School of Forestry & Environmental Studies 2017–2018

BULLETIN OF YALE UNIVERSITY

Series 113 Number 12 August 20, 2017

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The closing date for material in this bulletin was July 30, 2017.
The University reserves the right to withdraw or modify the courses of instruction or to change the instructors at any time.

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Contents

Calendar

FALL 2017

Aug. 3–5	TH–SA	Orientation for international students
Aug. 6	SU	Orientation for summer modules
Aug. 7–24	M–TH	Training modules in technical skills & orientation events
Aug. 28	M	Meeting with the dean and academic orientation—part I for first-year students (mandatory), Burke Auditorium
Aug. 29	T	Academic orientation—part II
Aug. 30	W	Fall-term classes begin, 8:30 a.m.
Sept. 4	M	Labor Day; classes do not meet
Sept. 13	W	Course registration closes
Sept. 20	W	Add/Drop period ends
Oct. 17	T	October recess begins, 11 p.m.
Oct. 23	M	Classes resume, 8:30 a.m.
Oct. 27	F	Midterm
Nov. 10	F	Open house for prospective students
Nov. 17	F	November recess begins, 5 p.m.
Nov. 27	M	Classes resume, 8:30 a.m.
Dec. 8	F	Classes end, reading period begins, 5 p.m.
Dec. 9–20	SA–W	Reading period/final examinations
Dec. 20	W	Fall term ends; winter recess begins, 5 p.m.

SPRING 2018

Jan. 3	W	Fall-term grades due
Jan. 16	T	Spring-term classes begin, 8:30 a.m.
Jan. 30	T	Course registration closes
Feb. 6	T	Add/Drop period ends
Mar. 9	F	Midterm
		Spring recess begins, 5 p.m.
Mar. 26	M	Classes resume, 8:30 a.m.
Apr. 27	F	Classes end, reading period begins, 5 p.m.
Apr. 28–May 9	SA–W	Reading period/final examinations
May 9	W	Spring term ends, 5 p.m.
May 14	M	Spring-term grades due for graduating students
May 21	M	University Commencement
May 25	F	Spring-term grades due for continuing students

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A Message from the Dean

Since its founding, the Yale School of Forestry & Environmental Studies has been at the forefront of bringing science to solutions. Our history is steeped in the kinds of path-breaking scholarship, practice, and impactful engagement that advance the solution of complex natural resource and environmental challenges.

The School's legacy of impact for a sustainable environment goes back to its founding. Yale University alumni Gifford Pinchot and Henry S. Graves (1889 and 1892, respectively) established the School in 1900 after receiving forestry degrees in Europe. Pinchot, who created the U.S. Forest Service and served as its first chief, advocated for the "conservation of natural resources" and, with his family, endowed the Yale Forest School.

Now in its second century, the School has broadened to meet new environmental challenges. This evolution was reflected in its new name, the Yale School of Forestry & Environmental Studies, adopted in 1972. The School's research, teaching, and practice still address forest science and management, but also a broad range of issues related to the health of the planet and human-environment interactions, including the scientific understanding and long-term management of all ecosystems for sustainability and human benefit.

The School's alumni—4,700 and counting—have become nationally and internationally prominent leaders in forestry, natural resources, and the environment. Among our first graduates was Aldo Leopold (1909), the renowned conservationist and writer who developed a land ethic that promotes the strong link between human health and the health of the land. Our alumni share a passion for the outdoors and for environmental sustainability, and they work in NGOs, government, business, and academia all over the world. The F&ES alumni network supports critical connections for our School, providing guidance for us to prepare students for current professional challenges, and mentorship for students.

Today our School aspires to lead the world toward a more sustainable future with cutting-edge research, teaching, and public engagement on society's urgent environmental challenges. The heart of this mission remains our academic program, which provides a balance of interdisciplinary breadth, focused areas of study, and professional skills development. This, along with our strong relationships with schools and programs across the Yale campus and a multitude of external organizations, enables students to understand the scale of today's challenges and to become leaders in addressing them across a range of sectors—including government, business, law, nongovernmental organizations, academia, public health, and communications.

The challenges we face require ever greater levels of innovative scholarship and leadership. In the coming years we will hone and implement a new strategic plan to chart our future. Together we will work to broaden and deepen the School's impact on a sustainable future through scholarship, practice, training, and engagement. With a sense of urgency and a spirit of dedication, we seek to honor and expand on our historical strengths and commitment to provide leading scholarship and impact across the full range of issues we address. And we will continue to strengthen our own community, empowering a wider

range of individuals and contributions, creating a sense of collective identity committed to the common good, and promoting a diverse and inclusive F&ES community.

We invite you to be a part of our exciting future.

Ingrid C. Burke
Carl W. Knobloch, Jr. Dean
School of Forestry & Environmental Studies

School Mission

The Yale School of Forestry & Environmental Studies aspires to lead the world toward a sustainable future with cutting-edge research, teaching, and public engagement on society's evolving and urgent environmental challenges.

Our mission is grounded in seven fundamental values:

Excellence We promote and engage in pathbreaking science, policy, and business models that build on a fundamental commitment to analytic rigor, data, intellectual integrity, and excellence.

Leadership We attract outstanding students nationally and internationally and offer a pioneering curriculum that defines the knowledge and skills needed to be a twenty-first-century environmental leader in a range of professions.

Sustainability We generate knowledge that will advance thinking and understanding across the various dimensions of sustainability.

Community We offer a community that finds strength in its collegiality, diversity, independence, and commitment to excellence and lifelong learning.

Diversity We celebrate our differences and identify pathways to a sustainable future that respects diverse values including equity, liberty, and civil discourse.

Collaboration We foster collaborative learning, professional skill development, and problem solving—and we strengthen our scholarship, teaching, policy work, and outreach through partnerships across the university and beyond.

Responsibility We encourage environmental stewardship and responsible behavior on campus and beyond.

In pursuit of our mission, we:

- Build on more than a century of work bringing science-based strategies, ethical considerations, and conservation practices to natural resource management.
- Approach problems on a systems basis and from interdisciplinary perspectives.
- Integrate theory and practice—and provide innovative solutions to society's most pressing environmental problems.
- Address environmental challenges at multiple scales from local to global and multiple settings from urban to rural and from managed to wild—including working lands and landscapes.
- Draw on the depth of resources at Yale and the network of alumni that extends across the world.
- Create opportunities for research and policy application as well as professional development through a structure of faculty-led centers and programs.
- Provide a neutral forum to convene conversations on difficult issues that are critical to progress on sustainability.
- Bring special focus on the most significant threats to a sustainable future including climate change, the corresponding need for clean energy, and the increasing stresses on our natural resources.

History of the School of Forestry & Environmental Studies

Yale University has played a leading role in the development of American conservation and natural resource management since the 1800s, when Yale graduates such as William Henry Brewer, Othniel C. Marsh, Clarence King, and George Bird Grinnell were deeply involved with the exploration of the West and the proper use of that region's resources. In 1900 that tradition was strengthened further when the University established the Yale Forest School. The men responsible for establishing the School were Gifford Pinchot, B.A. 1889, LL.D. 1925, and Henry S. Graves, B.A. 1892, LL.D. 1940. Pinchot was the first American to receive professional forestry training in Europe, and Graves the second. As consulting foresters, and later at the government's Division of Forestry, they demonstrated the first examples of forest management on private lands in the United States. The School was founded with a gift from the Pinchot family to ensure a continuing supply of professionals to carry out the work that lay ahead.

Pinchot, who became one of the leading figures in the administration of President Theodore Roosevelt, created the USDA Forest Service and served as its first chief. Credited with coining the phrase "conservation of natural resources," he defined conservation as the wise use of the Earth for the good of present and future generations.

Since its founding, it has been the School's mission to turn Pinchot's vision of conservation into educational and professional reality. Leading that quest until 1939 was the School's first dean and intellectual leader, Henry S. Graves. To Graves, graduate education, as in law and medicine, would define the new profession. Over the years, objectives have broadened, the mission has been interpreted differently, and methods of instruction have changed. Each decade has presented its singular challenges, and the School has responded vigorously to meeting them. In 1972 the School changed its name to the School of Forestry & Environmental Studies to recognize that it is concerned, in the broadest sense, with the scientific understanding and long-term management of ecosystems for human benefit.

In its second century, the School's research and teaching are focused on the following broad areas: ecology, ecosystems, and biodiversity; environmental management and social ecology in developing societies; forest science and management; global change science and policy; health and environment; industrial environmental management; policy, economics, and law; urban ecology, environmental planning, design, and values; and coastal and watershed systems.

Statement of Environmental Policy

We the faculty, staff, and students of the Yale School of Forestry & Environmental Studies affirm our commitment to the responsible environmental stewardship of our School, the University, the city of New Haven, and the places where we teach and conduct research. In the course of these activities, we shall strive to:

- reduce our use of natural resources;
- support the sustainable production of the resources we must use by purchasing renewable, reusable, recyclable, and recycled materials;
- minimize our use of toxic substances and ensure that unavoidable use is in full compliance with federal, state, and local environmental regulations;
- reduce the amount of waste we generate and promote strategies to reuse and recycle waste that cannot be avoided; and
- restore the environment where possible.

Each member of the School community is encouraged to set an example for others by being a steward of our environment.

Master's Degree Programs

TWO-YEAR MASTER'S DEGREE PROGRAMS

The School of Forestry & Environmental Studies offers four two-year master's degrees: the professionally oriented Master of Environmental Management (M.E.M.) and the Master of Forestry (M.F.), and the research-oriented Master of Environmental Science (M.E.Sc.) and Master of Forestry Science (M.F.S.). The master's degree programs vary in their level of prescription, but all are sufficiently flexible to accommodate the diverse academic backgrounds, professional experiences, and career aspirations of a large and vibrant student body. The program curricula draw from more than 200 courses taught by more than fifty F&ES faculty, as well as from courses taught elsewhere at Yale. Each student's course of study is customized through consultation with a faculty adviser who guides the student's learning experience from the first week at Yale until graduation. The master's degree programs require a minimum of two years in residence, 48 credits of course work at Yale, a summer internship or research experience, and completion of the Training Modules in Technical Skills prior to the student's first term (see below).

Master of Environmental Management

The Master of Environmental Management curriculum draws from course work in the natural and social sciences and focuses on the complex relationships among science, management, and policy. The purpose of the program is to provide students with a scientific understanding of natural and social systems that can be applied in a policy or management context. Students are also expected to hone their capacities as leaders and managers through summer internships, professional skills courses, and other opportunities.

The M.E.M. curriculum is flexible enough to allow students to tailor their course of study in a way that builds on their interests and experiences and that meets their specific career goals. All M.E.M. students take courses in three major areas: Foundations, Electives, and the Capstone, for a total of 48 credits over four terms. The School's body of elective courses is supplemented by credit-earning Professional Skills courses that are intended to build expertise in management and leadership.

M.E.M. students have the option to enroll in any of eight specializations. The specializations represent key areas of student interest, as well as emerging or enduring career fields within environmental management. The specializations are:

1. Business and the Environment
2. Ecosystem Conservation and Management
3. Energy and the Environment
4. Environmental Policy Analysis
5. Human Dimensions of Environmental Management
6. Sustainable Land Management, Use, and Policy
7. Industrial Ecology and Green Design
8. Water Resources Science and Management

The majority of the specializations require between 18 and 24 credits of prescribed course work and share a similar overall structure, consisting of specialization-specific core

courses, electives, and a capstone. Formal acknowledgment of successful completion of the prescribed course work of a specialization is given on a student's official transcript. Students are not, however, required to specialize.

Master of Forestry

The Master of Forestry program trains professionals for the protection, management, and restoration of native forests and woodlands and associated human-made forest ecosystems (urban trees, agroforests, plantations); and for mediating and resolving the conflicting values of society that concern forests and associated ecosystems. Since 1900, the Master of Forestry program has provided leadership in the education of professional foresters. It is the oldest continuing forestry program in the Western Hemisphere. Almost all the early foresters in North America had their roots at Yale, including Aldo Leopold, M.F. '09, and nine of the first twelve chiefs of the USDA Forest Service.

Master of Forestry graduates have pursued a variety of professional opportunities in forestry. Most start as general practitioners in management and with experience move through management to become policy makers and organizers. Some graduates use the degree as preparation for advanced study in doctoral programs.

The broad objective of the two-year M.F. program is realized by requiring a multidisciplinary suite of formal course work coupled with a progressive synthesis of knowledge in a significant project. Course work is supplemented through an array of local, regional, national, and international field trips to witness the practice of forestry in diverse settings. Real-world professional experience is provided through the Yale Forest and summer internships at a wide variety of resource management and policy organizations. Opportunities to engage in discussion with forest leaders are provided through workshops, meetings with visiting speakers of national and international repute, and involvement in the School's programs such as the Global Institute of Sustainable Forestry, the Forests Dialogue, the Tropical Resources Institute, and the Urban Resources Initiative.

The teaching objectives of the M.F. program are (1) to integrate knowledge about forests, natural resources, and society to form a sound basis for making management decisions; (2) to provide electives and other educational opportunities to specialize by focusing on a particular land use or management issue concerning forest ecosystem management; and (3) to provide opportunities for independent problem solving, critical thinking, and self-development. Students take a mixture of natural, social, and quantitative science courses, culminating in the second year with courses in integrated resource management and leadership. Flexibility in the choice of courses within the core curriculum as well as choice of electives allows each student to tailor the program to a desired specialization. Sample specializations have included community development and social forestry; protected areas management; extension and education; consulting forestry; business; watershed health and restoration; tropical forest management; agroforestry; and industrial forest management.

The Master of Forestry degree is accredited by the Society of American Foresters (SAF). A minimum of two full years in residence and sixteen full courses (48 credits) is required for completion of this program.

Master of Environmental Science/Master of Forest Science

The Master of Environmental Science and the Master of Forest Science degree programs are expressly designed for students wishing to conduct research that contributes to basic and applied knowledge in any of the fields taught at F&ES, such as ecology, hydrology, social ecology, economics, industrial ecology, or policy. These degrees are intended to facilitate a deeper disciplinary focus than the Management degrees, while allowing students the flexibility in course election that will allow them to meet diverse educational goals. The Master of Environmental Science is intended for students who wish to work broadly in different fields of environmental science. The Master of Forest Science is intended for students who wish to work in forest-related topics.

The course of study for both degrees includes formalized School-level training in the philosophy and practice of science. Training is provided through key courses in combination with extended project research and disciplinary and nondisciplinary electives. The scientific research required for this degree will be conducted in close collaboration with an F&ES faculty adviser. *Therefore students must have a commitment from a faculty adviser before being admitted to these degree programs*. The Master of Environmental Science and Master of Forest Science programs require the student to produce a "scholarly product." This product may take the form of a traditional master's thesis or a paper(s) submitted to a refereed journal.

Training Modules in Technical Skills (MODs)

All incoming master's students participate in three weeks of summer modules, which introduce the students to a basic understanding of field data, the basis for all environmental science and policy. MODs have three goals: (1) introduce basic systems analysis techniques, the foundation for all environmental science, management, and policy, using three local ecosystems; (2) build F&ES community spirit; and (3) introduce new students to the landscape they will be living, studying, and working in for the next few years. MODs take place in three settings: the urban environment of New Haven, the Yale Myers Forest in northeast Connecticut, and the Great Mountain Forest in northwestern Connecticut.

These modules are *required* of all first-year master's students enrolled in two-year programs, the M.E.M. Fifth Year program, and the one-year midcareer degree program. Course work is primarily in the field and covers three technical areas:

Ecosystem analysis Understanding the process of data collection, analysis, and interpretation is important for all natural resource professionals, from field researchers to resource managers and policy makers. The objective of this module is to improve the ability to evaluate ecosystem data by introducing/reviewing principles of and techniques for quantifying natural resources.

Urban The goal of this module is to acquaint students with field skills for characterizing and understanding urban ecosystems. It is designed to complement the ecosystem analysis module, which uses an ecosystem framework and examines largely undisturbed systems. In contrast, the urban module explicitly considers how the actions of humans and the existence of the built environment alter ecosystem structure and function.

Reading the landscape The goal of this module is to provide a basic understanding of how to interpret landscapes, taking into consideration land use history, land management, ecological conditions, and geological features, and how they have combined to shape the land and ecosystems today. Students are also introduced to the fundamentals of navigation, surveying, and map making, leading to an understanding of how to interpret various representations of spatial information.

ONE-YEAR MIDCAREER MASTER'S DEGREE PROGRAM

The midcareer M.E.M. or M.F. degree program is intended to permit environmental and forest managers to build on their work experience in order to acquire skills that will enable them to pursue their career goals more effectively. To this end, those admitted into the program must have at least seven years of directly relevant professional experience in the environmental or forestry field that is sufficient to provide a corpus of experiential learning equivalent to one year of academic study at F&ES. So that the admissions committee may fairly judge each applicant's work record in light of this requirement, applicants must detail their career work experience. Relevant work experience is not the sole criterion for admission into this degree program; the breadth of prior academic training is also considered, and those applicants who are better prepared (see Preparation for Admission, in the chapter Admissions: Master's Degree Programs) are more likely to succeed in this competitive admission process.

The midcareer degree program is not appropriate for those seeking to make an abrupt career change, nor is it suitable for those who have acquired seven or more years of work experience that is tangentially related to environmental or forest management. Normally, voluntary service will not be considered equivalent to career experience needed for acceptance into this degree program.

The one-year midcareer Master of Environmental Management and Master of Forestry degree programs have less structured curricula than the two-year programs. Attendance at the Training Modules (see Training Modules in Technical Skills, above) is required, and the successful completion of 24 credits of course work and independent study is required. One year in residence is normally required, as is initial enrollment at the start of the fall term.

JOINT MASTER'S DEGREE PROGRAMS

The School of Forestry & Environmental Studies supports several curricula that work concurrently toward two degrees from different academic units of Yale University. Opportunities for development of joint-degree programs exist with the School of Architecture, Divinity School, Law School, School of Management, School of Public Health, the Graduate School of Arts and Science's Global Affairs program coordinated through the Jackson Institute, the International and Development Economics program of the Graduate School's Department of Economics, and three programs offered by the Graduate School and coordinated through the MacMillan Center (African Studies, East Asian Studies, and European and Russian Studies). Joint-degree programs with Pace Law School and Vermont Law School constitute additional options. Applicants are urged to apply to both units at the same time. All of these programs are subject to the following general guidelines.

