Limited to 45 students. Prerequisite: BIOES 261 or permission of instructor. S-U grades optional. Lec and disc, T R 2:30–3:45. During the first 6 weeks of class, the Thursday meetings may run to 5:30 because of field trips. Offered alternate years. Not offered fall 1999. 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 agroecosystems, 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.]

SCAS 483 Environmental Biophysics
Spring. 3 credits. Prerequisite: SCAS 260 or equivalent or permission of instructor. 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 will be covered. Applications to agronomic and environmental problems and instrument design and use are considered through discussion and problems sets.

SCAS 663 Pedology
Spring. 3 credits. Prerequisite: SCAS 361 or permission of instructor. Textbook recommended, not required. Offered even spring semesters. R. B. Bryant.
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.

SCAS 667 Advanced Soil Physics
Spring. 3 credits. Prerequisites: one year of college physics and SCAS 483 or permission of instructor. S-U grades optional. Hours to be arranged. Offered alternate years. 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. Mechanical and thermodynamical analysis of the equilibrium status of aqueous solutions in deformable soils. Formal lectures are complemented by tutorial sessions.

SCAS 669 Organic Matter—Soils, Sediments, and Waters
Spring. 2 or 3 (with discussion) credits. Prerequisites: SCAS 260 and CHEM 357–358 or equivalent. T R 9:05; disc, W 1:25–2:15. 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. Interaction with anthropogenic organics and effects of anthropogenic activities on natural organics are considered.

SCAS 671 Soil Chemistry
Fall. 3 credits. Prerequisite: one year of physical chemistry or permission of instructor. Offered alternate years. Offered fall 1999. Lecs, M W F 10:10. 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 will be emphasized. The behavior of environmental contaminants in soils, particularly metals and toxic organics, will be described.

SCAS 693 Special Topics in Soil Science
Fall or spring. 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.

SCAS 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.

SCAS 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.

SCAS 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.

VEGETABLE CROPS

See Horticultural Sciences.

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. Assoc. Prof., Entomology (Geneva)
Ahner, Beth A., Ph.D., Massachusetts Institute of Technology. Asst. Prof., Agricultural and Biological Engineering
Aist, James R., Ph.D., U. of Wisconsin. Prof., Plant Pathology
Albright, Louis D., Ph.D., Cornell U. Prof., Agricultural and Biological Engineering
Aldwinckle, Herbert S., Ph.D., U. of London (England). Prof., Plant Pathology (Geneva)
Allee, David J., Ph.D., Cornell U. Prof., Agricultural, Resource, and Managerial Economics

