

# College of Agriculture and Life Sciences

## DEGREE PROGRAMS

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

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

### Bachelor of Science Degree

Departments in the College of Agriculture and Life Sciences sponsor study for the B.S. degree in 24 major programs. To qualify for the degree, students must fulfill requirements established by the faculty of the college and administered through the Office of Academic Programs. Students are admitted into a single major but afterwards may pursue and graduate with two or more majors within the College of Agriculture and Life Sciences. Students need an advisor in each major. Course requirements for double majors may overlap. The Counseling and Advising Office (140 Roberts Hall) and department representatives have a form for students to complete to officially recognize the double major. The following units offer major fields of study for undergraduates. A faculty advising coordinator is listed for each unit. Students should consult with the faculty coordinator regarding requirements and opportunities for concentrations in the major.

#### EAS Majors Included:

Atmospheric science: Mark Wysocki, 1114 Bradfield Hall, [mww3@cornell.edu](mailto:mww3@cornell.edu)

Science of earth systems: John Cisne, 2102 Snee Hall, [john.cisne@cornell.edu](mailto:john.cisne@cornell.edu)

#### Minors

Students in the College of Agriculture and Life Sciences may pursue one or more minor fields of study in any department in any college that offers them, subject to limitations placed by the department offering the minor or by the student's major. Minor fields of study do not require an academic advisor, but each minor field has a contact person who will provide information and verify on the application to graduate that the student will successfully complete the requirements of the minor by graduation. Students may complete as many minors as they wish; the requirements of minors may overlap. Minors are described along with the majors later in the CALS section of this catalog. Not all majors or departments offer minors. Minors available in CALS can be found on the CALS counseling and advising web site ([cals.cornell.edu/cals/current/advising/options/doubmaj.cfm](http://cals.cornell.edu/cals/current/advising/options/doubmaj.cfm)). For minors outside of CALS, please consult with the specific department.

### Graduate Fields of Study

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

#### EAS Graduate Fields Included:

(Updated 10/08)

Atmospheric sciences: Dan Wilks, 1113 Bradfield Hall, [dsw5@cornell.edu](mailto:dsw5@cornell.edu)

**For more information about research opportunities, honors program, careers, non-Cornell credit, graduation procedures, and other academic policies and procedures, etc., see:**

<http://cuinfo.cornell.edu/Academic/Courses/ALS.php>

### Off-Campus Opportunities

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

The Marine Biological Laboratory's (MBL) Semester in Environmental Science is a semester-long program held each fall in Woods Hole, Massachusetts. This is a multi-university and college program run by the staff of the Ecosystems Center of the MBL. Approximately 15–20 students interact intensively with the world-class research staff of the Ecosystems Center in a mixture of classroom, laboratory, and field-

research activities. The major foci of the program are on biogeochemistry, ecosystem science, and the impacts of land use and global change on the environment. Students spend about 20 hours each week conducting intensive, hands-on field and lab work in coastal forests, freshwater ponds, and estuaries, and complete an independent research project as part of the curriculum. The MBL is one of the oldest (founded in 1888) and most distinguished biological field stations in North America. Cornell credit for up to 16 credits is offered. More information on the program can be obtained from the Cornell faculty liaison (Prof. Bob Howarth, E309 Corson Hall, 255-6175) or from the director of the program (Dr. Ken Foreman, MBL Ecosystems Center, 508-289-7777; [courses.mbl.edu/SES](http://courses.mbl.edu/SES)).

## SEA Semester

The Sea Education Association is a nonprofit educational institution offering ocean-focused academic programs and the opportunity to live, work, and study at sea. Science, the humanities, and practical seamanship are integrated in small, personal classes. The 17-credit program is 12 weeks in length. Six weeks are spent in Woods Hole, and the following six weeks are spent on either one of SEA's two sailing vessels: the SSV Robert Seamans or the SSV Corwith Cramer. For more information, contact Sea Education Association, P.O. Box 6, Woods Hole, MA 02543 (1-800-552-3633 x 770) or visit <http://www.sea.edu>. CALS students should file an intent to study off campus form with the college registrar as early as possible to ensure proper registration and enrollment in courses.

## Shoals Marine Laboratory (SML)

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

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

# GRADUATION REQUIREMENTS FOR THE BACHELOR OF SCIENCE

## 1. Credit Requirements

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

Important Exceptions:

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

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

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

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

E. Maximum credits from endowed colleges: 55 endowed credits can be completed without incurring excess tuition charges. Endowed credits include all courses from departments in the College of Arts and Sciences, Architecture, Art, and Planning, Engineering, the Hotel School, the Johnson School of Graduate Management, and the Law School. Courses completed during the summer and winter sessions do not count against the 55 endowed credit limit.