Applicants must apply to, and be accepted by, both units of the University according to normal admissions procedures. A minimum of one and one-half years (three terms) and 36 credits is required at the School of Forestry & Environmental Studies. For successful integration of the two programs, it is recommended that students spend a complete academic year (two terms) at one school, the following academic year at the other school, and then split the final year between the two schools.

Upon successful completion of the formal joint-degree program, the student will be awarded one of the four F&ES master's degrees, together with the joint degree. The joint-degree programs, sponsoring Yale academic units, and associated residency requirements (which are in addition to the three-term requirement of F&ES) are as follows:

1. School of Architecture: Master of Architecture I (five terms); Master of Architecture II (three terms).
2. Divinity School: Master of Arts in Religion (three terms); Master of Divinity (five terms).
3. Schools of law (Yale Law School, Pace Law School, and Vermont Law School): Juris Doctor (five terms).
4. School of Management: Master of Business Administration (three terms).
5. School of Public Health: Master of Public Health (three terms).
6. Global Affairs (Graduate School of Arts and Sciences): Master of Arts (three terms).
7. Department of Economics, International Development and Economics program (Graduate School of Arts and Sciences): Master of Arts (two to three terms).
8. African Studies (Graduate School of Arts and Sciences): Master of Arts (three terms).
9. East Asian Studies (Graduate School of Arts and Sciences): Master of Arts (three terms).
10. European and Russian Studies (Graduate School of Arts and Sciences): Master of Arts (three terms).

For questions about these joint-degree programs, please contact the F&ES Office of Admissions at fesinfo@yale.edu or 800.825.0330.

Joint-Degree Program with Tsinghua University

F&ES offers a three-year joint-degree program with Tsinghua University School of Environment in China. This program consists of one and one-half years (three terms) at Tsinghua working toward a Master of Environmental Engineering and one and one-half years (three terms) at Yale working toward a Master of Environmental Management, Master of Environmental Science, Master of Forestry, or Master of Forest Science. Students who begin their program at F&ES will spend one year (two terms) at F&ES, followed by one and one-half years (three terms) at Tsinghua, and then conclude their program with one-half year (one term) at F&ES. Students who begin their program at Tsinghua will spend one-half year (one term) at Tsinghua, one and one-half years (three terms) at F&ES, and then conclude their program with one year (two terms) at Tsinghua.

Applicants must apply to, and be accepted by, both F&ES and Tsinghua University under normal admissions procedures. For questions about this joint-degree program, please contact the F&ES Office of Admissions at fesinfo@yale.edu or 800.825.0330.

Joint Management Program with Universidad de los Andes

F&ES offers an additional joint program with the Universidad de los Andes in Bogotá, Colombia. This program consists of two years (48 credits) at F&ES working toward the Master of Environmental Management, followed by fifteen months at the Universidad de los Andes working toward completion of the full-time Master of Business Administration. Upon successful completion of each program, the student will be awarded a Master of Environmental Management degree from Yale and a Master of Business Administration degree from Universidad de los Andes.

Applicants must apply to, and be accepted by, both F&ES and the Universidad de los Andes under normal admissions procedures. For questions about this joint-degree program, please contact the F&ES Office of Admissions at fesinfo@yale.edu or 800.825.0330.

PART-TIME PROGRAM

Students who wish to obtain a degree through the part-time option must complete the same curriculum as full-time students. Participants must enroll for at least two courses per term and must complete the degree requirements within four years of matriculation. Part-time tuition will be $13,516.25 per term for the academic year 2017–2018.

SPECIAL STUDENTS

For those who do not wish to pursue a degree program, F&ES offers the option of special-student status. Special students may be registered for a period as short as one term and may enroll in a minimum of one course or elect to take a full program of four courses per term. Please note that international applicants who are not coming through a preestablished Memorandum of Understanding between a partner university and Yale University will likely not be able to participate in the special student program. Special students may not be eligible to participate in the summer Training Modules in Technical Skills. Under normal circumstances, no one may hold special-student status for more than one academic year. No degree or certificate is granted for special-student course work. Students will receive official transcripts of course work completed. For information on tuition for special students, see the chapter Tuition, Fees, and Other Expenses.

Doctoral Degree Program

The Doctor of Philosophy (Ph.D.) degree is conferred through the Yale Graduate School of Arts and Sciences. Work toward this doctoral degree is directed by the Department of Forestry & Environmental Studies of the Graduate School, which is composed of the faculty of the School of Forestry & Environmental Studies. Doctoral work is concentrated in areas of faculty research, which currently encompass the following broad foci: agroforestry; biodiversity conservation; biostatistics and biometry; community ecology; ecosystems ecology; ecosystems management; energy and the environment; environmental and resource policy; environmental anthropology; environmental biophysics and meteorology; environmental chemistry; environmental ethics; environmental governance; environmental health risk assessment; environmental history; environmental law and politics; environmental management and social ecology in developing countries; forest ecology; green chemistry and engineering; hydrology; industrial ecology; industrial environmental management; plant physiology and anatomy; pollution management; population ecology; resource economics; silviculture; social ecology; stand development, tropical ecology, and conservation; sustainable development; urban ecology; urban land cover change; urban geography; urban planning; and water resource management.

REQUIREMENTS FOR THE DOCTORAL DEGREE

All courses listed in this bulletin are open to students working for the doctoral degree. Additional courses are available in other departments—e.g., Anthropology; Chemistry; Ecology and Evolutionary Biology; Economics; Geology and Geophysics; Management; Mathematics; Molecular, Cellular, and Developmental Biology; Political Science; Sociology; and Statistics—and are listed in the bulletin of the Graduate School.

A doctoral committee will be appointed for each student no later than the student's second term in the program. The committee consists of a minimum of three faculty members from the Yale University community. When appropriate for their research areas, students are encouraged to suggest committee members from other universities. Doctoral students work under the supervision of their doctoral committees. The committee should be chaired or cochaired by an F&ES ladder faculty member.

Students are required to take the Doctoral Student Seminar (F&ES 900) during the first year of their program.

Two Honors grades must be achieved before a student is eligible to sit for the qualifying examination. In addition, students are expected to serve four terms (10 hours per week) as teaching fellows, in partial fulfillment of their doctoral training.

A written and oral qualifying examination is required upon completion of the course requirements. Students are expected to take the examination by the end of their second year, although this can be extended to the third year in cases with appropriate extenuating circumstances. At the time of the qualifying examination, the student must present a prospectus of the research work proposed for the dissertation. Successful completion of the qualifying examination and submission of the prospectus will result in admission to candidacy.

The director of doctoral studies (DDS) of the School serves as director of graduate studies for the Department of Forestry & Environmental Studies of the Graduate School, administers the doctoral program, and may be consulted if questions arise.

Before beginning work, the student must secure approval from the student's committee and the DDS for a proposed program of study and for the general plan of the dissertation. Appropriate advanced work is required. Courses chosen should form a coherent plan of study and should support research work for the proposed dissertation.

The dissertation should demonstrate the student's mastery of the chosen field of study as well as the ability to do independent scholarly work and to formulate conclusions that may modify or enlarge previous knowledge.

Candidates must present themselves for the oral defense of the dissertation at such time and place as the student, the DDS, and the committee determine. Upon completion of the dissertation, the candidate must make unbound copies of the dissertation available to the faculty. Copies of the approved dissertation must be submitted to the Graduate School.

COMBINED DOCTORAL DEGREE

Department of Anthropology

The School of Forestry & Environmental Studies offers a combined doctoral degree with Yale's Department of Anthropology. The purpose and attraction of the degree are threefold: (1) it combines the disciplinary identity and strengths of the Anthropology department with the interdisciplinary character and possibilities of F&ES, especially in terms of bridging the social and natural sciences; (2) it combines the strengths in ecological and environmental studies of F&ES with the social science strengths of the Anthropology department; and (3) it combines the Anthropology department's strengths in theory with the emphasis within F&ES on linking theory with policy and practice. The combined doctoral degree offers its graduates great flexibility when entering the marketplace: they can represent themselves as anthropologists and/or environmental scientists, as theoreticians and/or practitioners. They have the credentials to apply for policy-oriented positions with international institutions, as well as academic positions in teaching and research. The academic program of each student in the combined-degree program is to some extent tailored specifically to that student's particular history, interests, and needs, but there are general guidelines that combined students can be expected to follow.

Prospective combined-degree students must initially apply either to Anthropology or to F&ES but not to both at the same time. However, in keeping with the current Yale Graduate School application process, they should indicate their interest in the combined degree by marking the application form appropriately. Once the student is accepted in the initially chosen doctoral program, the application file will be considered in the second program, and a decision on the combined-degree application will be communicated by the Graduate School by the usual deadline for acceptance of admission offers. Such students will be allocated to their initially chosen program as their primary administrative home, but will enter Yale as members of the combined-degree program. Being turned down for entry into the combined-degree program at this point does not preclude reapplication after arriving at Yale the following fall term. More detailed guidelines for

the combined-degree program can be found on the F&ES website at http://environment.yale.edu/doctoral/degrees/combined-anthropology.

New York Botanical Garden

The School of Forestry & Environmental Studies offers a combined doctoral degree with the New York Botanical Garden, which is funded by the Lewis B. Cullman Fellowship. The objective is to train biological scientists to use an interdisciplinary approach to solving problems associated with tropical environments.

Areas of study include agroforestry and forest management, ecosystem analysis, economic botany, economic evaluation of tropical resources, ethnobotany, plant biodiversity and conservation, social processes affecting management of natural resources, tropical field studies, and tropical silviculture.

For more information about the combined doctoral degree, please contact the director of doctoral studies at 203.432.5146.

Subjects of Instruction

Courses offered by the School of Forestry & Environmental Studies are described below. The letters "a" and "b" following the course numbers indicate fall- and spring-term courses, respectively. The letter "E" following a course number indicates an online course. Bracketed courses will not be offered during the 2017–2018 academic year.

Project courses involve individually assigned advanced field or laboratory work, or literature review, on topics of special interest to the student; credits and hours for these projects are determined for each student in consultation with the instructor.

Courses throughout the University are generally open to students enrolled in the School of Forestry & Environmental Studies, subject to limitations on class size and requirements for prerequisites.

Note For updated course listings, please see the School of Forestry & Environmental Studies website, http://environment.yale.edu/courses.

LIST OF COURSES BY TOPIC

Foundations

Professional Skills Courses

Integrative Frameworks

Capstone

Ecology

COMMUNITY AND ECOSYSTEM ECOLOGY

WILDLIFE ECOLOGY AND CONSERVATION BIOLOGY

ENVIRONMENTAL EDUCATION AND COMMUNICATION

Forestry

FOREST BIOLOGY

FOREST MANAGEMENT

Physical Sciences

ATMOSPHERIC SCIENCES

ENVIRONMENTAL CHEMISTRY

SOIL SCIENCE

WATER RESOURCES

Quantitative and Research Methods

Social Sciences

ECONOMICS

ENERGY AND THE ENVIRONMENT

ENVIRONMENTAL POLICY

SOCIAL AND POLITICAL ECOLOGY

HEALTH AND ENVIRONMENT

INDUSTRIAL ECOLOGY, ENVIRONMENTAL PLANNING, AND TECHNOLOGY

F&ES ONLINE AND FLIPPED COURSES

In addition to offering courses in the traditional classroom setting, the School of Forestry & Environmental Studies in recent years has made a growing commitment to providing quality education through online learning. As part of this initiative, the School introduced a series of courses that "flip" the typical classroom model. These courses allow students to watch lectures online while still providing an opportunity for weekly personal interactions with F&ES faculty. The digital format helps the instructors incorporate multimedia resources that are difficult to use in the classroom and enables more time for discussion, questions, and/or group work during student-instructor interactions. During the 2017–2018 academic year, the School will offer several courses that use the flipped model. We are also actively developing flipped courses and integrating technology into the classrooms. Therefore, classes not listed here may include some flipped features. Courses offered in 2017–2018 include the following:

COURSE DESCRIPTIONS

At F&ES, new courses are often added after this bulletin is printed. Our website at http://environment.yale.edu will have an updated list, as well as a list of environmental courses available in other departments at Yale. See also Yale University's online course information website: www.yale.edu/oci.

Foundations

[**F&ES 500a, Landscape Ecology** 3 credits. This Foundations course is an introduction to the study of large-scale ecological patterns and processes. Landscape ecology is a relatively young, rapidly changing field. The topics covered reflect the diverse interests of ecologists: species-area relationships, island biogeography, metapopulation theory, individual-based models, cellular automata, models of biodiversity, etc. Throughout the course the emphasis is on when and how to integrate a spatial perspective into consideration of major ecological questions. Readings from the primary literature augment material covered in lectures. Students complete a project resulting in a manuscript on a landscape-related topic. Knowledge of the concepts and principles covered in Landscape Ecology is assumed for all other F&ES courses in ecology and is essential for informing many kinds of decisions regarding ecosystem management. David K. Skelly]

F&ES 505a, Economics of the Environment 3 credits. This Foundations course within the M.E.M. program provides an introduction to the field of environmental and natural resource economics and policy. It covers both general methodological principles and specific applications. Rather than serving as a standard course in environmental and natural resource economics, the course is tailored specifically to M.E.M. students and hence focuses on environmental problem solving in the real world. While the course begins with a review of the principles of microeconomic analysis applied to environmental and natural resource management, it quickly moves into applications of particular concern for environmental management. Robert O. Mendelsohn

F&ES 510a, Introduction to Statistics and Data Analysis in the Environmental Sciences 3 credits. An introduction to statistics and data analysis with emphasis on practical applications in the environmental sciences. Includes graphical analysis, common probability distributions, hypothesis testing, confidence intervals, and linear regression. The second part of the course introduces the topics of multiple regression and ANOVA that are typically not covered in an introductory class such as AP statistics. There are weekly problem sets using MINITAB, SPSS, or R, as well as a final project. This course is a prerequisite for other statistics courses offered through F&ES, and it presents statistical methods used in many Yale courses in both the natural and social sciences. Three hours lecture. Jonathan D. Reuning-Scherer

F&ES 510Ea, Introduction to Statistics and Data Analysis in the Environmental Sciences 3 credits. An introduction to probability and statistics with emphasis on applications in forestry and environmental sciences. Includes methods of graphical analysis, introduction of common probability distributions, and hypothesis testing. The final third of the course introduces the topics of regression and analysis of variance that are

covered more thoroughly in F&ES 753a. There are weekly problem sets using MINITAB software, as well as a final project. This course is a prerequisite for all other statistics courses offered through F&ES, and it presents statistical methods used in many of the School's courses in both the natural and social sciences. This course is taught in a flipped classroom approach. Enrollment limited to thirty. Jonathan D. Reuning-Scherer

F&ES 515a, Physical Sciences for Environmental Management 3 credits. This Foundations course seeks to provide students with the physical science basics that they need in order to understand and manage environmental problems. The course draws on the disciplines of climatology, environmental chemistry, geology, hydrology, meteorology, oceanography, and soil science. Focus is on understanding both the underlying concepts and how they apply to real-world environmental challenges. Useful both as a freestanding course and as a gateway to a wide spectrum of intermediate and advanced courses. Shimon C. Anisfeld

F&ES 520a/ANTH 581a, Society and Environment: Introduction to Theory and Method 3 credits. An introductory course on the scope of social scientific contributions to environmental and natural resource issues. Section I, overview. Section II, initial framing of environmental problems: placing problems in their wider political context, new approaches to uncertainty and failure, and the importance of how the analytical boundaries to resource systems are drawn. Section III, questions of method: the dynamics of working within development projects, and the art of rapid appraisal and short-term consultancies. Section IV, local communities, resources, and (under)development: representing the poor, development discourse, and the question of indigenous peoples and knowledge. There are two guest lectures by prominent scholars in the field. No prerequisites. This is a Foundations course in F&ES, a core course in the combined F&ES/Anthropology doctoral degree program, and a prerequisite for F&ES 869/ANTH 572. Three hours lecture/seminar. Michael R. Dove

[**F&ES 525a, The Politics and Practice of Environmental and Resource Policy** 3 credits. The purpose of this Foundations course is to provide a survey of public policy theory and practice, as related to development and implementation of environmental and natural resource policy. The course examines theories of policy formation; the intricacies of the policy-making process; the history of natural resource and environmental policy; and applied techniques in policy analysis and evaluation. The course has been specifically designed to provide both a theoretical and practical introduction to natural resource and environmental public policy. Upon completion of the course, the student will understand the political environment within which public policy is formulated, including the role of ideas, science, and learning. Students also will be able to demonstrate basic technical competence in environmental public policy development and the implementation process. The course has been developed to accommodate biologists and other natural scientists and assumes no prior knowledge of political science or the policy-making process. Benjamin W. Cashore]

F&ES 530a, Ecosystems and Landscapes 4 credits. This Foundations course is an introduction to concepts in ecosystem and landscape ecology. Topics covered include element cycling, food web interactions, species-area relationships, whole system metabolism,

models of biodiversity, etc. The course emphasizes how to integrate knowledge to understand ecological patterns and processes at multiple scales in order to study, manage, and conserve species and ecosystems. Mark A. Bradford, Peter A. Raymond

F&ES 540a, Global Environmental Governance 3 credits. This course provides an overview of global environmental policy and the management of long-term environmental policy challenges. Concepts include international negotiations, compliance, and effectiveness, while the empirical domains encompass the three major global conventions on climate change, biodiversity, and desertification. Using a portfolio approach to examinations, students prepare a range of individual and group assignments. Detlef F. Sprinz

Professional Skills Courses

F&ES 576b, PSC: Collaboration, Negotiation, and Meeting Facilitation 1 credit. Public decision making takes place in an increasingly complicated and challenging policy-making environment. Decision-making processes need to accommodate complex issues and a crowded and diverse field of stakeholders, all of whom seek a voice in the decision-making process. Process management skills are among the unsung and often untaught skills required by people working in environmental management and public policy. These skills include knowing whom to include when working on a tricky topic; planning and running good meetings; developing strong coalitions; assessing disputes well, then building sound public processes based on what you learn; and determining when it might be helpful to have additional neutral support to assist you in resolving a complex public dispute. This course introduces students to some of the key concepts behind when and how to engage the public or key stakeholders in a productive way to address important environmental and public policy topics. The three six-hour sessions each include presentations, small-group exercises or simulations, and large-group discussion of student and trainer experience. Course content is designed around real-world situations from the instructor's experience as an impartial public issues mediator and facilitator. Meeting dates to be determined. Enrollment limited to twenty-five. Ona Ferguson