Altman, Naomi S., Ph.D., Stanford U. Assoc. Prof., Biometrics Unit
Andersen, Robert L., Ph.D., U. of Minnesota. Prof., Horticultural Sciences (Geneva)
Anderson, Bruce L., Ph.D., U. of California at Berkeley. Assoc. Prof., Agricultural, Resource, and Managerial Economics
Aneshansley, Daniel J., Ph.D., Cornell U. Assoc. Prof., Agricultural and Biological Engineering
Arneson, Phil A., Ph.D., U. of Wisconsin. Assoc. Prof., Plant Pathology
Austic, Richard E., Ph.D., U. of California at Davis. Prof., Animal Science
Baer, Richard A., Ph.D., Harvard U. Prof., Natural Resources
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., Agricultural, Resource, and Managerial Economics
Bartsch, James A., Ph.D., Purdue U. Assoc. Prof., Agricultural and Biological Engineering
Bassuk, Nina L. Ph.D., U. of London (England). Prof., Floriculture and Ornamental Horticulture
Batt, Carl A., Ph.D., Rutgers U. Prof., Food Science
Baugher, Sherene, Ph.D., SUNY Stonybrook. Asst. 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., Soil, Crop, and Atmospheric Sciences
Beer, Steven V., Ph.D., U. of California at Davis. Assoc. 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., Fruit and Vegetable Science
Bergstrom, Gary C., Ph.D., U. of Kentucky. Prof., Plant Pathology
Bills, Nelson L., Ph.D., Washington State U. Prof., Agricultural, Resource, and Managerial Economics
Bjorkman, Thomas N., Ph.D., Cornell U. Assoc. Prof., Horticultural Sciences (Geneva)
Blake, Robert W., Ph.D., North Carolina State U. Prof., Animal Science
Blossey, Bernd, Ph.D., Christian-Albrechts U., Germany. Asst. Prof., Natural Resources
Boisclair, Yves R., Ph.D., Cornell U. Asst. Prof., Animal Science
Boisvert, Richard N., Ph.D., U. of Minnesota. Prof., Agricultural, Resource, and Managerial Economics
Boor, Kathryn J., Ph.D., U. of California at Davis. Asst. Prof., Food Science
Brady, John W., Jr., Ph.D., SUNY at Stonybrook. Assoc. Prof., Food Science
Broadway, Roxanne M., Ph.D., U. of California at Davis. Assoc. Prof., Entomology (Geneva)
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., Soil, Crop, and Atmospheric Sciences
Burr, Thomas J., Ph.D., U. of California at Berkeley. Prof., Plant Pathology (Geneva)
Butler, Walter R., Ph.D., Purdue U. Prof., Animal Science
Calderone, Nicholas W., Ph.D., Ohio State U. Asst. Prof., Entomology
Carlsen, William S., Ph.D., Stanford U. Assoc. Prof., Education
Casella, George, Ph.D., Purdue U. Prof., Biometrics Unit
Castillo-Chavez, Carlos, Ph.D., U. of Wisconsin. Prof., Biometrics Unit
Chan, Alice P., Ph.D., Michigan State U. Asst. Prof., Communication
Chapman, Lewis D., Ph.D., U. of California at Berkeley. Prof., Agricultural, Resource, and Managerial Economics
Chase, Larry E., Ph.D., Pennsylvania State U. Assoc. Prof., Animal Science
Cherney, Jerome H., Ph.D., U. of Minnesota. Prof., Soil, Crop, and Atmospheric Sciences
Christy, Ralph D., Ph.D., Michigan State U. Prof., Agricultural, Resource, and Managerial Economics
Coffman, W. Ronnie, Ph.D., Cornell U. Prof., Plant Breeding and Biometry
Colle, Royal D., Ph.D., Cornell U. Prof., Communication
Collmer, Alan R., Ph.D., Cornell U. Prof., Plant Pathology
Colucci, Stephen J., Ph.D., SUNY. Assoc. Prof., Soil, Crop, and Atmospheric Sciences
Conneman, George J., Ph.D., Pennsylvania State U. Prof., Agricultural, Resource, and Managerial Economics
Conrad, Jon M., Ph.D., U. of Wisconsin. Prof., Agricultural, Resource, and Managerial Economics
Conroy, Carol A., Ph.D., Pennsylvania State U. Asst. Prof., Education
Contreras, Martha, Ph.D., U. of California at Riverside. Asst. Prof., Biometrics Unit
Cook, Kerry H., Ph.D., North Carolina State U. Assoc. Prof., Soil, Crop, and Atmospheric Sciences
Cooke, J. Robert, Ph.D., North Carolina State U. Prof., Agricultural and Biological Engineering
Cox, William J., Ph.D., Oregon State U. Prof., Soil, Crop, and Atmospheric 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. Asst. Prof., Entomology