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

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

\*The prorated formula is available at <http://www.cals.cornell.edu/current/registrar>.

## 2. Physical Education Requirement

A. Pass two PE courses with a satisfactory grade.

Exception: External transfer students are credited with one course of physical education for each semester previously enrolled full-time (12 or more credits) at another college before matriculation.

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

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

## 3. Residency Requirements

- A. Eight semesters of full-time study are expected. Transfer students are credited with one semester in residence for each 15 credits earned at another institution.
- B. Internal transfer students must be enrolled in CALS for at least two semesters, not including residency in the Internal Transfer Division.
- C. The final semester before graduation must be completed in a Cornell program as a full-time student in continued good academic standing.
- D. Students in the ninth and final semester may apply for prorated tuition. The eligibility criteria are listed below. The student will be charged the full administrative fee and student service charge, plus one-fifteenth of the remaining full tuition per credit hour.

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

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

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

#### 4. Grade-Point Average (GPA) Requirements

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

#### 5. Schedule Requirements

- A. Students are expected to enroll in at least one CALS course each semester until 55 CALS credits have been earned.
- B. Freshmen may not enroll in more than 18 credits, not including physical education.
- C. Freshmen are limited to one S-U course per semester.
- D. PE does not count toward the 12 credit minimum required for full-time status.

#### 6. Distribution Requirements

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

Please note: Credits received for independent study, field, teaching, research, work experience, and internships cannot be used to fulfill the distribution requirement. Courses judged to be review or supplemental in the discipline, such as 1000- to 1099-level courses, will not be counted in the distribution areas.

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

Introductory Biology: BIOG 1101–1104, 1105–1106, 1107–1108, 1109–1110

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

Included on the list is:

**EAS (EXCEPT 2900)**

## MAJOR FIELDS OF STUDY

The college curriculum consists of 24 major program areas that reflect the departmental academic effort in the college. Faculty curriculum committees in each area identify a sequence of courses appropriate to all students studying in that field. Courses of study are designed to provide systematic development of basic skills and concepts as well as critical thinking. Opportunity for concentration in an area of particular interest is usually available.

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

### Atmospheric Science

Atmospheric science is the study of the atmosphere and the processes that shape weather and climate. The curriculum emphasizes the scientific study of the behavior of weather and climate, and applications to the important practical problems of weather forecasting and climate prediction. Students develop a fundamental understanding of atmospheric processes and acquire skill and experience in the analysis, interpretation, and

forecasting of meteorological events. All students are required to complete a minimum of three semesters of calculus, two semesters of physics, and a semester each of chemistry, computer science, and statistics.

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

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

<b><u>Operational</u></b> <b>required</b>	<b><u>Education</u></b> <b>required</b>	<b><u>Broadcasting</u></b> <b>required</b>	<b><u>Business</u></b> <b>required</b>	<b><u>Environmental</u></b> <b>required</b>
EAS 2500	EAS 1310	EAS 1310	EAS 1310	CHEM 2070
EAS 2960	EAS 1330	EAS 1330	EAS 1330	CHEM 2080
EAS 4560	EAS 2500	EAS 2500	EAS 2680	EAS 3340
EAS 4700		EAS 2960		EAS 4570
		EAS 4700		
		COMM 2010		
<b>suggested</b>	<b>suggested</b>	<b>suggested</b>	<b>suggested</b>	<b>suggested</b>
EAS 1310	Courses in (ASTRO, EAS)	EAS 2680	Minor in business	EAS 1310
EAS 1330	Minor in education	Minor in communication	EAS 2680	EAS 2500
EAS 2680				EAS 2680
EAS 3310				EAS 3020
EAS 4350				EAS 3310
				EAS 4350
				EAS 4830

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

A student may minor in atmospheric science by completing any four of the following EAS courses\*: 1310, 2500, 2680, 3310, 3340, 3410, 3420, 3520, 4350, 4470, 4510, 4560, 4570, 4700, 6510, 6520 or 6660.