F&ES 577b, PSC: Environmental Communicator 1 credit. This course prepares students for the communication tasks they will face as environmental professionals, researchers, or employees. In their careers, most professionals spend more than half their work time communicating with others, both inside and outside their organization. To advance in their careers and contribute to the progress of an environmental cause, students need a refined ability to communicate their ideas with clarity and credibility. This course focuses on building a constellation of skills that students can apply to their work. They learn how to use communication to influence others, advocate their ideas, and collaborate with colleagues on project teams. Course topics include strategy in communication, diplomatic language, public speaking, writing styles, listening to people, and framing environmental issues for the public. The course meets for a weekly two-hour lecture and demonstration, and students attend a one-hour small-group practice session that allows them to reinforce new communicative behaviors in simulated job tasks, such as project meetings, budget requests, and public hearings. Meeting dates to be determined. Enrollment limited to forty-five. William A. Vance

F&ES 578a, PSC: Financial Concepts for Environmental Managers 1 credit. This course exposes students to the financial concepts used by companies to make and evaluate business decisions. The class covers key financial statements of for-profit businesses; building financial projections for a business, project, or investment; financial markets: what they are and how they operate; investors: the tools they use to evaluate potential investments; and common valuation techniques: uses and limitations. Meeting dates to be determined. Enrollment limited to sixty. Maureen Burke

F&ES 581a, Multifunctional Carbon-Sequestering Agroforestry 1 credit. This course examines carbon-sequestering agriculture practices and their potential to provide solutions to a range of social and environmental problems from climate justice to land degradation. It introduces a global toolkit of practices old and new, and profiles promising plant species. A key group of species explored is perennial staple crops, a group of trees and other long-lived plants providing protein, carbohydrates, and fats for human consumption. We explore industrial ecological applications of perennial crops for materials, chemicals, and energy. While many tropical species and systems are already implemented on a large scale, the course also closely views cold-climate developments. Students are introduced to the farm business planning challenges of production in regenerative integrated systems. Diverse strategies for implementation are presented, including policy, grassroots, and consumer-driven options. Local field trips explore temperate agroforestry, perennial crops, and organic no-till systems. Eric Toensmeier

Integrative Frameworks

F&ES 610a, Science to Solutions 3 credits. While there are many different approaches to understanding and managing complex environmental problems, most involve several major steps: (1) describing/understanding the nature of the problem and its causes (both biophysical and human); (2) using technical, policy, social, and other management tools/processes to help address it; while (3) recognizing/making the value judgments embedded in each (what problems/data are "important"? what solutions are "best"?). The purpose of this course is to illustrate how one might integrate scientific understanding with management choices as part of an effort to manage any particular system over time. It focuses on how to use the broad range of scientific analyses, data, and insights and place them into the context of how they inform problem solving. The interface of science with policy, law, community empowerment, business and economics, and most importantly decision making is the theme that runs through the course. The term-long case study that acts as the organizing framework for the course is toxic chemicals. After receiving essential fundamental facts about the current chemicals management framework, student teams prepare and present "briefing papers" on a toxic of their choosing (e.g., Atrazine in agriculture, Bisphenol A in plastics, brominated flame retardants, phthalates, etc.), including functional uses, toxicology, environmental justice, and governmental regulation, and how and why our current system to design, commercialize, and manage chemicals has failed. These briefings provide the basis of the final phase of the course, which includes the construction of formal recommendations on how to innovate a sustainable chemicals future. This course is intended for people of all backgrounds, from basic to advanced levels of scientific understanding. Preference given to first-year M.E.M. students. Julie B. Zimmerman, Paul T. Anastas

[**F&ES 620a, Integrative Assessment** 3 credits. This course illustrates how to integrate the insights and models of different disciplines to address key environmental management questions facing society. Examples are drawn from across pollution and natural resource issues so that students can become familiar with a diverse set of issues. The course illustrates the merits of learning about the natural sciences, engineering, and economics in order to practice environmental management. Robert O. Mendelsohn]

Capstone

F&ES 953a or b, Business and the Environment Consulting Clinic 3 credits. In this class, students work as a team on a specific project for an external organization. It provides students with an opportunity to apply their knowledge of business and environmental issues to real-life situations. It also provides a unique opportunity for students to manage a real-life client consulting engagement. Examples of projects include (1) developing a sustainability reporting strategy for a company; (2) assessing water risk in a company's supply chain; and (3) recommending operational improvements around energy usage, waste disposal, etc. The intent is to provide a "capstone" experience, calling for the application of skills and tools learned from previous classes. Class sessions consist of a mix of in-class lectures, team meetings with the instructor, and guest lecturers. Lectures address topics such as project management and business strategy. Guest speakers discuss various environmental and sustainability topics such as sustainability reporting and environmental certifications and labeling. Prerequisites for F&ES students applying to the clinic are at least one of the following courses (or equivalent experience): F&ES 578, 680, 807, 821. Enrollment limited to twenty-four. Maureen Burke

F&ES 954a, Management Plans for Protected Areas 6 credits. A seminar that comprises the documentation of land use history and zoning, mapping and interpretation, and the collection and analysis of socioeconomic, biological, and physical information for the construction of management plans. Plans are constructed for private smallholders within the Quiet Corner Initiative partnership managed by the Yale School Forests. In the past, plans have been completed for the Nature Conservancy; Massachusetts Trustees of Reservations; town land trusts; city parks and woodlands of New Haven, New York, and Boston; and the Appalachian Mountain Club. Prerequisite: F&ES 659 or permission of the instructor. Ten days fieldwork. Enrollment limited to twenty. Mark S. Ashton

F&ES 955a or b, Seminar in Research Analysis and Communication in Forest Ecology 3 credits. Students work through the peer-review publication process on data sets and projects in applied forest ecology. Discussions involve rationale and hypothesis testing for a project, data analysis techniques, reporting and interpretation of results. It is expected that manuscripts developed in the course are worthy of publication and that oral presentations are of a caliber for subject area conferences and meetings. Prerequisite: F&ES 659 or permission of the instructor. Three hours lecture. Enrollment limited to twelve. Mark S. Ashton

F&ES 958b, Interdisciplinary Strategies for Real-World Environmental Problem Solving 3 credits. Natural resource and environmental challenges have become increasingly complex. Solving them requires environmental leaders who understand the scientific,

social, economic, legal, and political factors at play; have the capacity to develop comprehensive strategies to effectively address them; and can communicate their solutions to diverse audiences. This capstone course is designed to challenge students to apply the disciplinary and interdisciplinary knowledge and professional skills they have developed to real-world natural resource and environmental problems. Students work in teams with clients from the public and private sectors on contemporary national and international natural resource and environmental issues. Client projects challenge students' ability to formulate science-based, integrated, and comprehensive solutions to complex problems as well as strategies for their implementation. Students are required to present their findings and recommendations to clients in a clear and convincing manner and demonstrate their ability to communicate the outcomes of their work to target audiences (which may include the public, policy makers, stakeholders, and/or the media). James R. Lyons

F&ES 961b, Entrepreneurial Venture Creation 3 credits. Entrepreneurship is all about starting and running your own business. Before starting a business, entrepreneurs must research the viability of their business and develop a strategy for executing the business. While the steps for doing this are often the same, regardless of the business, the *specific* issues and areas for investigation usually depend on the type of business and the industry it is in. This course offers students the opportunity for personalized coaching and feedback on their individual business concept. The course is for up to four teams of *three to four* students each, who want to pursue their own new start-up venture. Ventures must have the potential to be eligible for F&ES's annual Sabin Prize or one of the other annual business venture competitions hosted across the University. This means they should have the potential to grow big by solving a large problem in a unique and feasible way. The scope of the work includes: (1) doing in-depth market, product, and competitor research; (2) creating a strategy for a viable business; (3) developing a financial model; (4) writing a professional-quality business plan; (5) developing an "investor pitch" presentation. There is an application process, and admission is by permission of the instructor. Meeting dates to be determined. Maureen Burke

[**F&ES 964b, Large-Scale Conservation: Integrating Science, Management, and Policy** 3 or 6 credits. Environmental sustainability and human dignity are important societal goals, but figuring out how to achieve them on large scales—geographic, temporal, and in terms of complexity—has proven to be extremely challenging. Abundant trend data show that many species, ecosystems, and other environmental and human systems are being overused, stressed, or degraded, thus undercutting the likelihood that we can reach sustainability and human rights for all. In addition, our institutions for science, management, and policy are not designed to address sustainability challenges on these scales. Over the last few decades numerous management and policy initiatives have been put forward to address large-scale resource use, including single and multiple use, parks and protected areas, ecosystem management, bioregional planning, integrated conservation and development, transboundary approaches, and adaptive governance. This course (a mixed seminar and practicum) explicitly uses an integrative (i.e., via interdisciplinary) framework to examine the conceptual and contextual basis for these efforts; compares and contrasts their scientific, management, and policy components; explores themes of leadership, problem solving, decision making, governance, change, and learning; and

surveys cases from three arenas (terrestrial, aquatic, and marine). The course takes a problem-oriented, contextual, and multi-method approach that offers students conceptual, practical, and professional benefits. It includes readings, lectures, discussions, workshops, exercises, oral presentations, guest speakers, individual and small-group assignments, and possibly a field trip and group project. In past years the course has taken field trips to the Connecticut River system to evaluate region-wide conservation efforts, the Greater Yellowstone ecosystem, and the Grand Canyon ecosystem. It also organized an international workshop focused on the Yellowstone to Yukon initiative, and assisted a major U.S. NGO plan for transboundary projects along the U.S.-Canadian border. Extensive student participation is required throughout. Enrollment limited to eighteen. Susan G. Clark]

F&ES 965b/ANTH 598b, Advanced Readings: Social Science of Conservation and Development 3 credits. This course is an advanced seminar on the social science theory of conservation and development, designed as an M.E.M. capstone course and to give M.E.Sc. and doctoral students a wider theoretical context for analyzing and writing up their research. The course traces the conceptual history of the social science theory of conservation and development, focusing on theories of power, governmentality, subject creation, and the economy. It examines relations between these theories, alternative theories, and how this history influences the field. The course covers the works of Michel Foucault most relevant to the field, important social scientists who have used Foucault's ideas (e.g., Timothy Mitchell, Tania Li, Donald Moore, David Mosse, Anand Pandian), alternative theories of power (e.g., James Scott, Bruno Latour, Timothy Mitchell), applications of Foucault's ideas to development (James Ferguson, Arturo Escobar), applications of Foucault's ideas to the environment (especially Arun Agrawal, Bruce Braun, Eric Darier), theories of the economic subject (Peter Miller and Ted O'Leary, Anna Tsing, Katherine Rankin), Foucault on the economy and neoliberalism, the power of the economy in Tania Li, theories of resistance and counter-conduct (Foucault, Carl Death, James Scott), and Foucault and space. Students are expected to use the course to develop, and present in class, their own research and writing. Prerequisite: F&ES 839, 877, or 882. Three hours lecture/seminar. Enrollment limited to twelve. Carol Carpenter

[**F&ES 966a, The Entrepreneurial Approach to Environmental Problem Solving** 3 credits. This course provides a format for students ready to develop entrepreneurial plans for specific environmental businesses. There are two aspects to any business: knowing the technical subject, and understanding the business environment. It is assumed that students have a background in both aspects, and this course is to enable the students to work in groups to "flesh out" a business. The course has regular meetings, but much of the work—and reporting—is done by the students, with advice and input from the faculty and others at Yale and in the business world. The course (and its prerequisite) may be used in conjunction with competing for the Sabin Prize. Prerequisite: F&ES 657. Chadwick D. Oliver]

[**F&ES 969b, Rapid Assessments in Forest Conservation** 3 credits. An advanced interdisciplinary course concerned with assessing the protection and management of biologically diverse, complex forested ecosystems that produce various goods and services. Examples of independent case analyses concern landscape management of biogeographic

regions in the Pacific Northwest, Ecuador, Costa Rica, Venezuela, Belize, central and southern Mexico, and the Panama Canal Watersheds. Students are encouraged to travel on extended class field trips to these regions. Prerequisite: F&ES 659 or permission of the instructor. Three hours lecture. Eight days fieldwork. Limited enrollment. Next offered spring 2018. Mark S. Ashton]

F&ES 970a or b/LAW 30164, Environmental Protection Clinic: Policy and Advocacy 3 credits. A clinical seminar in which students are engaged with actual environmental law and policy problems on behalf of client organizations (environmental groups, government agencies, international bodies, etc.). The class meets weekly, and students work ten to twelve hours per week in interdisciplinary groups (with students from the Law School and other departments or schools at Yale) on projects with a specific legal or policy product (e.g., draft legislation or regulations, hearing testimony, analytic studies, policy proposals, white papers, memos, etc.). Students may propose projects and client organizations, subject to approval by the instructor. Brief statement of interest required; please e-mail joshua.galperin@yale.edu for information. Enrollment limited to thirty. This course follows the Yale Law School academic calendar. Joshua Galperin, David Hawkins, Lisa Suatoni

F&ES 971b, Land Use Clinic 3 credits. This clinic explores a variety of specific community land use topics of current concern and relevance to the field, to the curriculum, and to society. Potential project topics include renewable energy, natural resources, rural-based land uses, agriculture, and sustainable urban planning. Students work with the instructor to develop papers, research memorandums, presentations, and publications on a selected topic. The instructor or guest speakers lecture on specific topics related to student projects. Additionally, students attend field trips relevant to the curriculum and may participate in project meetings with clients. Students select from a project list or meet with the instructor to design a relevant project. Jessica Bacher

F&ES 972a or b/LAW 30165, Advanced Environmental Protection Clinic 1–6 credits. Open only to students who have successfully completed Environmental Protection Clinic: Policy and Advocacy (F&ES 970). Permission of the instructor required. Enrollment limited to twenty. This course follows the Yale Law School academic calendar. Joshua Galperin, David Hawkins, Lisa Suatoni

F&ES 974a/LAW 30187, Environmental Protection Clinic: Practice at the Intersection of Civil Rights and Environment Law 4 credits. Students have the opportunity to help launch Yale Law School's new environmental justice clinic, which will be in its second term, and to develop a docket to improve environmental quality and public health in communities of color and low-income communities. In the wake of a national conversation about the water crisis in Flint and lead poisoning across the country, students will be in on the ground floor as the clinic takes on cases to address inequality in the distribution of health hazards as well as procedural inequities they face as they try to assert their own vision for the future of their neighborhoods, towns, and cities. The clinic's work includes cases and advocacy projects to enforce civil rights in the environmental context, and, in the new political climate, work with clients to develop legal and advocacy strategies to address issues of environmental injustice in particular communities. In addition to civil

rights compliance and enforcement in the environmental context, the clinic evaluates potential litigation and advocacy to address the sources and impacts of air and water contamination in disproportionately affected communities, with a focus on communities in Connecticut. Students also participate in a seminar intended to explore issues raised by the clinical practice, including both substantive issues of environmental and civil rights law, as well as questions related to practice, including ethical and social dimensions of lawyering in this context. The seminar meets approximately two hours per week. In addition to class meetings and preparation, students must complete and document approximately fifteen hours of clinical work per week. They are also expected to participate in two weekly one-half-hour team meetings. While there is no prerequisite for the clinic, participants should have a strong interest in working on behalf of environmentally overburdened communities — often communities of color and low-income communities. Limited enrollment. Permission of the instructor required. Non-Law students interested in the clinic should send a CV and one-page statement of interest to marianne.englemanlado@yale.edu. Marianne Engelman Lado

F&ES 975a/LAW 30206, Advanced Environmental Protection Clinic: Fieldwork: Practice at the Intersection of Civil Rights and Environmental Law 1 to 4 credits. Students have the opportunity to continue the development of Yale Law School's new environmental justice clinic and to develop a docket to improve environmental quality and public health in communities of color and low-income communities. In the wake of a national conversation about the water crisis in Flint and lead poisoning across the country, students will continue to be in on the ground floor as the clinic represents clients challenging inequality in the distribution of health hazards as well as procedural inequities they face as they seek to assert their own vision for the future of their neighborhoods, towns, and cities. The clinic's work includes cases and advocacy projects to enforce civil rights in the environmental context and to address issues of environmental injustice in particular communities. Students must complete and document hours of clinical work per week commensurate with their credit hours. They are also expected to participate in weekly one-half-hour team meetings. Previous participation in the environmental justice clinic is a prerequisite for Advanced Fieldwork. Permission of the instructor required. Open only to students who completed the spring clinic. In addition to listing this clinic among experiential course selections, previous EJ Clinic students should submit a short statement expressing continued interest in the clinic to marianne.engelman-lado@yale.edu by June 22 at 4:30 p.m. Only F&ES students who receive 3 credits or more for this advanced clinic can count it as a capstone course. Marianne Engelman Lado

[**F&ES 976b, Cities in Hot Water: Urban Climate Mitigation and Adaptation** 3 credits. This capstone class works in partnership with the City of New Haven to analyze and make recommendations for how city planners and engineers should cope with heat stress and extreme rainfalls in current and future climate conditions. Higher temperatures and larger rainfall variability are the two most severe climate stresses predicted to impact the Northeastern part of the United States. The situation is worsened in urban centers owing to the urban heat island effect and concentrated stormwater runoff. Students are divided into teams, with each team consisting of members with complementary skills. Each team works closely with city partners, as well as staff in the Yale Office of Sustainability, the

Community Alliance for Research and Engagement in the School of Public Health, and the Urban Resources Initiative in F&ES. Specific tasks include inventorying the efforts already under way in New Haven to prepare for changes in climate; reviewing existing urban climate strategies in major cities around the world; quantifying the likely range of severity of future climate stresses in the New Haven region; and identifying the impacts of these stressors on the lives of local residents. The final deliverables are designed to be helpful to the climate-related planning by the City of New Haven. Students may also have the opportunity to participate in field implementation of one or more mitigation actions. Assessment of student performance is based on class participation, class presentations, writing assignments, client feedback, and peer evaluations. Enrollment limited to twenty. Xuhui Lee, Bradford S. Gentry]

F&ES 977a, Creating Science Narratives for Solutions 3 credits. This course surveys, studies, and practices strategies toward effective climate and environmental science-based messaging with an eye toward public policy engagement and public interest. Students learn of new and emerging interdisciplinary research and theory in narratology, psychology, education, and cultural, social, and media sciences to help build skills they then practice in partnership with professional stakeholders on projects related to climate and energy policy, goals, and planning across the public and private sectors. Paul Lussier

Ecology

COMMUNITY AND ECOSYSTEM ECOLOGY

F&ES 634a, Ecology of Global Drylands 3 credits. This course explores the controls on the geographic distribution, community and ecosystem structure, and functioning of drylands globally. Lectures, writing, and student-led discussions. William Lauenroth