Datta, Ashim K., Ph.D., U. of Florida. Assoc. Prof., Agricultural and Biological Engineering
Decker, Daniel J., Ph.D., Cornell U. Prof., Natural Resources
DeGloria, Stephen D., Ph.D., U. of California at Berkeley. Assoc. Prof., Soil, Crop, and Atmospheric Sciences
de Gorter, Harry, Ph.D., U. of California at Berkeley. Assoc. Prof., Agricultural, Resource, and Managerial Economics
Delaney, Terrence, Ph.D., U. of Washington. Asst. Prof., Plant Pathology
Deshler, J. David, Ed.D., U. of California at Los Angeles. Assoc. Prof., Education
Dillard, Helene R., Ph.D., U. of California at Berkeley. Prof., Plant Pathology (Geneva)
Dunn, James A., Ph.D., U. of Michigan. Prof., Education
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., Soil, Crop, and Atmospheric Sciences
Earle, Elizabeth D., Ph.D., Harvard U. Prof., Plant Breeding and Biometry
Eberts, Paul R., Ph.D., U. of Michigan. Prof., Rural Sociology
Eckenrode, Charles J., Jr., Ph.D., U. of Wisconsin. Prof., Entomology (Geneva)
Ellerbrock, LeRoy A., Ph.D., Cornell U. Assoc. Prof., Fruit and Vegetable Science
English-Loeb, Gregory M., Ph.D., U. of California at Davis. Asst. Prof., Entomology (Geneva)
Everett, Robert W., Ph.D., Michigan State U. Prof., Animal Science
Ewer, John, Ph.D., Brandeis U. Asst. Prof., Entomology
Ewert, D. Merrill, Ph.D., U. of Wisconsin. Assoc. Prof., Education
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. Asst. Prof., Soil, Crop and Atmospheric Sciences
Fick, Gary W., Ph.D., U. of California at Davis. Prof., Soil, Crop, and Atmospheric Sciences
Fiori, Bart J., Ph.D., Cornell U. Assoc. Prof., Entomology (Geneva)
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
Gavin, Thomas A., Ph.D., Oregon State U. Assoc. Prof., Natural Resources
Gay, Geraldine K., Ph.D., Cornell U. Assoc. Prof., Communication
Gebremedhin, Kifle G., Ph.D., U. of Wisconsin. Prof., Agricultural and Biological 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. Asst. Prof., Entomology
Gillett, James W., Ph.D., U. of California at Berkeley. Prof., Natural Resources
Gleason, Kathryn L., Ph.D., Oxford U. Asst. Prof., Landscape Architecture
Gonsalves, Dennis, Ph.D., U. of California at Davis. Prof., Plant Pathology (Geneva)
Good, George L., Ph.D., Cornell U. Prof., Floriculture and Ornamental 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
Gray, Stewart M., Ph.D., North Carolina State U. Assoc. Prof., Plant Pathology
Griffths, Phillip D., Ph.D., U. of Florida. Asst. Prof., Horticultural Sciences (Geneva)
Grunes, David L., Ph.D., U. of California at Berkeley. Prof., Soil, Crop, and Atmospheric Sciences
Gurak, Douglas T., Ph.D., U. of Wisconsin. Prof., Rural Sociology
Hagen, James M., Ph.D., U. of Illinois. Asst. Prof., Agricultural, Resource, and Managerial Economics
Hahn, Russell R., Ph.D., Texas A. & M. U. Assoc. Prof., Soil, Crop, and Atmospheric Sciences

Haith, Douglas A., Ph.D., Cornell U. Prof., Agricultural and Biological Engineering
Hajek, Ann E., Ph.D., U. of California at Berkeley. Asst. Prof., Entomology
Halseth, Donald E., Ph.D., Cornell U. Assoc. Prof., Fruit and Vegetable Science
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)
Harwood, Edward D., Ph.D., U. of Wisconsin-Madison. Assoc. Prof., Cooperative Extension Administration
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. Assoc. 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 Zürich (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., Agricultural and Biological Engineering
Irwin, Lynne H., Ph.D., Texas A & M U. Assoc. Prof., Agricultural and Biological Engineering
Jacobson, Jay S., Ph.D., Columbia U. Assoc. Prof., Natural Resources
Jahn, Margaret M., Ph.D., Cornell U. Assoc. Prof., Plant Breeding and Biometry
Jewell, William J., Ph.D., Stanford U. Prof., Agricultural and Biological Engineering
Johnson, Patricia A., Ph.D., Cornell U. Assoc. Prof., Animal Science
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