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

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

## Science of Earth Systems (SES)

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

The SES major emphasizes the basic study of the Earth system as one of the outstanding intellectual challenges in modern science and as the necessary foundation for the future management of our home planet. Cornell's strengths across a broad range of earth and environmental sciences have been fused to provide students with the tools to engage in what will be the primary challenge of the 21st century. The SES major has its home in the Department of Earth and Atmospheric Sciences, but includes collaboration with other departments across the university. The SES curriculum includes a strong preparation in mathematics, physics, chemistry, and biology during the freshman and sophomore years. During the junior and senior years, students complete the SES core sequence, studying such topics as climate dynamics, Earth system evolution, biogeochemistry, and Earth's interior. These classes emphasize the interconnectedness of the Earth system. The selection of upper-level

concentration courses allows the student to develop an area of expertise that complements the breadth of the introductory and SES core courses. Traditional concentrations include atmospheric sciences, biogeochemistry, geological sciences, and ocean sciences. Students desiring a concentration focused on less traditional areas of study are encouraged to work with their advisors to develop an individually designed concentration. Individually designed concentrations might encompass more interdisciplinary studies in topics such as sustainable Earth and environmental systems or Earth system science and policy.

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

## Requirements for the Major

### 1. Basic Math and Sciences

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

- a. MATH 1910–1920 (or MATH 1110–1120)
- b. PHYS 2207–2208 (or PHYS 1112–2213)
- c. CHEM 2070–2080 or 2070–1570 or 2090–2080
- d. BIOG 1101/1103–1102/1104, or 1105–1106, or BIOG 1109/1110

### 2. Required Introductory Course: EAS 2200 The Earth System

### 3. Science of Earth Systems Core Courses

These courses are founded on the most modern views of the planet as an interactive and ever-changing system, and each crosses the traditional boundaries of disciplinary science. Three courses selected from the following four core courses are required for the major.

EAS 3010 Evolution of the Earth System

EAS/NTRES 3030 Biogeochemistry

EAS 3040 Interior of the Earth

EAS 3050 Climate Dynamics

### 4. Concentration Courses

Four intermediate to advanced-level courses (3000 level and up) that build on the core courses and have prerequisites in the basic sciences and mathematics courses are required. Note that additional basic math and science courses may be required as prerequisites for courses chosen for the concentration. The concentration courses build depth and provide the student with a specific expertise in some facet of Earth system science. The concentration should be chosen during the junior year or before in consultation with an SES advisor whose interests match those of the student. Four concentrations are defined for the major: atmospheric sciences, biogeochemistry, geological sciences, and ocean sciences (see EAS web site for details). Other concentrations can be tailored to a student's interests in concert with the student's advisor and upon approval of the SES curriculum committee. Examples include sustainable Earth and environmental systems, earth system science and policy, hydrology, planetary science, and soil science.

### 5. Field/Observational/Laboratory Experience

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

Courses in the Hawaii Environmental Semester program; Courses given by the Shoals Marine Laboratory;

EAS 2500 (Meteorological Observations and Instruments);

EAS 3520 (Synoptic Meteorology I);

EAS 4170 (Field Mapping in Argentina);

EAS 4370 (Geophysical Field Methods);

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

Field courses taught by another college or university (3-credit minimum).

For more information, contact Professor John Cisne, Department of Earth and Atmospheric Sciences, [john.cisne@cornell.edu](mailto:john.cisne@cornell.edu), or visit

<http://www.eas.cornell.edu>.

## Special Programs in Agriculture and Life Sciences

Interdisciplinary Studies. The opportunity to develop an independent major in interdisciplinary studies is available for students interested in pursuing a general education in agriculture and life sciences. In consultation with a faculty advisor, students may plan a sequence of courses suited to their individual interests, abilities, and objectives. In addition to the distribution and other college requirements, this major may include a concentration of courses in one of several academic units of the college or university. A course of study for interdisciplinary studies must be planned with and approved by a college faculty advisor. Information on the options and names of faculty advisors prepared to advise in special programs are available in the Counseling and Advising Office, 140 Roberts Hall.

## **General Courses**

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

## **Atmospheric Science**

## **Science of Earth Systems**

## **Field Study in Hawaii**

Field study is a fundamental aspect of earth system science. Students wishing to increase their field experience may fulfill some of the requirements for the SES major by off-campus study through the Cornell Earth and Environmental Semester program (EES). The EES program is offered during the spring semester and emphasizes field-based education and research. It is based on the island of Hawaii, an outstanding natural laboratory for earth and environmental sciences. Courses that may be applied to the SES major include EAS 3400, 3220, and 3510. The EES program also offers opportunities for internships with various academic, nonprofit, and government organizations. Typically students participate in the EES program during their junior year, although exceptions are possible. For further information on the EES program see <http://www.geo.cornell.edu/geology/classes/hawaii/course.html>.