F&ES 681a, Ethnobotany 3 credits. Ethnobotany is the scientific study of mutual relationships among peoples, plants, and the environment. This course presents ethnobotany as a broad interdisciplinary field at the interface of anthropology and botany and discusses its methodology, ranging from plant inventories to multivariate analysis of plant knowledge. The course focuses on classic themes of interest to ethnobotany, such as the importance of plants for local livelihoods (including nutrition and medicine) and the ethnobotanical importance of selected plant families, but it also explores topics of current ethnobotanical investigation, such as urban ethnobotany, intellectual property rights, development cooperation, biocultural diversity, and conservation. The course topics have been selected to provide an all-round overview of how ethnobotany research has evolved over the past decades and to represent a well-rounded mix of theory and practice, with the aim to prepare an aspiring junior ethnobotanist for field research. Ina Vandebroek

F&ES 717b, Tropical Field Ecology 3 credits. This course is designed to give students firsthand knowledge of tropical biology and the issues surrounding conservation of biodiversity in a developing nation, through a combination of seminar-style discussions and a mandatory field trip over winter break. The emphasis is on active learning and developing independent research projects carried out during the field trip. Using a case-study approach, topics covered include patterns of biodiversity, tropical forest dynamics, reforestation, species interactions and coevolution, climate change impacts, ecosystem

services, and human land use. Students also gain experience with study design, data collection methods, and statistical analysis. This year's field trip is to Panama, a country famous for its high biological, cultural, and economic diversity. We visit a variety of forest ecosystems and hear from local and international scientists about current research in the field. Students undertake two short research projects and also learn basic identification and natural history of tropical plant, bird, and insect species. Students should expect to spend a major part of each day outside in the natural tropical environment under adverse conditions. Enrollment limited to fifteen, with priority given to students who have taken F&ES 725. Liza S. Comita, Simon A. Queenborough

F&ES 723a, Wetlands Ecology, Conservation, and Management 3 credits. Wetlands are ubiquitous. Collectively they cover 370,000 square miles in the United States and globally encompass more than five million square miles. Most points on a map are less than one kilometer from the nearest wetland. Yet wetlands are nearly invisible to most people. In this course we explore wetlands in all of their dimensions, including the critical services they provide to other systems, the rich biodiversity they harbor, and the links by which they connect to other systems. Additionally, wetlands are lynchpin environments for scientific policy and regulation. The overarching aim of the course is to connect what we know about wetlands from a scientific perspective to the ways in which wetlands matter for people. L. Kealoha Freidenburg

[**F&ES 731b, Tropical Field Botany** 3 credits. This course teaches students how to identify the most important tropical plant families, with an emphasis on woody taxa. Students learn key characteristics for identification. We concentrate on families that have high economic, ecological, or ethnobotanical importance. We also discuss distribution, habitat, and ecology. The course has a strong practical component, and instructors emphasize vegetative characters to identify families and higher-level taxa. The course includes a two-week field trip to Costa Rica over spring break. Enrollment limited to twelve. NYBG Faculty: Lawrence Kelly, Fabian Michelangeli]

[**F&ES 733b, Synthesizing Environmental Science for Policy** 3 credits. A seminar exploring science-based environmental policy in order to direct scientific synthesis as well as new research that meets the criteria for policy relevance. The seminar involves two discussions each week and relies on concepts and data from ecological and biogeochemical disciplines to predict and manage the impacts of environmental changes, such as invasive species and changing climate, on supporting ecosystem services that underlie the provisioning of resources such as food and clean water. Prerequisites: F&ES 500 and 515, or permission of the instructor. Mark A. Bradford]

F&ES 734b, Biological Oceanography 3 credits. This natural science course provides a foundation for those interested in the ecology and management of marine systems. It includes an exploration of a range of coastal and pelagic ecosystems as well as relationships between biological systems and the physical processes that control the movements of water and productivity of marine systems. The course also covers anthropogenic impacts on oceans, such as the effects of fishing and climate change. Includes up to three Friday field trips. Recommended prerequisite: college-level biology or ecology course. Three hours lecture. Enrollment limited to fifteen. Mary Beth Decker

[**F&ES 741b, Introduction to Indigenous Silviculture** 3 credits. The course examines small-holder management systems in the tropics from several different perspectives. A brief overview of tropical forest ecology is provided first, with an emphasis on the factors that limit the nature and intensity of resource use. An analysis of silviculture as applied forest ecology follows, together with a description of the major silvicultural systems employed commercially throughout the world. The distinct operational and contextual differences between conventional and indigenous forms of forest management are presented, and the three main types of indigenous silvicultural practice are defined and described in detail. Examples from Asia, Central America, South America, and Africa are provided to illustrate each system. The relative economic, social, and ecological benefits of community forest management are discussed in detail, and the major constraints to a greater acceptance and application of the "conservation through sustainable use" paradigm are highlighted. A selection of case studies is used to examine existing policies that regulate the use, management, and trade of forest resources by local communities. A final lecture and discussion weave together these themes to assess the overall potential of managed landscapes as a viable conservation strategy. Charles M. Peters]

F&ES 752a, Ecology and Conservation of Tropical Forests 3 credits. Tropical forests contain extraordinarily high biological diversity and provide critical ecosystem services, yet are being rapidly destroyed and degraded by human activities. This course focuses on the structure, function, and diversity of intact and degraded tropical forests, with an emphasis on the ecological processes that shape these unique and diverse ecosystems. We also discuss the major threats to tropical forests, as well as examples of tropical forest recovery following disturbance. The course involves a mix of lectures and student-led discussions. Students who successfully complete this course are given priority for Tropical Field Ecology (F&ES 717). Liza S. Comita

F&ES 768b, Pests, Pathogens, and Parasites in Natural and Managed Systems 2 credits. Insect and microbial natural enemies play an integral role in shaping ecological communities, but receive much less attention than more charismatic megafauna. In this seminar, we discuss the good, the bad, and the truly disgusting. Weekly meetings focus on student-led discussions of recent scientific articles. Topics include parasites as indicators of ecosystem health; climate change and insect herbivore outbreaks in temperate forests; the role of pathogens in maintaining tropical forest diversity; disease spillover between natural and managed systems; how escape from enemies contributes to the success of invasive species; emerging infectious diseases in wildlife; and parasitic mind control. Students gain a better understanding of species interactions in ecological communities and the importance of considering those interactions when making conservation and management decisions. Liza S. Comita

WILDLIFE ECOLOGY AND CONSERVATION BIOLOGY

[**F&ES 736b, Ecology Seminar** 1 credit. The ability to read and understand the literature is a critical skill. This seminar is structured to encourage participation in discussions of papers from the ecological literature. The specific papers to be read vary from year to year; however, each year we focus on papers that have made major contributions to the conceptual foundations of ecology. Many of the papers have direct or indirect relevance to

applied issues such as the conservation of species and ecosystems. Seminar responsibilities include active participation in weekly meetings and the leadership of one discussion. David K. Skelly]

[**F&ES 738a, Aquatic Ecology** 4 credits. An intensive introduction to the ecology of populations and communities in freshwater systems. The aim of this class is to learn the concepts, patterns, and organisms important in lakes and streams along with the major techniques of information collection and analysis. Weekly field trips are used to gather data that form the basis of lab exercises and research projects. The course presumes familiarity with ecological concepts and terminology. Permission of the instructor required. David K. Skelly]

[**F&ES 739b, Species and Ecosystem Conservation: An Integrated, Interdisciplinary Approach** 3 credits. The loss of global biodiversity is a major problem with profound repercussions for present and future human generations. Professional conservationists now living are the last generation that can prevent the extinction of large numbers of species and the disruption of large-scale ecosystem processes. Professionals must not only apply relevant conservation sciences to these problems, but also bring to bear explicit knowledge about the real-world organizational and policy settings in which they will work and expert skills in influencing those systems. The course combines the problem-solving approaches of the conservation sciences with those of the policy sciences by surveying a range of policy and organizational contexts, theories, techniques, and professional settings using a variety of case studies. We typically have guests who focus on contemporary challenges and offer successful cases from their own experience. Students learn an interdisciplinary analytic framework and apply it to a case of their choice. The role and problem-solving styles of the individual professional in these complex contexts are emphasized. Students must keep a journal. Active student participation is required, as well as a presentation and a paper. The course helps students gain a very important skill set for problem solving and positions students to work for many nongovernmental, governmental, and business organizations, assuming leadership and problem-solving positions. Enrollment limited to sixteen; application required. Susan G. Clark]

[**F&ES 740b, Dynamics of Ecological Systems** 3 credits. The course provides students in-depth understanding of theory on multiple species interactions and dynamics including predation, competition, food chain, and food web interactions. Considerable emphasis is placed on mathematical modeling to formalize ideas about how species interactions structure ecological communities and to specify the appropriate focus of empirical research, study design, and data gathering. The course addresses contemporary issues in community and ecosystem ecology including scaling from individual behavior to community and ecosystem dynamics, the link between biodiversity and system stability, alternative dynamic regimes, spatially extended systems, and metacommunities. A course in calculus is recommended. Oswald J. Schmitz]

F&ES 744b, Conservation Science and Landscape Planning 4 credits. This advanced course applies ecological principles to understand and manage biodiversity and attendant ecosystem functioning and services in the anthropocene. The course addresses the ethical and functional basis for conservation and fosters thinking about why and how humans

ought to share the planet with nonhuman life. It covers scientific principles such as evolution, life-history and the viability of species, species endangerment and extinction risk, the kinds of biodiversity, the spatial distribution of biodiversity, the functional roles of species in ecosystems, vulnerability and risk assessments, and valuing biodiversity and ecosystem services. The course applies these principles to the exploration of such topics as biodiversity's role in the functioning and sustainability of ecological systems, restoration of environmental damages, conserving biodiversity in dynamic landscapes, adapting landscapes to climate change, balancing conservation with urban development and agriculture, and renewable energy siting. It provides students with the quantitative skills to conduct population viability analyses, geospatial analyses of the distribution of biodiversity across landscapes, vulnerability analyses, and decision-analysis to balance trade-offs among multiple objectives of human land development and biodiversity conservation. Prerequisites: F&ES 530 or equivalent course in population or community ecology, F&ES 755 or equivalent course in GIS, and F&ES 510 or equivalent course in statistical analysis of biological data. A course in economics or applied math for environmental studies is strongly encouraged. Oswald J. Schmitz

ENVIRONMENTAL EDUCATION AND COMMUNICATION

F&ES 742b, Fundamentals of Working with People 3 credits. Using environmental science to help inform and change human actions is a key challenge for environmental managers. Doing so requires that professionals be able to work across different scales, including: (1) understanding their own values and ways of working, as well as those of others; (2) forming, working in, and leading teams reflecting a diversity of experiences and skills; (3) influencing the actions of the organizations within which they are working; and (4) building and managing collaborative networks with others in other organizations affecting the resource systems about which they care. The purpose of this course is to introduce students to the scholarship being done (mostly within management fields) on how best to make these connections, as well as the ways individuals are putting those lessons learned into action. The course also introduces students to the professors, individual courses, workshops, and other offerings across Yale that offer deeper dives into specific approaches to working more effectively with people. Stuart DeCew, Bradford S. Gentry

F&ES 745a, Environmental Writing 1 credit, half term, or 3 credits, full term. Students in this course should plan to produce one full-length article, 3,000 to 4,000 words, that could appear in a wide-circulation magazine such as *Audubon, Orion, Sierra,* or *The New Yorker*. One-credit students begin a potentially publishable article; three-credit students complete a publishable article. Admission is by application, which must include a proposed writing topic, at the beginning of the term. For information on applying, please see the course information at http://fes745.coursepress.yale.edu. Three hours seminar and writing workshops. Enrollment limited to fifteen. Fred Strebeigh

F&ES 747a, Global Communication Skills 3 credits. This course helps students to sharpen their language and strategy in professional communication. Course topics include accent reduction, language accuracy, writing styles, presentation skills, meeting leadership, barriers to communication, and types of persuasion in multicultural contexts.

We first address aspects of intelligibility, exploring how improved word choices and speech clarity affect audience understanding. We then look at the problem of comprehension and discuss strategies for increasing the student's ability to listen accurately and read efficiently. We also examine common difficulties and cultural differences in the arrangement of information, use of evidence, and academic argumentation. Several sessions are devoted to specific skills, such as negotiating agreements and writing research reports. The course meets for lecture (two hours), and students attend a weekly small-group practicum (one hour). The practicum allows students to reinforce new communicative behaviors in oral and written assignments, while receiving feedback from peers and the instructor. As students polish their skills, they improve their ability to express ideas and to interact in both academic and professional contexts. Enrollment limited to fifteen. William A. Vance

F&ES 750a, Writing the World 3 credits. This is a practical writing course meant to develop your skills as a writer. But its real subject is perception and the writer's authority—the relationship between what you notice in the world around you and what, culturally speaking, you are allowed to notice. What you write during the term is driven entirely by your own interest and attention. How you write is the question at hand. We explore the overlapping habitats of language—present and past—and the natural environment. And, to a lesser extent, we explore the character of persuasion in environmental themes. Every member of the class writes every week, and we all read what everyone writes every week. It makes no difference whether you are a would-be journalist, scientist, environmental advocate, or policy maker. The goal is to rework your writing and sharpen your perceptions, both sensory and intellectual. Enrollment limited to fifteen. Verlyn Klinkenborg

F&ES 900a, Doctoral Student Seminar and Responsible Conduct of Research 3 credits. This course provides an introduction to doctoral study at the School of Forestry & Environmental Studies. Students attend the F&ES Wednesday seminar each week and then meet with the seminar speakers after their presentations. Weekly assigned readings support these discussions, which are used as a foundation to explore diverse approaches to formulating and addressing research questions. Students also work with their advisers to design an assignment to be completed during the term. Students may choose to write and submit a fellowship application (e.g., to NSF, NASA, EPA), carry out a literature review, or develop a collaborative research project. Students present their embryonic research ideas in class and use feedback from the group to further develop their ideas. The course also introduces the topic of research misconduct with examples of specific cases. Concepts and resources for responsible conduct of research are discussed in the areas of data acquisition and management, authorship and publication, peer review, conflicts of interest, mentoring, collaborative research, and animal and human subjects research. Required of all doctoral students in their first term. Karen Seto

F&ES 902a or b, Environmental Anthropology Research Lab 1 credit, pass/fail. A biweekly seminar for Dove doctoral advisees and students in the combined F&ES/Anthropology doctoral degree program. It consists of the presentation and discussion of dissertation prospectuses and proposals, dissertation chapters, and related publications;

collaborative writing and publishing projects on subjects of common interest; and discussion of such topics as grantsmanship, data analysis, writing and publishing, and the job search. Two-hour seminar. Michael R. Dove

F&ES 910b, Survival Skills for Finishing Doctoral Students 3 credits, pass/fail. This course is aimed at preparing advanced doctoral students for successful and rewarding careers in ecology and environmental science. Students learn about academic and non-academic careers from readings of and presentations by scientists in those positions. Students identify important steps toward planning and launching their career paths, and skills for being effective in these positions; and they develop their own career plan, curriculum vitae, teaching and research plans, and critiques of professional Web pages. Finally, the course exposes students to resources and opportunities for continuing to apply and polish their skills. William Lauenroth, Ingrid C. Burke

Forestry

FOREST BIOLOGY

F&ES 652b, Wood: Structure and Function 3 credits. This course focuses on the extraordinary diversity of wood anatomy at the cellular level, and on the practice of dendrochronology that allows students to take advantage of predictable, inter-annual variability in tree growth to reconstruct environmental history. The primary focus of the course is on common northeastern trees and other commercially important timber species. A primary goal is to participate in the development of a master tree-ring chronology for the School forests. Basic statistics and a background in tree physiology and anatomy are strongly recommended. Craig R. Brodersen

F&ES 654a/MCDB 660a, Anatomy, Physiology, and Development of Trees and Other Vascular Plants 3 credits. This course focuses on two aspects of plant life: (1) basic processes that drive plant development, such as seed formation, germination, seedling establishment, maturation, and senescence; and (2) basic structure and function of plants (such as root systems, leaf formation and development, height, and diameter growth). Differences between different groups of seed plants are analyzed from structural, functional, ecological, and evolutionary standpoints. Special attention is given to woody plants and their importance in the biosphere and human life. Coverage includes tropical, temperate, and boreal trees. Plant biology is discussed in the context of physiological and structural adaptations in terms of strength, storage, and water and solute transport. Graeme P. Berlyn

[**F&ES 655b, Research Methods of the Anatomy and Physiology of Trees** 4 credits. Advanced investigative techniques with emphasis on instrumentation, experimental design, execution, and analyses. After a series of class experiments and demonstrations are completed, each student selects a personal project under the direction of the instructor and prepares a minidissertation complete with literature review, materials and methods, results, and discussion. Weekly seminars and progress reports on the projects are required. Prerequisites: F&ES 654 and 656 and permission of the instructor. Four hours lecture/laboratory. Limited enrollment. Graeme P. Berlyn]

F&ES 656b, Tree Physiology and Ecophysiology 3 credits. Mineral nutrition and cycling, mycorrhizas, symbiosis, nitrogen fixation, light processing, photosynthesis, respiration, water relations including transpiration, and ecophysiology are covered. The interaction of photosynthesis with water relations, mineral nutrition, temperature, and environmental stress is discussed. Effects of climate changes on forests, past and present, and other current topics are also considered. Term paper required. Graeme P. Berlyn

F&ES 671a, Temperate Woody Plant Taxonomy and Dendrology 3 credits. Dendrology literally translates as "the study of trees" and integrates morphology, phenology, ecology, biogeography, and the natural history of tree species. In this course students learn how to identify the major temperate plant families, with a focus on North American forest species. In addition, they learn the morphological and ecological traits used for field identification of woody plants. We use phylogenetic systematics as the structure for understanding the evolutionary history and relationships between species. Enrollment limited to thirteen. Marlyse C. Duguid

F&ES 674b, Seminar in Forest Health 3 credits. This course is an introduction to the biotic and abiotic agents affecting the health of forest ecosystems and forest sustainability, including insects, pathogens, parasites, climate change, and other large-scale disturbances, and includes the consideration of linkages between forest health and human health. Using a case-study approach, several different forest types are examined in detail, with students interacting with research and management professionals who visit the class in person or via remote conferencing. Students learn concepts and methods of assessing forest health, as well as some of the challenges in describing and defining forest health. The course emphasizes the ecological roles played by disturbance agents (both biotic and abiotic), discusses how they affect the health and sustainability of forest ecosystems, and identifies when and how management can be used to improve forest health and/or forest sustainability to manage or mitigate disturbance agents such as invasive pathogens and insects. The course provides students with the necessary background to determine how different stressors may negatively impact management objectives, to identify the probable stress agents, and to decide what, if any, actions should be initiated to protect forest health and sustainability. The course includes several field trips and workshops on the weekends. Mark S. Ashton, Talbot Trotter III

F&ES 679a, Plant Ecophysiology 3 credits. This course focuses on the physiological ecology of plants and their interaction with the biotic and abiotic environment, understood through the lens of first principles. We use a quantitative approach to demonstrate the linkages between photosynthesis, growth, and carbon allocation at the tissue and whole plant level, which can then be scaled up to forests and ecosystems. We also focus on specific physiological and anatomical adaptations plants use to survive in the many varied habitats on Earth. The laboratory component of this course (F&ES 679L) involves the theory, programming, and deployment of micrometeorological equipment to monitor environmental conditions in the field; as well as methods for measuring photosynthesis and growth in the greenhouse and field. Craig R. Brodersen

F&ES 679La, Lab: Plant Ecophysiology 1 credit. Craig R. Brodersen

F&ES 691b, Trees: Environmental Biology 3 credits. Underlying principles that govern tree biology in both time and space. Water transport, nutrient uptake, photosynthesis, growth, and reproduction from individual plant organs to the tree and forest canopy. Principles of cells and membranes; the fundamental differences between plant and animal cells; regional and global patterns in forest dynamics; implications of disruptions in the biotic and abiotic environment. Case studies focus on understanding forests and forest products and their global significance, including building materials, furniture, and musical instruments. Craig R. Brodersen

FOREST MANAGEMENT

[**F&ES 657b, Managing Resources** 3 credits. Resource sustainability requires knowing how to "get things done" with resources, whether one's goal is policy, investment, or on-the-ground management. The challenge of resource management is knowing how to provide the many commodity and noncommodity objectives people demand from the terrestrial ecosystems across time and space. This management can be cost-effective and applicable to many places with the proper integration of management and social scientific knowledge. Students master the scientific basis, methods (and reasons for the methods), and techniques for management of various resources. The course covers managing an ecosystem with concerns about water, agriculture, grazing, wildlife, timber, recreation, people, and hazards of wind, fire, avalanche, and flood. The class examines the basic issues and describes tools and techniques for analyzing and managing. Case studies of specific areas are used for many of the analyses. The course covers systems concepts; decision analysis; area, volume, and other regulatory systems; silvicultural pathways; growth models; wind and fire hazard analyses; habitat and biodiversity analyses; carbon sequestration; payment for ecosystem services; cash flow; operations scheduling; portfolio management; monitoring; and continuous quality improvement and adaptive management. Class includes lectures and exercises in which students integrate these subjects. Chadwick D. Oliver]

[**F&ES 658a, Global Resources, International Resource Exchanges, and the Environment** 3 credits. Students first learn the global distribution of resources—the amounts, importance, and causes of distribution, and potential changes of soils, water, biodiversity, human societies, energy sources, climates, agriculture, forests and forest products, minerals, and disturbances. They also learn how to analyze and interpret data on global resource distributions. Secondly, they gain an understanding of the value of multiple-country trading of resources. Thirdly, they gain an understanding of the many mechanisms that facilitate such exchanges, including policies and treaties; business, markets, trading partners, and economics; "good will"; social "taboos"; force; news media; philanthropy; skillful negotiations; cultural/social affiliation; technologies; shared infrastructures; and others. Four teaching methods are used: lectures on the different resources and policy mechanisms; analytical exercises for understanding how to use and interpret international data—and its limitations; a class negotiation exercise for learning the uses of international trade; and guest lectures by faculty and meetings with practitioners for learning the facilitation mechanisms. Three hours lecture; possible field trips. Chadwick D. Oliver, other faculty, and guest speakers]

F&ES 659b, The Practice of Silviculture: Principles in Applied Forest Ecology 4 credits. The scientific principles and techniques of controlling, protecting, and restoring the regeneration, composition, and growth of natural forest vegetation and its plantation and agroforestry analogs worldwide. Analysis of biological and socioeconomic problems affecting specific forest stands and design of silvicultural systems to solve these problems. Applications are discussed for management of wildlife habitat, bioenergy and carbon sequestration, water resources, urban environments, timber and nontimber products, and landscape design. Recommended: some knowledge of soils, ecology, plant physiology, human behavior, and resource economics. Four to six hours lecture. One hour tutorial. Seven days fieldwork. Mark S. Ashton

F&ES 660a, Forest Dynamics 3 credits. This course reviews the biophysical drivers of stand development in forest ecosystems. We begin by briefly exploring the ecophysiology of woody plants, the distribution of trees and forests, and plant community theory. We build on this basis focusing on the ecology and developmental dynamics of complex forest systems. Lectures, exercises, and readings drawn from the scientific and popular literature are supported by field trips exploring disturbance and stand development in New England forests. This class is a core component of the M.F. degree but is explicitly designed to be accessible to anyone interested in an in-depth exploration of forest ecosystems. Kristofer R. Covey

F&ES 668b, Field Trips in Forest Resource Management and Silviculture 1 credit. Seven- to twelve-day field trips to study the silviculture and forest management of particular forest regions. In previous years, classes have visited Slovenia, Germany, Austria, the United Kingdom, British Columbia, and, in the United States, the southern Coastal Plain and Piedmont, and the Allegheny, Appalachian, Adirondack, and Green mountains. Enrollment limited to sixteen. Mark S. Ashton

F&ES 669b, Forest Ecosystem Management and Operations 4 credits. This second-year capstone course introduces students to the quantitative, socioeconomic, and legal aspects of managing forested landscapes for different landowners and social values. Part 1 covers a variety of quantitative decision support tools that are used by land managers and investors to predict ecological and financial outcomes on managed forestlands. Topics include growth and yield modeling, a tool used to anticipate future forest conditions and understand the associated changes in value. Exercises demonstrate how to integrate information into decision support tools for financial modeling of timber investments and carbon markets. The course progresses from the theoretical framework of G&Y models and the inventories they are based upon, to hands-on application using real models and sample datasets. Students then input the results from the modeling exercises (timber yield or other ecosystems services such as carbon or water) into financial models to see how harvests and other management decisions affect forestland values and revenues into the future. Part 2 uses the quantitative knowledge gained to describe the principles of sustained yield, forest regulation, allowable cut, and the scheduling of harvests and operations. Training is provided in landscape-level analysis of resource allocation between and among different products and services to society and to develop management prescriptions and decisions for different landowner scenarios. Students identify management

objectives for various properties and ownership types and integrate scientific knowledge and both timber and nontimber considerations with landowner objectives to derive management prescriptions and decisions. Forest certification systems (FSC, SFI, ATF, PEFC) are reviewed, including comparison of standards, implementation strategies, and the benefits/costs to various types of landowners (public, large for-profit private, large not-for-profit private, small private). Part 3, the field trip and workshop component, covers the operational aspects of managing forestland. Field trips are local and are organized to view forestry operations and to develop and refine field skills. Topics essential to professional practice include harvesting (planning, layout, implementation, and post-operation evaluation); assessments of (best) management practices; regulatory and wetlands considerations; and the legal and socioeconomic aspects of sale organization, contracts, and marketing of products. The ethical and professional responsibilities of forest managers who are responsible for land-altering activities are also considered in a required satisfactory completion workshop. The course assumes knowledge of forest biology, forest measurements, silviculture, and economics. Faculty

F&ES 670b, Southern Forest and Forestry Field Trip 1 credit. This course augments our forestry curriculum by providing a forum for viewing and discussing forestry and forest management with practitioners. The trip provides M.F. candidates and other interested students with an opportunity to experience the diversity of southeastern forested ecosystems and ownership objectives ranging from intensively managed pine plantations to restoration and protection of endangered habitats. Students discuss forest management issues—including forest health, fragmentation, policy, law, and business perspectives—with landowners and managers from large industries, nonindustrial private landowners, TIMOs, federal and state land managers, NGOs, and forestry consultants. We also tour sawmills, paper mills, and other kinds of forest products processing facilities, active logging operations, and, weather permitting, participate on prescribed fires. Not least, we experience the unique cultures, food, and hospitality of the southeastern United States. The course can be taken for 1 credit by any student at F&ES or combined with the 2-credit Forest Management Operations (F&ES 669) for 3 credits. Faculty

F&ES 675b, Growth and Yield 2 credits. This advanced quantitative course introduces students to the variety of decision support tools used by land managers and investors to predict ecological and financial outcomes on managed forestlands. Growth and yield modeling is a tool used to anticipate future forest conditions and understand the associated changes in value. This course is designed for F&ES and SOM students interested in forestland management and investment to understand how these models function and how to integrate results of modeling exercises into decision support tools such as financial modeling for timber investment and carbon markets. The course progresses from the theoretical framework of G&Y models and the inventories they are based upon, to hands-on application using real models and sample datasets. Students then input the results from the modeling exercises (timber yield or other ecosystems services such as carbon or water) into financial models to see how harvests and other management decisions affect forestland values and revenues into the future. The course relies primarily on guest lecturers. Faculty

F&ES 680a, Forest and Ecosystem Finance 3 credits. Understanding the tools used in financial analysis is an important component of successful forestland investment and forest management decision making. In addition, as new ecosystem services markets develop, these skills become even more critical in determining those management strategies that are both ecologically sound *and* financially viable. This course provides students with a basic suite of financial tools used in the acquisition and management of forestland/timber as well as in the management of ecosystem services. It includes an overview of traditional financial analysis metrics used in land acquisition, timber management, and risk management. It also applies these metrics in ecosystem services markets, which allows students to assess the financial impacts of various management choices. Concepts are reinforced through spreadsheet-based exercises and case studies. Prerequisite: F&ES 578 or permission of the instructor. Deborah Spalding

F&ES 683b, Seminar in Tropical Forest Restoration in Human-Dominated Landscapes 3 credits. This seminar is focused on the biological and social science, management, and policy governing reforestation in tropical regions. Topics covered include the ecology and management of native species plantations and second-growth forests; understanding the social drivers and barriers of restoration; and becoming familiar with the methodological protocols of gathering and assessing social, economic, and cultural values. A particular emphasis is placed on tropical Asia and Latin America. Part of this course is taught online, part in a series of weekly discussions. Optional 1-credit field trip on dry tropical forest restoration, Azuero, Panama. Prerequisite: F&ES 659. Enrollment limited to twenty. Mark S. Ashton

Physical Sciences

ATMOSPHERIC SCIENCES

F&ES 700b, Alpine, Arctic, and Boreal Ecosystems Seminar 3 credits. Biogeoclimatic analysis of these systems worldwide with special attention to biogeography, biometeorology, physiology, histology, morphology, autecology, and silviculture of high-elevation and high-latitude forests through lectures, guest lectures and discussions, student seminars, and field experience. Graeme P. Berlyn, Xuhui Lee

F&ES 701a and b, Climate Change Economics Seminar 3 credits. The course reviews several valuation studies that form the backbone of modern greenhouse gas damage estimates. Each small group of students chooses a study; downloads the data and methods of that study from the authors or a journal; and then reproduces the published results. The purpose of this exercise is to replicate results, understand all the assumptions, and measure how sensitive the results are to these assumptions. The course meets every other week for the entire year to give students time to go through their studies and present their results to the class. Robert O. Mendelsohn, William Nordhaus

[**F&ES 702b, Climate Change Seminar** 2–3 credits. An advanced seminar that explores current topics in global climate change, including scientific evidence for global warming, climate change impacts on natural ecosystems and the human society, and policy and management options for mitigating climate change. Meetings are divided between student presentation, invited lecture, and panel debate on selected hot issues. Preference

is given to second-year students, but first-year students with background and interest in the subject area are also encouraged to participate. Presentation/literature critique/term paper. Prerequisite: F&ES 703 or 704. Xuhui Lee]

[**F&ES 704a, Workshop on Remote Sensing and Photogrammetry with Drones** 1–3 credits. This workshop explores the current state and future outlook of remote sensing and photogrammetry with unmanned aerial vehicles (UAVs or drones) for environmental monitoring. UAV-based remote sensing is a rapidly developing field in environmental science and technology. Versatile and inexpensive, it has the potential to offer solutions in a wide range of applications, such as forestry inventory, precision agriculture, hazard assessment, pollution monitoring, and land surveys. The class meets once a week for three hours. The workshop is divided into three parts: (1) reviewing the state of the technology on UAV types, sensor configurations, and data acquisition methods; (2) exploring GIS and remote-sensing software tools for analyzing spectral data acquired by rotary- and fixed-wing drones at super high resolutions; (3) working with clients to complete a project on digital landscaping or other photogrammetry applications. Students have the opportunity to conduct drone flight missions. Data analysis/presentation/literature critique/field trips. Prerequisite: F&ES 726 or equivalent experience. Xuhui Lee]

F&ES 722a, Boundary Layer Meteorology 3 credits. This course examines the interactions between the atmosphere and Earth's surface. Students gain an understanding of the surface energy and radiation balance, air motion in the atmospheric boundary layer, impacts of land use on surface climate, land surface parameterization for climate models, and field research methods. One outcome of the course is a solutions manual, authored by the students and to be published by Springer, for a new textbook on boundary layer meteorology. Three hours lecture and discussion. Data analysis/term paper/presentation. Permission of the instructor required. Xuhui Lee

ENVIRONMENTAL CHEMISTRY

[**F&ES 706a, Organic Pollutants in the Environment** 3 credits. An overview of the pollution problems posed by toxic organic chemicals, including petroleum, pesticides, PCBs, dioxins, chlorinated solvents, and emerging contaminants. Processes governing the environmental fate of organic pollutants, e.g., evaporation, bioconcentration, sorption, biodegradation. Technologies for prevention and remediation of organic pollution. Previous experience with organic chemistry is not required. Shimon C. Anisfeld]

F&ES 707b/ENAS 640b, Aquatic Chemistry 4 credits. A detailed examination of the principles governing chemical reactions in water. Emphasis on developing the ability to predict the aqueous chemistry of natural, engineered, and perturbed systems based on a knowledge of their biogeochemical setting. Calculation of quantitative solutions to chemical equilibria. Focus on inorganic chemistry. Topics include acid-base equilibria, alkalinity, speciation, elementary thermodynamics, solubility, mineral stability, redox chemistry, and surface complexation reactions. Prerequisites: general chemistry and a working knowledge of algebra; F&ES 708 or equivalent is desirable, but not required. Three hours lecture, weekly problem sets. Gaboury Benoit

F&ES 708a, Biogeochemistry and Pollution 3 credits. A descriptive overview of baseline biogeochemistry and the nature and behavior of pollutants in the environment. The course is designed to aid future environmental professionals who sometimes may find it necessary to make decisions based on knowledge of environmental chemistry. It is geared to the nonspecialist who needs to establish familiarity with various classes of pollutants and the chemical, biological, and physical processes that control their sources, behavior, toxicity, and fate. Topics include the fundamental kinds of chemical reactions in the environment, critical analysis of chemical data, sampling techniques, analytical methods, natural biogeochemical controls on environmental chemistry, water treatment, and green infrastructure, as well as detailed examination of contaminants of special interest like acid precipitation, nutrients, urban runoff, and sewage. Prerequisite: college-level general chemistry. Three hours lecture. One class project, problem sets, midterm, final exam. A small number of field trips. Gaboury Benoit

F&ES 773a, Air Pollution Control 3 credits. An overview of air quality problems worldwide with a focus on emissions, chemistry, transport, and other processes that govern dynamic behavior in the atmosphere. Quantitative assessment of the determining factors of air pollution (e.g., transportation and other combustion-related sources, chemical transformations), climate change, photochemical "smog," pollutant measurement techniques, and air quality management strategies. Drew R. Gentner

SOIL SCIENCE

[**F&ES 709a, Soil Science** 3 credits. Lectures, labs, and discussions of soil science, with emphasis on soil ecology. Topics cover the structure and functioning of soils, and how this relates to soil fertility and ecosystem health in a changing environment. Prerequisites: F&ES 500 and 515, or permission of the instructor. Mark A. Bradford]

WATER RESOURCES

F&ES 644a, Watershed Science 3 credits. Watershed science is a powerful scientific approach that utilizes the watershed unit and the integrative nature of water to solve problems. This class in watershed science is designed to cover fundamental knowledge, tools, and case studies that have emerged through research over the past fifty years. Included are units on watershed classification, hydrology, chemistry, models, management, and case studies. The goal is to provide students with a knowledge and tool base that allows them to be system thinkers with respect to modern-day environmental problems. Peter A. Raymond

F&ES 710b, Coastal Governance 3 credits. Effective governance combines a basic understanding of natural systems with human values to create new coastal institutions. Single-use regulations of the past (energy, wastewater, ports, marsh conservation) are being replaced by more holistic thinking (spatial management and/or ecosystem-based management). To understand the state of this transition, policy analysis frameworks are applied to sector-based and ecosystem-based management initiatives. Term projects allow student teams to consider the merit of various alternatives that they create to address contemporary problems, which have included sea-level rise, hurricane damage, fisheries, and management in developing countries. F&ES 515 and 525 or equivalent

knowledge recommended. Three hours seminar; term project. Enrollment limited to eighteen. Richard Burroughs

F&ES 712b, Water Resource Management 4 credits. An intermediate-level exploration of water resource management at scales ranging from local to global. The course looks at multiple dimensions of the water crisis, including both human and ecosystem impacts, quantity and quality issues, and science and policy. Theory is illustrated through a variety of case studies. Topics covered include global water resources; flooding; water scarcity; residential, agricultural, and industrial water use; water and health; impacts of climate change and land use change; stormwater management; dams and other technologies for water management; human impacts on aquatic ecosystems; water and energy; water economics; water rights and water conflict and cooperation. Prerequisites: F&ES 515 and 610. Enrollment limited to sixteen. Shimon C. Anisfeld

F&ES 713a, Coastal Ecosystems 4 credits. An examination of the natural processes controlling coastal ecosystems, the anthropogenic threats to the health of these systems, and the potential for restoration. Coverage of estuaries, rocky shores, seagrass meadows, coral reefs, and mangrove swamps, with a special emphasis on tidal marshes. The course covers a wide range of physical, chemical, and ecological processes. Anthropogenic impacts covered range from local to global and include nutrient enrichment, hypoxia, sea-level rise, invasive species, over-fishing, chemical pollution, marsh drowning, and wetland filling. Shimon C. Anisfeld

[**F&ES 714b/ENAS 646b, Environmental Hydrology** 3 credits. Exploration of the roles of natural processes and anthropogenic activities in regulating the quantity, distribution, and chemical composition of Earth's freshwater. Students gain exposure to theoretical and applied elements of surface and subsurface hydrology. The theory covered in the course focuses on hydrologic phenomena of societal and environmental importance, including stream-flow generation, wetland-water cycling, groundwater-flow dynamics, contaminant migration in surface and groundwater, and water use and redistribution by plants. Application of theory is accomplished through student use of hydrologic simulation models, which are expressions of theory and essential tools of water-resource management and assessment. Intended as a first course in scientific hydrology; appropriate for M.E.M., M.E.Sc., and Ph.D. students, as well as for advanced undergraduates. Because hydrology is a quantitative science, treatment of the course subject matter involves mathematics. F&ES 714 is designed for students who typically do not have previous course work in mathematics beyond one semester of college-level calculus. Students who have not completed a college-level calculus course can succeed in F&ES 714 provided that they are comfortable with arithmetic operations and algebra and are willing to learn a few, very basic principles of introductory calculus. Although students use hydrologic simulation models, the course does not involve any computer programming and requires no special computer skills. James E. Saiers]

F&ES 715b, Water Science Seminar 3 credits. This class reads biogeochemistry papers from the primary literature, focusing on new papers across a spectrum of topics and ecosystem types. Papers are chosen by the instructor with some input from students. Students read and critique each paper. The primary author of the paper is then interviewed

via Skype by the entire class. The course meets once a week. Enrollment limited to twelve. Peter A. Raymond

[**F&ES 724b, Watershed Cycles and Processes** 3 credits. This course explores abiotic and biotic controls on the cycling of water and chemicals within watershed systems. Students gain an understanding of the coupled roles of climate, hydrology, and biogeochemistry in regulating the fate of nutrients, carbon, and pollutants in watersheds. The class also features six guest lectures on issues at the forefront of watershed science. Upon successful completion of the course, students have acquired scientific knowledge that is relevant to interpreting watershed-based observations and to informing watershed-management decisions. Peter A. Raymond, James E. Saiers]

F&ES 729b, Caribbean Coastal Development: Cesium and CZM 3 credits. A field-intensive seminar exploring human-ecosystem interactions at the land-sea interface in the Caribbean, with Roatan, Honduras, as the focus site. Many tropical islands are undergoing rapid, uncontrolled development, placing severe local stress on several unique and vulnerable ecosystem types. In addition, human-induced environmental changes on scales up to global also impose stresses. This course examines the normal functioning of these ecosystems, scientific methods to evaluate and characterize ecosystem condition and processes, how human activities interfere with natural cycles in biophysical systems, and what management and policy tools can be applied to reduce impacts. An organizing framework for the course is the close coupling of coastal watersheds and adjacent marine ecosystems, especially coral reefs, mangroves, and seagrass meadows. A major part of the course is a one-week field trip to the Caribbean during spring break. We also meet twice each week throughout the term to discuss readings and arrange logistics. Student presentations and projects. Enrollment limited to ten; priority given to F&ES students, with others admitted as space permits. Students are selected during the fall term. Gaboury Benoit, Mary Beth Decker

F&ES 732a, Hydrology and Riverine Geomorphology 3 credits. This course is designed to build a general understanding of the physical processes that control river channel formation, including climatology, erosion, and sedimentation, and their implications with respect to fluvial (river) geomorphology. The course examines the classic themes in precipitation, stream flow, statistical hydrology, river hydraulics, sediment transport and storage, riverine habitat and riparian vegetation, fluvial geomorphology, and stream rehabilitation. This course is designed to provide students with a mix of classroom theory, dataset management, and field experience. In addition, it provides students a global perspective on the interrelationship between the hydrologic processes and natural resources management. Jonathan Morrison

F&ES 777a, Water Quality Control 3 credits. Study of the preparation of water for domestic and other uses and the treatment of wastewater for recycling or discharge to the environment. Topics include processes for removal of organics and inorganics, regulation of dissolved oxygen, and techniques such as ion exchange, electrodialysis, reverse osmosis, activated carbon adsorption, and biological methods. Jaehong Kim

Quantitative and Research Methods

F&ES 550a, Natural Science Research Methods 3 credits. The course prepares students to design and execute an intensive research project. It covers elementary principles and philosophy of science; research planning, including preparation, criticism, and oral presentation of study plans; communicating research findings; limitations of research techniques; the structure of research organizations; and professional scientific ethics. Xuhui Lee

F&ES 551a, Qualitative Social Science Research 3 credits. This course is designed to provide a broad introduction to issues of qualitative research methods and design. The course is intended for both doctoral students who are in the beginning stage of their dissertation research, as well as master's students developing research proposals for their thesis projects. The course covers the basic techniques of designing qualitative research and for collecting, interpreting, and analyzing qualitative data. We explore three interrelated dimensions of research: theoretical foundations of science and research, specific methods available to researchers for data collection and analysis, and the application and practice of research methods. The final product for this course is a research proposal. Amity Doolittle

F&ES 552b, Master's Student Research Conference 0 credits. One of the most important aspects of scientific research involves the communication of research findings to the wider scientific community. Therefore, second-year M.E.Sc. and M.F.S. students are required to present the results of their faculty-supervised research as participants in the Master's Student Research Conference, a daylong event held near the end of the spring term. Student contributors participate by delivering a fifteen-minute oral presentation to the F&ES faculty and student body or by presenting a research poster in a session open to the F&ES community. Students receive a score of satisfactory completion for this effort. Matthew J. Kotchen

F&ES 611a, Data Science for Social Research: An Introduction 1 credit. This course provides an introduction to a rapidly growing and promising area of social scientific research that has accompanied the explosion of data in our digital age, as nearly every aspect of life is now connected (e.g., mobile phones, smart devices, social media) and digitized (book archives, government records, websites). Students are introduced to various techniques and software for collecting, cleaning, and analyzing data at large scales, especially text data (e.g., machine learning, topic modeling, location extraction, semantic networks). Strong emphasis is placed on integrating these methods into actual research, in hopes of moving new or ongoing student papers toward publication. Because of the pragmatic focus of the course, and because these techniques require various degrees of expertise, students are required to meet with the instructor throughout the term to best tailor data science to their particular project. Justin Farrell

F&ES 638a, Carbon Footprints—Modeling and Analysis 3 credits. Carbon footprints are important tools in climate policy making. Carbon footprints describe the greenhouse gas emissions associated with an activity, company, household, or nation and are based on a life-cycle perspective, assigning emissions of greenhouse gases to the end user. Carbon footprints are also discussed in connection with responsibility for reducing greenhouse

gas emissions. This course offers an introduction to the assessment of carbon footprints using input-output techniques and life-cycle assessment, and it examines scientific, policy, and management issues associated with carbon footprinting. It also offers an introduction to the analysis and interpretation of carbon footprint results. The course is split into two parts. In the first, students learn the techniques of carbon footprint modeling and analysis using generic tools such as MatLab and Excel through both lectures and exercises. The second part of the course is dedicated to assessing and understanding carbon footprints of areas of final demand (e.g., food), specific product groups (e.g., cars), or organizations (e.g., F&ES, YNHH). Grading is based on problem sets, a midterm exam, and a final project. The students must be comfortable with quantitative analysis and prepared to acquire basic programming and modeling skills. Prior knowledge of life-cycle assessment and industrial ecology is desirable and may be gained through taking F&ES 884. Edgar G. Hertwich

F&ES 720a, Introduction to R 3 credits. This seminar provides an overview and introduction to the statistical software R for the analysis and graphical presentation of natural and social science data. We follow a flipped style of teaching, with class time primarily used for worked examples and problems. Students also work together in small groups to analyze data from collaborators (or the student's own data) with a view to publication. The course provides the practical training in R for theoretical courses such as F&ES 510 and 753; they can be taken concurrently or sequentially, although some statistics background is preferred. Simon A. Queenborough

F&ES 725a, Remote Sensing of Land Cover and Land Use Change 3 credits. This is an advanced course on the use of satellite remote sensing to monitor land use and land cover change. The course emphasizes digital image processing techniques to detect landscape dynamics using data from NASA's satellites. Topics include pre-processing data for change detection, accuracy assessment of change maps, and methodologies to detect changes such as urban expansion, deforestation, seasonal variations in vegetation, agricultural expansion, vegetation health, and wildfires. Prerequisite: F&ES 726. Lecture and lab. Karen Seto

F&ES 726b/ARCG 762b/EMD 548b/G&G 562b, Observing Earth from Space 3 credits. A practical introduction to satellite image analysis of Earth's surface. Students develop a theoretical foundation and practical skills for satellite remote sensing; gain an understanding of Earth's surface, ocean, and atmosphere, including natural processes and human impacts; and establish familiarity with remote-sensing products and their applications. Topics include the spectrum of electromagnetic radiation, satellite-borne radiometers, data transmission and storage, computer image analysis, the merging of satellite imagery with GIS and applications to weather and climate, oceanography, surficial geology, ecology and epidemiology, forestry, agriculture, archaeology, and watershed management. Classroom lectures are supplemented with laboratory exercises and short showcases on remote-sensing platforms and data products. Prerequisites: college-level physics or chemistry, two courses in geology and natural science of the environment or equivalents, and computer literacy. Weekly labs and problem sets; midterm exam; course project. Ronald B. Smith, Xuhui Lee

F&ES 751b, Sampling Methodology and Practice 3 credits. This course is intended to provide a fundamental understanding of the principles of statistical sampling, alternative estimators of population parameters, and the design basis for inference in survey sampling. Natural, ecological, and environmental resource applications of sampling are used to exemplify numerous sampling strategies. Sample designs to be studied include simple random; systematic; unequal probability, with and without replacement; stratified sampling; sampling with fixed-radius plots; horizontal point sampling; and line intercept. The Horvitz-Thompson, ratio, regression, and other estimators are introduced and used repeatedly throughout the course. Three hours lecture. Weekly and biweekly problem sets requiring the use of a computer spreadsheet. Timothy G. Gregoire

F&ES 753a, Regression Modeling of Ecological and Environmental Data 3 credits. This course in applied statistics assists scientific researchers in the analysis and interpretation of observational and field data. After considering the notion of a random variable, the statistical properties of linear transformations and linear combinations of random data are established. This serves as a foundation for the major topics of the course, which explore the estimation and fitting of linear and nonlinear regression models to observed data. Prerequisite: a course in introductory statistics. Three hours lecture. Statistical computing with R, weekly problem exercises. Timothy G. Gregoire

F&ES 754a, Geospatial Software Design 3 credits. This course introduces computer programming tools and techniques for the development and customization of geospatial data-processing capabilities. It relies heavily on use of the Python programming language in conjunction with ESRI's ArcGIS and on JavaScript in conjunction with Google's Earth Engine geographic information systems (GIS). Prerequisite: previous experience in GIS. Three hours lecture, problem sets. C. Dana Tomlin

F&ES 755b, Modeling Geographic Space 3 credits. An introduction to the conventions and capabilities of image-based (raster) geographic information systems (GIS) for the analysis and synthesis of spatial patterns and processes. In contrast to F&ES 756, the course is oriented more toward the qualities of geographic space itself (e.g., proximity, density, or interspersion) than the discrete objects that may occupy such space (e.g., water bodies, land parcels, or structures). Three hours lecture, problem sets. No previous experience is required. C. Dana Tomlin

F&ES 756a, Modeling Geographic Objects 3 credits. This course offers a broad and practical introduction to the nature and use of drawing-based (vector) geographic information systems (GIS) for the preparation, interpretation, and presentation of digital cartographic data. In contrast to F&ES 755, the course is oriented more toward discrete objects in geographical space (e.g., water bodies, land parcels, or structures) than the qualities of that space itself (e.g., proximity, density, or interspersion). Three hours lecture, problem sets. No previous experience is required. C. Dana Tomlin

[**F&ES 757b, Statistical Design of Experiments** 3 credits. Principles of design for planned experiments, coupled with methods of analysis of experimental data. The course is applications-oriented using the results of established theory. The nuances, strengths, and weaknesses of a number of classical designs are discussed. These include completely

randomized design, block designs, and split plot designs. The analysis of data from these designs is treated at length. This course also deals with the question of sample size estimation. Students may use R or SAS for the completion of assignments. Prerequisite: a prior course in introductory statistics. Jonathan D. Reuning-Scherer or Timothy G. Gregoire]

F&ES 758b, Multivariate Data Analysis in the Environmental Sciences 3 credits. An introduction to the analysis of multivariate data. Topics include multivariate analysis of variance (MANOVA), principal components analysis, cluster analysis (hierarchical clustering, k-means), canonical correlation, multidimensional scaling ordination methods, discriminate analysis, factor analysis, and structural equations modeling. Emphasis is placed on practical application of multivariate techniques to a variety of natural and social examples in the environmental sciences. Students are required to select a dataset early in the term for use throughout the term. There are regular assignments and a final project. Extensive use of computers is required—students may use any combination of R, SAS, SPSS, STATA, and MINITAB. Prerequisites: a prior course in introductory statistics and a good understanding of multiple linear regression. Three hours lecture/discussion. Jonathan D. Reuning-Scherer

F&ES 762a, Applied Math for Environmental Studies (AMES): Foundations for Measuring and Modeling Environmental and Socioenvironmental Systems 3 credits. The language of mathematics is an important leg in the stool of interdisciplinary research and analysis, and many graduate courses at F&ES involve mathematical content. However, many graduate students have not taken a math course in years, and their math skills are rusty. Furthermore, many graduate-level mathematical concepts may be entirely new. Experience suggests that many students either opt out of taking courses they are truly interested in or muddle through, struggle with the math, and miss important concepts. AMES is meant to help students refresh or acquire new math skills and succeed in content and "toolbox" graduate-level courses. AMES provides a structured opportunity to learn a range of mathematical concepts used in environmental studies. The course assumes that, at a minimum, students took college algebra and perhaps a semester of calculus (but might not really remember it). Concepts are presented heuristically in a "how to" and "why" approach with examples from environmental studies. The goal is for students to be conversant and have intuition about (i.e., to demystify) why logs, exponents, derivatives, integrals, linear algebra, probability, optimization, stability analysis, and differential equations show up throughout environmental studies. Students learn (review) how to use these techniques. Also covered is a bit of history of math and an introduction to computer programming. Eli P. Fenichel

[**F&ES 780b, Seminar in Forest Inventory** 2 credits. An advanced seminar that explores the design and implementation of forest inventory. Topics are varied to meet the interest of the class, but generally include the evolution and current status of broad regional and national inventories in the United States and abroad. Each week readings are assigned from primary sources that document the development of, and motivation for, various sampling methods for forest inventory. These include fixed and variable radius plot sampling, 3P sampling, double sampling for stratification in forest inventory, sampling with

partial replacement, and line intersect sampling. Time and interest permitting, there is discussion of some newer, more specialized methods such as Monte Carlo methods and randomized branch sampling. A familiarity with the precepts and vernacular of probability sampling or statistics is presumed. Prerequisite: F&ES 751. Timothy G. Gregoire]

[**F&ES 781b/S&DS 674b, Applied Spatial Statistics** 3 credits. An introduction to spatial statistical techniques with computer applications. Topics include modeling spatially correlated data, quantifying spatial association and autocorrelation, interpolation methods, variograms, kriging, and spatial point patterns. Examples are drawn from ecology, sociology, public health, and subjects proposed by students. Four to five lab/homework assignments and a final project. The class makes extensive use of the R programming language as well as ArcGIS. Timothy G. Gregoire, Jonathan D. Reuning-Scherer]

[**F&ES 794b, Confronting Models with Data** 1.5 credits. We read and discuss Hilborn and Mangel's classic book, *The Ecological Detective*. This book covers philosophy of science and hypothesis testing and various frameworks for confronting models with data. The book makes use of real scientific and resource management problems to communicate concepts. While it focuses on ecology, the concepts are broadly applicable to all areas of environmental studies that use data and test hypotheses. It is also useful for students interested in using scientific results for policy and decision making. Students take turns leading discussion and write a short research proposal using concepts from the book. Eli P. Fenichel]

Social Sciences

ECONOMICS

F&ES 795b, Nature as Capital: Merging Ecological and Economic Models 3 credits. This course helps students understand concepts from and develop skills in natural resource economics. It is designed to familiarize students with concepts and tools for thinking about natural resources as capital assets with a specific link to quantitative measures that may be useful in assessing sustainability. Students gain a working knowledge of concepts necessary to apply capital theory to ecosystems and develop a skill set sufficient to build dynamic bioeconomic models that can help them approximate the value of changes in ecosystems. Students also learn computational tools in dynamic optimization, which are useful for forward-looking decision making. Eli P. Fenichel

[**F&ES 802b, Valuing the Environment** 3 credits. This quantitative course demonstrates alternative methods used to value environmental services. The course covers valuing pollution, ecosystems, and other natural resources. The focus of the course is on determining the "shadow price" of nonmarket resources that have no prices but yet are considered valuable by society. Taught every other year. Three hours lecture. Robert O. Mendelsohn]

F&ES 804b/ECON 737b, Economics of Environmental Natural Resource Management 3 credits. This course uses economic theory and empirical evidence to address pollution control, nonrenewable resource extraction, and renewable resource management. The course teaches students how to apply economics to real-world problems. The pollution section explains the origin of externalities, and their optimal regulation. The

nonrenewable resource section focuses on how markets consume resources of limited size over time with applications to fossil fuels, metals, and minerals. The renewable resource section covers the management of water, land, and ecosystems. Robert O. Mendelsohn

F&ES 805a or b, Seminar on Environmental and Natural Resource Economics 1.5 credits. This seminar is based on outside speakers and internal student/faculty presentations oriented toward original research in the field of environmental and natural resource economics and policy. Presentations are aimed at the doctoral level, but interested master's students may enroll with permission of the instructors. Eli P. Fenichel, Matthew J. Kotchen

[**F&ES 904a, Doctoral Seminar in Environmental Economics** 3 credits. This course critically examines a set of recent and also famous papers in environmental and resource economics. The purpose of each paper, its method, results, and conclusions are all discussed. The course is intended to prepare students for a career in economic research. Robert O. Mendelsohn]

[**F&ES 905b, Doctoral Seminar in Environmental and Energy Economics** 3 credits. This course is designed to bring doctoral students up to speed on the latest developments in the literature on environmental and energy economics. Key papers are presented, and associated mathematical and empirical methods are covered. Topics to be covered include uncertainty and climate change policy, estimating energy demand, electricity markets, and behavioral economics and the environment. A focus is on identifying areas that deserve future research attention. Open to advanced master's students with permission of the instructor. Kenneth T. Gillingham]

ENERGY AND THE ENVIRONMENT

[**F&ES 617a/AMST 744a/HIST 744a/HSHM 747a, Readings and Research in Energy History** 3 credits. The history of energy in the United States and the world. Readings and discussion range widely across different forms of energy: animal power, biomass, and early hydropower; coal, oil, and atomic energy; and present-day hydraulic fracturing, wind, and solar. Themes include relations between energy producers and communities, including resistance to energy projects; cultural and social change associated with dominant energy regimes; labor struggles and environmental transformations; the global quest for oil; and changing national energy policies. We explore new approaches to writing and teaching the history of energy. Open to undergraduates with permission of the instructor. Paul Sabin]

F&ES 618a, Energy Policy in Practice 3 credits. Energy is pervasive in our economy and our lives. How energy is supplied and consumed has implications for economic competitiveness, employment, household welfare, national security, and the environment. While U.S. energy markets are generally deep and established, without appropriate regulation energy markets cannot be relied on to protect consumers or the environment, or to supply a range of nonmarket benefits. As a result, the United States has a long history of government intervention in energy markets. Recent years have seen far-reaching energy policy interventions, such as the Clean Power Plan and the elimination of the crude oil export ban, alongside rapid changes in energy markets, such as strong growth in oil and

natural gas production from shale and steep drops in the cost of renewable energy technologies. While energy markets are regulated at all levels of government and in service of a range of objectives, this course focuses primarily on federal energy policy intervention that seeks to correct for externalities associated with production and consumption of energy. Dan G. Utech

F&ES 635b/MGT 683, Renewable Energy Project Finance 3 credits. The course is intended to be a practicum, exposing students to real-world tools of the trade as well as the theory underlying them. In place of a textbook, students are provided with approximately 400 pages of actual project documents used for a U.S. wind energy project constructed relatively recently. Through weekly homework assignments, students develop the skills necessary to construct a detailed financial model, largely comparable to what would be used by an investment firm, project developer, or independent power producer. Modeling skills include sizing debt capacity, sensitivity analysis, stochastic forecasting, taxes, and the creation of financial statements. Lectures also provide an introduction to risk management, energy market dynamics, alternative contractual structures, financial structuring, and the core engineering and risks inherent in the most common renewable energy technologies. Daniel Gross

F&ES 716b, Renewable Energy 3 credits. Introduction to renewable energy, including physical principles, existing and emerging technologies, and interaction with the environment. Energy demand; transmission and storage; generation by hydroelectric, wind, solar, biofuel, and geothermal sources, as well as waves and tidal generation. Includes field trips to conventional, hydroelectric, and wind-power facilities in Connecticut. Prerequisites: high school physics, chemistry, and mathematics; college-level science, engineering, and mathematics recommended. Ronald B. Smith

[**F&ES 798Eb, China's Energy and Environmental Sustainability Challenge** 3 credits. Developing solutions for global energy and climate challenges necessitates an understanding of China. This course examines China's economic rise in the context of its energy and environment, as they relate both within China and abroad. Issues of security, the long-term sustainability of current resource consumption and growth, and the need for innovative technology and policy are all challenges China's energy system faces. At the same time, as the world's largest consumer of energy and emitter of greenhouse gases, China has the ability to singlehandedly shape the course of the global climate system. The environmental consequences of China's energy consumption and growth are also critical considerations, particularly as China's air and water pollution have become transboundary in nature. This is the first joint course offered with students at Yale-NUS College in Singapore. Angel Hsu]

[**F&ES 800b, Energy Economics and Policy Analysis** 3 credits. This course examines energy policy issues that pertain to the environment, with a focus on providing tools for analyzing these issues. A primary objective is to apply economics to particular issues of energy markets, environmental impacts, investment in renewables, and other energy issues such as transportation and energy efficiency. We cover the economic and technical considerations behind a particular energy policy issue and then discuss a related article or case study. Prerequisites: F&ES 505 (or equivalent) and at least one course on energy. Kenneth T. Gillingham]

[**F&ES 812b, Energy's Impact on Freshwater Resources** 3 credits. Energy development depends on freshwater. Water is consumed to mine uranium, tar sands, and coal; to recover oil and natural gas; and to grow biofuel feedstocks. More water is needed to convert these primary energy sources to useable forms of energy, such as electricity, refined fuels, and heat. Water appropriation for energy development alters stream flows and depletes aquifers, thereby exacerbating ecosystem stresses induced by freshwater demands of agriculture and other human needs. Energy development also influences freshwater quality, usually in deleterious ways. Coal-mine drainage, leaky oil and gas wells, hydraulic fracturing, and uranium processing are among the culprits tied to energy development that have been implicated in contamination of surface and subsurface waters. The burden of energy development on freshwater resources is increasing as the world's economies grow. Changing this trajectory will not be easy, but progress will be made by those scientists and decision makers who understand the potential responses and vulnerabilities of freshwater resources to major forms of energy development. The course is intended to help students gain this understanding through analysis of the academic and professional literature on the linkages between freshwater systems and energy resource extraction, processing, and conversion. Readings focus on natural gas, oil, uranium, coal, bioenergy, and at least one other energy type chosen by student consensus. Water demand is also explored as a function of the energy sector. James E. Saiers]

F&ES 814a/MGT 563a, Energy Systems Analysis 3 credits. This lecture course offers a systems analysis approach to describe and explain the basics of energy systems, including all forms of energy (fossil and renewable), all sectors/activities of energy production/conversion, and all energy end uses, irrespective of the form of market transaction (commercial or noncommercial) or form of technology (traditional as well as novel advanced concepts) deployed. Students gain a comprehensive theoretical and empirical knowledge base from which to analyze energy-environmental issues as well as to assess energy investment projects. Special attention is given to introducing students to formal methods used to analyze energy systems or individual energy projects and also to discussing traditionally less-researched elements of energy systems (energy use in developing countries; energy densities and urban energy use; income, gender, and lifestyle differences in energy end-use patterns) in addition to currently dominant energy issues such as climate change. Active student participation is required, including completion of problem sets. Invited outside speakers and additional Professional Modules (scheduled as extra evening classes) complement topics covered in class. The class is open to all interested students and has no prerequisites. Students are advised that the time investment for successful completion of the class is significant. Faculty

F&ES 816b, Electric Utilities: An Industry in Transition 3 credits. The U.S. electric utility industry is a $370 billion business with capital expenditures on the order of $100 billion per year to replace aging infrastructure, implement new technologies, and meet new regulatory requirements. A reliable electricity infrastructure is essential for the U.S. economy and the health and safety of its citizens. The electric industry also has a significant impact on the environment. In the United States, electric power generation is responsible for about 40 percent of human-caused emissions of carbon dioxide, the primary greenhouse gas. Electric utilities in the United States are at a crossroads.

Technological innovations, improving economics, and regulatory incentives provide a transformational opportunity to implement demand-side resources and distributed energy technologies that will both lower emissions and improve service to customers. Such significant changes could, however, disrupt existing utility business models and therefore may not be fully supported by incumbent utilities. This course focuses on the issues, challenges, risks, and trade-offs associated with moving the U.S. utility industry toward a cleaner, more sustainable energy future. We explore how utilities are regulated and how economic factors and regulatory policies influence outcomes and opportunities to align customer, environmental, and utility shareholder interests to craft win-win-win solutions. Lawrence Reilly

ENVIRONMENTAL POLICY

F&ES 615b, Environmental Policy in the European Union 3 credits. This course uses a spring break trip to Tenerife in the Canary Islands to augment a term-long exploration of environmental policy making in the European Union. On campus, we use lectures, readings, discussions, and writing to explore the methods and tools sanctioned by the European Union for analysis of environment impacts by the member states. This course also explores how the tools of environment impact analysis inform policy and decision making. William Lauenroth

F&ES 627a, American Environmentalism 1 credit. What is environmentalism? The purpose of this seminar is to rigorously discuss that question and use our answers to better understand why we work to protect the environment, with a constant focus on what diverse environmental perspectives mean for environmental policy and law. This course focuses on the tools and tactics of environmental protection, but also on the values that drive environmentalism. The course in part traces the history of environmentalism, studies campaign techniques, and analyzes environmental laws, but we look at these issues in the broader context of what it means to be an environmentalist. Through our discussions we try to construct a vision of effective and lasting environmentalism for the present and the future while challenging ourselves to think about our own values and theories of change, about why we entered this field in the first place. Joshua Galperin

F&ES 633a/LAW 30205, Advanced Environmental Protection Clinic: Seminar: Practice at the Intersection of Civil Rights and Environmental Law 1 credit; graded pass/fail. Students participating in F&ES 975 can participate in this advanced seminar, which is intended to dive into issues raised by the clinical practice, including both substantive issues of environmental and civil rights law, as well as questions related to practice, including ethical and social dimensions of lawyering in the environmental justice context. The seminar meets approximately one hour per week and is student-organized. Marianne Engelman Lado

F&ES 799a, Sustainable Development Goals and Implementation 3 credits. This course has students (working alone or in a small group) design a specific implementation plan for a specific country for a specific item that is part of the Sustainable Development Goals adopted by the U.N. in September 2015. Students study the new post-2015 sustainable development goals and their implementation in the real world. The course focuses primarily on understanding and developing the ability to effectively apply a variety of

tools and means of implementation, relying primarily on guest lecturers. The aim is for each student or group of students to combine a geographic area/region (for example, a country of key interest), a sustainable development goal, and a tool for implementation to design an effective implementation strategy to present to those at the ministerial and decision-making level. Gordon T. Geballe

F&ES 807a/LAW 20490/MGT 688a, Corporate Environmental Management and Strategy 3 credits. This survey course focuses on understanding how adroit environmental management and strategy can enhance business opportunities; reduce risk, including resource dependency; promote cooperation; and decrease environmental impact. The course combines lectures, case studies, and class discussions and debates on management theory and tools, legal and regulatory frameworks shaping the business-environment interface, and the evolving requirements for business success (including how to deal with diverse stakeholders, manage in a world of transparency, and address rising expectations related to corporate responsibility). Marian R. Chertow, Daniel C. Esty

[F&ES 808b/LAW 21107/REL 926b, Law, Environment, and Religion: A Communion of Subjects 2–3 credits. Thomas Berry once wrote, "The universe is a communion of subjects, not a collection of objects." One might also insist that the university is a communion of subjects, not a collection of disciplines. Perhaps no subject better illustrates this point than the environment, for to understand and appreciate the environment requires expertise from multiple intellectual traditions, including history, religion, philosophy, anthropology, aesthetics, economics, political science, and legal studies. This course focuses on the scholarship and practice of leading figures working at the intersection of law, environment, and religion, who will be brought to campus to participate in a discussion series that forms the core of the course. In preparation for these visits, teams of students are assigned to study deeply the writing and actions of a designated speaker. Class sessions during this preparatory phase resemble a traditional graduate seminar, with readings and discussion designed to stimulate engagement with the most challenging and vital questions facing the "communion" of law, environment, and religion. During the core phase of the course, speakers interact with students in multiple ways. The central activity is an in-depth interview led by members of the student team. Other students conduct a podcast interview with the speaker at Yale's audio recording studio; these podcast interviews, which are intended to engage speakers in a more personal conversation about their life history, values, and worldviews, will be posted on Yale's iTunes University site. One of the conceits of the academy is often that such subjective elements have little bearing on one's intellectual work. As a result, too little attention is paid within the university to the role of family, community, religion, and other critical biographical factors in shaping one's ideas. Enrollment limited to twenty-four. Douglas A. Kysar, John Grim, Mary Evelyn Tucker]

F&ES 815b, Governing through Markets: The Potential and Pitfalls of Private Governance and CSR in the Global Era 3 credits. This seminar assesses the proliferation of policy innovations aimed at promoting and encouraging "corporate social responsibility" (CSR). We define CSR broadly to include the diverse range of self- and civil regulation, voluntary instruments, private authority, and nonstate market-driven (NSMD) initiatives that have emerged in the past fifteen years to engage firms directly, rather

than working through traditional governmental process. Examples include firm-level initiatives, industry codes, product codes, third-party certification, ethical brands and labels, and "clean" investment funds. The course reviews the growing literature on these phenomena that now exists within political science, management, economics, sociology, environmental studies, and law. Our aim is to reflect on the broad array of scholarship on emergence and institutionalization of CSR innovations questions. While the class is interested in assessing the strategic advantage that CSR might bring firms, our emphasis is on whether, and how, CSR initiatives might address enduring policy problems where traditional governmental approaches have been ineffective. The course is organized into four components. First, we review and assess the different types of CSR or "private" policy instruments vying for firm-level support and distinguish them from traditional governmental mechanisms. Second, we discuss what is meant by "effectiveness" and the different ways of measuring success. Third, we assess the assumptions behind different theoretical frameworks about what types of CSR innovations firms are more likely to support, if any, and why. Fourth, we turn to empirical evidence to assess existing theories of support, and what this means for understanding support and effectiveness of CSR. This section draws on a variety of empirical methods including guest speakers from the world of CSR, analysis of large-N analyses on support, as well as detailed historical and comparative case studies. Benjamin W. Cashore

F&ES 817a, Urban, Suburban, and Regional Planning Practice 3 credits. This course explores the challenges and opportunities faced by America's suburban communities and urban centers as they work to become more sustainable and livable. The form of our cities and towns dictates our ability to meet the nation's housing demand and grow our employment while reducing greenhouse gas emissions, improving the environment, and enhancing quality of life. Planners play a key role in understanding trends, crafting policy solutions, and generating support for action through stakeholder engagement. Land use plans and regulations, private development, and public infrastructure shape our communities and determine where and how we use land. While most land use decision making is local, the majority of the challenges and opportunities we face cross political boundaries. New regional policies and partnerships, coupled with consensus-building across diverse constituencies, will be necessary to realize a new way to build our communities for the twenty-first century. This course explores the dynamic trends facing the United States and its communities and the evolution in planning practice that is occurring at the local and regional scale to address them. This course is part of the concentration in land use and planning, a subset of classes under the specialization in sustainable land management. This subset is for students interested in the interface of environmental issues with land use, planning, and development. The other courses in the subset are F&ES 820 and 835. David Kooris

F&ES 819b, Strategies for Land Conservation 3 credits (or audit). This is a professional seminar on private land conservation strategies and techniques, with particular emphasis on the legal, financial, and management tools used in the United States. The seminar is built around presentations by guest speakers from land conservation organizations. Speakers are assigned topics across the land conservation spectrum, from identification of target sites, through the acquisition process, to ongoing stewardship of the land after

the deal is done. The tools used to protect land are discussed, including the basics of real estate law, conservation finance, and project/organizational management. Students are required to undertake a clinical project with a local land conservation organization. Enrollment limited to twenty-five; preference to second-year students if limit reached. Bradford S. Gentry

F&ES 820b, Land Use Law and Environmental Planning 3 credits. This course explores the regulation by local governments of land uses in urban, rural, and suburban areas and the effect of development on the natural environment. The course helps students understand, in a practical way, how the environment can be protected through effective regulation at the local level. It introduces students to federal, state, regional, and local laws and programs that affect watershed protection and to the laws that delegate to local governments primary responsibility for decision making in the land use field. Theories of federalism, regionalism, states' rights, and localism are studied, as are the cases that provide a foundation in regulatory takings and the legitimate scope of land use regulation. The history of the delegation of planning and land use authority to local governments is traced, leading to an examination of local land use practices particularly as they relate to controlling development in and around watershed areas as well as regulatory response to sea-level rise and climate change. Students engage in empirical research working to identify, catalogue, and evaluate innovative local laws that successfully protect environmental functions and natural resources, and the manner in which towns, particularly on the coast, incorporate climate change into their planning and regulations. Nearby watersheds are used as a context for the students' understanding of the strengths and weaknesses of local planning and regulation. Attention is paid, in detail, to how the development of the land adversely affects natural resources and how these impacts can be mitigated through local planning and subsequent adoption of environmental regulations and regulations designed to promote sustainable development in a climate-changing world. The course includes examination of the state and local response to climate change, sea-level rise, growth management, alternatives to Euclidean zoning, low-impact development, brownfields redevelopment, energy conservation, and innovative land use strategies. Marjorie Shansky

F&ES 821b, Private Investment and the Environment: Legal Foundations and Tools 3 credits. As environmental problems become harder to regulate and public funds available for environmental protection decline, more people are looking to private investment as a tool for helping to improve environmental performance. This course explores the legal aspects of these initiatives, both opportunities and limits. It starts with an analysis of the goals of private investors—as a way to target efforts to change their decisions. It then moves to a review of the legal frameworks within which investors operate (property and tax law), as well as the legal tools that investors use to order their activities (contract law) and that governments use to address market failures (liability, regulation, information, and market mechanisms). The course concludes by examining efforts to use combinations of these legal tools to expand private investment in environmentally superior goods, services, and operations. Students are asked to choose an issue about which they care as the focus for their class deliverables. Faculty

F&ES 823a/LAW 20297, Regulation of Energy Extraction 2 or 3 credits. This comparative risk course explores the troubled intersection between energy and environmental policies. We consider a diverse range of regulatory approaches to minimize adverse environmental effects of various forms of energy development. These include emerging issues regarding hydraulic fracturing ("fracking") in the United States and European Union; regulation of off-shore drilling and lessons from the Deepwater Horizon oil spill; liability for natural resources and other damages from oil spills under the Oil Pollution Act of 1990 (OPA90); the Fukushima, Three Mile Island, and Chernobyl nuclear accidents; applicability of the National Environmental Policy Act (NEPA) to oil and coal leases on federal lands; the Endangered Species Act; visual pollution and other issues relating to wind farms; coal mine disasters; mountaintop mining and the Mine Safety Act; and tailings piles and the Surface Mining Control and Reclamation Act of 1977 (SMCRA). The class concludes by considering how concerns about climate change may affect the future of energy development. No more than three absences are permitted. No prerequisites. Supervised Analytic Writing or Substantial Paper credit is available for Law School students. Self-scheduled examination or paper option. E.D. Elliott

F&ES 824a/LAW 20348, Environmental Law and Policy 3 credits. This course is an introductory survey of environmental common law and the major federal environmental statutes, including the Clean Air Act, Clean Water Act, the National Environmental Policy Act, the Endangered Species Act, and hazardous waste and toxic substance laws. It explores foundational issues of statutory and regulatory analysis, ethics, politics, and economics in these various legal contexts. The course also considers various themes of environmental problems, including scientific uncertainty, risk, and risk perception. Given the breadth of the environmental law field, the course focuses on analyzing regulatory structure (i.e., the variety of existing and potential regulatory mechanisms for protecting and regulating usage of the environment) rather than either a superficial overview of every possible environmental topic or comprehensive analysis of only a few environmental statutes. The course also integrates a skills component that explores issues in statutory interpretation, legal ethics, federalism, and standing through several hypothetical problems as practiced from the perspective of environmental groups, government agencies, and regulated entity clients. Scheduled examination. Alejandro E. Camacho

F&ES 825b, International Environmental Law 3 credits. An introduction to public international law that both governs the global commons—atmosphere, climate, oceans, and stratospheric ozone layer—and guides the national obligations for ensuring transnational public health, advancing sustainable development, and managing Earth's shared resources: sources of energy and renewable stocks of plants and animals, biodiversity, and ecosystems services. The course explores how environmental law builds upon general principles of international law; the evolving norms of humanitarian law, human rights, environmental rights, and the rights of nature; and the substantive and procedural treaty obligations of nations. The principal multilateral environmental agreements (MEAs) are studied, with attention to how states enact environmental law regimes to implement the MEAs. Decision-making procedures of United Nations agencies and other international and regional bodies are critically examined. Robert Verchick

F&ES 826a, Foundations of Natural Resource Policy and Management 3 credits. This course offers an explicit interdisciplinary (integrative) framework that is genuinely effective in practical problem solving. This unique skill set overcomes the routine ways of thinking and solving conservation problems common to many NGOs and government organizations by explicitly developing more rigorous and effective critical-thinking, observation, and management skills. By simultaneously addressing rational, political, and practical aspects of real-world problem solving, the course helps students gain skills, understand, and offer solutions to the policy problems of managing natural resources. The approach we use requires several things of students (or any problem solvers): that they be contextual in terms of social and decision-making processes; that they use multiple methods and epistemologies from any field that helps in understanding problems; that they strive to be both procedurally and substantively rational in their work; and, finally, that they be clear about their own standpoint relative to the problems at hand. The approach used in this course draws on the oldest and most comprehensive part of the modern policy analytic movement—the policy sciences (interdisciplinary method)—which is growing in its applications worldwide today. The course includes a mix of critical thinking, philosophical issues, history, as well as issues that students bring in. Among the topics covered are human rights, scientific management, decision making, community-based approaches, governance, common interest, sustainability, professionalism, and allied thought and literature. In their course work students apply the basic concepts and tools to a problem of their choice, circulating drafts of their papers to other seminar participants and lecturing on and leading discussions of their topics in class sessions. Papers of sufficient quality may be collected in a volume for publication. Active participation, reading, discussion, lectures, guests, and projects make up the course. The seminar supports and complements other courses in the School and at the University. Enrollment limited to sixteen; application required. Susan G. Clark

F&ES 827a/LAW 20054, Animal Law 2 or 3 credits. This course examines the application of the law to nonhuman animals, the rules and regulations that govern their treatment, and the concepts of "animal welfare" and "animal rights." The course explores the historical and philosophical treatment of animals; discusses how such treatment impacts the way judges, politicians, lawyers, legal scholars, and lay people see, speak about, and use animals; surveys current animal protection laws and regulations, including overlap with such policy issues as food and agriculture, climate change, and biodiversity protection; describes recent political and legal campaigns to reform animal protection laws; examines the concept of "standing" and the problems of litigating on behalf of animals; discusses the current classification of animals as "property" and the impacts of that classification; and debates the merits and limitations of alternative classifications, such as the recognition of "legal rights" for animals. Students write a series of short response papers. An option to produce a longer research paper for Substantial or Supervised Analytic Writing credit is available for Law School students. Enrollment limited to forty. Douglas A. Kysar, Jonathan Lovvorn

F&ES 828b, Comparative Environmental Law in Global Legal Systems 3 credits. This course examines environmental law in the various legal systems of the world—from the common and civil law traditions to socialist law, customary law, and Islamic law. In

particular, environmental law and case studies from a number of countries are examined, including Australia, Canada, China, Europe, New Zealand, the United States, Singapore, and the states of Southeast Asia. The objective is to understand the scope and evolution of national environmental law through the patterns of legislative, administrative, and judicial decision making in the various legal regimes. The systems of central/unitary governments are contrasted with those of federal systems. As corporations engage in the same manufacturing activities around the world, it is important that corporate managers and their legal advisers understand how these activities are regulated in the different legal systems. Additionally, as Earth's natural systems are integrated throughout the biosphere, the effectiveness of one nation's environmental laws is complemented or undermined by the efficacy of another nation's comparable laws. Students are examined by a written paper that is a comparative study of some aspect of environmental law, involving at least two jurisdictions. Faculty

[**F&ES 829b, International Environmental Policy and Governance** 3 credits. The development of international environmental policy and the functioning of global environmental governance. Critical evaluation of theoretical claims in the literature and the reasoning of policy makers. Introduction of analytical and theoretical tools used to assess environmental problems. Case studies emphasize climate, forestry, and fisheries. Benjamin W. Cashore]

F&ES 835a, Seminar on Land Use Planning 1 credit. Land use control exercised by state and local governments determines where development occurs on the American landscape, the preservation of natural resources, the emission of greenhouse gases, the conservation of energy, and the shape and livability of cities and towns. The exercise of legal authority to plan and regulate the development and conservation of privately owned land plays a key role in meeting the needs of the nation's growing population for housing and nonresidential development, as well as ensuring that critical environmental functions are protected from the adverse impacts of land development. This course explores the multifaceted discipline of land use planning and its associated ecological implications. Numerous land use strategies are discussed that provide practical tools for professionals to create sustainable buildings, neighborhoods, and communities. The focus of this seminar is to expose students to the basics of land use planning in the United States and to serve as an introduction for the F&ES curricular concentration in land use. Guest speakers are professionals involved in sustainable development, land conservation, smart growth, and climate-change management. Classes include discussions on the trajectory for professional careers. Jessica Bacher

F&ES 835Eb, Seminar on Land Use Planning 1 credit. This is an online course. Land use control exercised by state and local governments determines where development occurs on the American landscape, the preservation of natural resources, the emission of greenhouse gases, the conservation of energy, and the shape and livability of cities and towns. The exercise of legal authority to plan and regulate the development and conservation of privately owned land plays a key role in meeting the needs of the nation's growing population for housing and nonresidential development, as well as ensuring that critical environmental functions are protected from the adverse impacts of land development.

This course explores the multifaceted discipline of land use planning and its associated ecological implications. Numerous land use strategies are discussed that provide practical tools for professionals to create sustainable buildings, neighborhoods, and communities. The focus of this seminar is to expose students to the basics of land use planning in the United States and to serve as an introduction for the F&ES curricular concentration in land use. Guest speakers are professionals involved in sustainable development, land conservation, smart growth, and climate-change management. Classes include discussions on the trajectory for professional careers. Jessica Bacher

[**F&ES 837b, Seminar on Leadership in Natural Resources and the Environment** 3 credits. This seminar explores the qualities, characteristics, and behaviors of leaders in the fields of natural resources, science, and management. Through lectures, guest speakers, and individual and team projects, students analyze the attributes of leadership in individuals and organizations. They examine leaders and organizations and develop skills and techniques for leading and for assessing various organizations' leadership strengths and weaknesses. The class travels to Washington, D.C., and meets with leaders in the policy, environmental, industry, and information segments. Through this experience, students have the opportunity to assess their own leadership capabilities and identify means to improve them. Enrollment limited to fifteen. Chadwick D. Oliver]

[**F&ES 840a/LAW 21754, Climate Change and Clean Energy** 3 credits. This course examines the scientific, economic, legal, political, institutional, and historic underpinnings of climate change and the related policy challenge of developing the energy system needed to support a prosperous and sustainable modern society. Particular attention is given to analyzing the existing framework of treaties, law, regulations, and policy—and the incentives they have created—which have done little over the past several decades to change the world's trajectory with regard to the build-up of greenhouse gas emissions in the atmosphere. What would a twenty-first-century policy framework that is designed to deliver a sustainable energy future and a successful response to climate change look like? How would such a framework address issues of equity? How might incentives be structured to engage the business community and deliver the innovation needed in many domains? While designed as a lecture course, class sessions are highly interactive. Self-scheduled examination or paper option. Daniel C. Esty]

[**F&ES 843b/AMST 839b/HIST 743b/HSHM 744b, Readings in Environmental History** 2 credits. Reading and discussion of key works in environmental history. The course explores major forces shaping human-environment relationships, such as markets, politics, and ecological dynamics, and compares different approaches to writing about social and environmental change. Paul Sabin]

[**F&ES 849b, Natural Resource Policy Practicum** 3 credits. This practicum provides opportunities for students to participate in the analysis and development of current issues/policies affecting natural resources in the United States and to learn about contemporary issues affecting natural resources and the environment. Students are organized into teams and assigned a number of current policy issues for analysis and discussion. The identified issues originate from discussions with staff of national environmental organizations, Congressional offices, and federal natural resource agencies that serve as "clients"

for the purposes of this practicum. Students are required to communicate directly with the organizations and individuals seeking policy analysis assistance, to conduct research and interdisciplinary analysis of the subject, to prepare a report and recommendations for the identified client, and to brief the client on the product of their analysis. Each team is responsible for a minimum of two policy analysis projects during the term. Following an initial organizational meeting, student teams meet with the instructor once a week to provide updates on projects and to discuss current national and international issues and concerns affecting natural resources and the environment. James R. Lyons]

F&ES 850b, International Organizations and Conferences 3 credits. This course focuses on an international environmental conference or symposium and the organization that sponsors the event. Both theoretical and clinical approaches are used. The course studies the mission of the organization and the role of the conference. Students prepare individual and group papers suitable for presentation at the conference. Every attempt is made to have the students participate in the conference, even if it occurs in the next term, but attendance is not guaranteed. The class has studied and participated in the 5th World Parks Congress, Durban, South Africa, 2003; the World Conservation Congress in Bangkok, Thailand, 2004, and in Barcelona, Spain, 2008; and the UNEP Council Meeting, Nairobi, Kenya, 2005. Since 2009, students have participated in the climate COP. This course is co-taught with an advanced doctoral student or visiting faculty member who brings knowledge of the specific organization and subject matter being studied. Enrollment limited to sixteen. Gordon T. Geballe

F&ES 851b, Environmental Diplomacy Practicum 3 credits. This course aims to provide experiential learning of how and why states at the United Nations make decisions and set standards for managing environmental matters and natural resources issues. The course also addresses what factors and circumstances may affect the result and implementation. Students participate in class discussions, guest lectures, and meetings and dialogues with diplomats and officials of UN agencies and civil society. This process of learning enables students to develop a better understanding and realistic assessment of UN efforts to address climate change, geo-engineering, biodiversity, ocean resources, ozone depletion, gender equality, and economic development. Faculty

[**F&ES 855a, Climate Change Mitigation in Urban Areas** 3 credits. This class provides an in-depth assessment of the relationships between urbanization and climate change, and the central ways in which urban areas, cities, and other human settlements can mitigate climate change. The course explores two major themes: (1) the ways in which cities and urban areas contribute to greenhouse gas emissions and climate change; and (2) the ways in which urban areas can mitigate greenhouse gas emissions and climate change. Class topics parallel the IPCC 5th Assessment Report, Chapter 12, Human Settlements, Infrastructure, and Spatial Planning, and include spatial form and energy use, land use planning for climate mitigation, urban metabolism, and local climate action plans. The class format is reading-, writing-, and discussion-intensive. Students are taught how to synthesize scientific literature, write policy memos, and develop effective oral presentations on the science of climate change mitigation in urban areas. Enrollment limited to sixteen. Karen Seto]

F&ES 859b/LAW 21182, Natural Resources Law 3 credits. Managing natural resources is complicated and contentious. Today's economy relies on oil and gas, but tapping those resources can scar landscapes and spoil tourism. Dredging a coastal marsh might free barge traffic, but might also sink bird habitat and erode natural flood barriers. Everyone loves a sunlit forest, but we need wood too. Trade-offs like these are everywhere. This course examines the ways that law allocates and manages many of our most important natural resources, including public lands, biodiversity, wetlands, and offshore oil. Readings take us to a variety of landscapes, from the Mojave Desert to the Rocky Mountains to Cajun swamps to Walden Pond. We examine constitutional dilemmas and the pivotal role played by administrative law. While the focus is on federal law (the National Environmental Policy Act, the National Forest Management Act, the Endangered Species Act, and more), the course also considers some aspects of state law, including doctrines of public trust. Throughout, we keep an eye on historical, ethical, and economic considerations too — and, of course, climate change. Classes include a few lectures, lots of discussion, and a few structured simulations. Self-scheduled examination. Robert Verchick

[**F&ES 862b/HPM 601b/LAW 21141/PSYC 601b, The Science of Science Communication** 2 credits. The simple dissemination of valid scientific knowledge does not guarantee it will be recognized by non-experts to whom it is of consequence. The science of science communication is an emerging, multidisciplinary field that investigates the processes that enable ordinary citizens to form beliefs consistent with the best available scientific evidence, the conditions that impede the formation of such beliefs, and the strategies that can be employed to avoid or ameliorate such conditions. This course surveys, and makes a modest attempt to systematize, the growing body of work in this area. Special attention is paid to identifying the distinctive communication dynamics of the diverse contexts in which non-experts engage scientific information, including electoral politics, governmental policy making, and personal health decision making. Paper required. Permission of the instructor required. Dan Kahan]

[**F&ES 866b/LAW 21566, The Law of Climate Change** 3 credits. This course explores legal and policy developments pertaining to climate change and the regulation of greenhouse gas emissions. Approaches considered range in scale (state, regional, national, international), temporal scope (incremental measures, multi-decade emissions goals, constitutional amendments), policy orientation (voluntary initiatives, disclosures rules, subsidization, tort litigation, command-and-control regulation, cap-and-trade schemes, emissions taxes), regulatory target (industry and manufacturing, commercial and retail firms, financial and insurance companies, consumers and workers), and regulatory objective (stabilization of greenhouse gas concentrations, reduction of emissions levels or intensity, energy security, optimal balancing of costs and benefits, adaption to unavoidable impacts). Although course readings and discussion focus on existing and actual proposed legal responses to climate change, the overarching aim of the course is to anticipate how the climate change conundrum will affect our laws and our lives in the long run. No prerequisites. Self-scheduled examination or paper option. Douglas A. Kysar]

F&ES 874a/MGT 862a, Introduction to Responsible Business: Oil and Wine 1.5 credits. What is "sustainable" or "responsible" business? This is an introductory course in the principles and tools of responsible business (including the concepts of sustainability, corporate responsibility, corporate social responsibility, and corporate citizenship). We first use the oil sector to introduce the key aspects of corporate responsibility (CR): strategy, management systems, governance structures, stakeholder engagement, metrics, and assurance. Here we define CR to include environmental as well as social and socioeconomic considerations. We then use the wine sector to explore the gray areas of responsible business, broadening the perception of CR toward sustainability by exploring the interaction between the environment and human society—including culture, religion, and the social utility of business. We take a deeper look at the value chain (growing grapes, producing wine, responsible consumption) to test the boundary of CR (where does a company's responsibility to environment and society begin and end?). Finally, we explore the scope of social and environmental impacts from the micro-scale (e.g., terroir impacts) to the global scale (e.g., climate change and socioeconomic megatrends). Although we use the oil and wine sectors to explore these concepts, the learning from this course is applicable to any corporate sustainability endeavor as well as to more applied sustainability courses. Todd Cort

F&ES 875Ea/MGMT 955a, Urban Resilience: Complexity, Collaborative Structures, and Leadership Challenges 3 credits. A Small Network Online Course (SNOC) through the Global Network for Advanced Management (GNAM). The world continues to urbanize. In the one hundred years since 1913, the proportion of the world's population that lives in cities grew fivefold from 10 to 50 percent, and estimates suggest that 75 percent of the world's population will do so in 2050. Though history reveals that urbanization has always been an accelerator of growth and development, it also poses profound challenges for residents, communities, corporations, cities, regions, and countries. A 2015 McKinsey report succinctly notes: "Cities are where most of the world's population live, work, and play, and they are important to everyone else, too. They are the world's economic engine, consuming the majority of global power and resources, while generating 80 percent of GDP and 70 percent of greenhouse-gas emissions. Making cities great is the critical infrastructure challenge of this century." This online course is a collaborative offering to students across the GNAM network schools. It brings together the 100 Resilient Cities (100RC) network, the Rockefeller Foundation, schools across the GNAM (with faculty from Yale, as well as the University of British Columbia, EGADE Business School, Ghana Business School, and the Indian Institute of Management-Bangalore), and practitioners from business, government, and civil society to engage with the topic of urban resilience. For the purposes of this course, we draw on the view of urban resilience articulated by 100RC as the ability of individuals, communities, businesses, institutions, and systems within a city to survive, adapt, and thrive in response to the acute shocks and chronic stresses they may experience. The purposes of the course are to help students: (1) articulate resilience challenges and opportunities facing global cities; (2) describe the holistic and integrated nature of resiliency and its key drivers; and (3) work in virtual global teams to design collaborative approaches to addressing urban resilience challenges involving business, government, and civil society. F&ES faculty host: Bradford S. Gentry

SOCIAL AND POLITICAL ECOLOGY

F&ES 606a, Modeling a Dynamic World 3 credits. The human and natural systems of the world we live in are dynamic, adaptive, and constantly interacting. Many of us are engaged in understanding and finding solutions to complex challenges—such as eradicating chronic poverty, stopping resources degradation, improving institutional governance, or adaptating to global climate change—that very often arise due to interactions between these systems. The dynamic and complex adaptive nature of such challenges necessitates newer theories, methods, and tools that can conduct interdisciplinary analysis beyond traditional disciplinary approaches. Systems approach and thinking have moved from being an "in vogue" concept on the periphery to being fundamental to analysis in a variety of disciplines. At the same time, modeling and simulation, while used in a variety of engineering and management related disciplines, have gained significant ground in both complexity and sustainability science. This course, while introducing theory associated with systems and sustainability science, is focused on providing hands-on fundamentals on modeling and simulation techniques originating in system dynamics. It engages in such questions as: What is a system? What is systems thinking? Why do we need systems thinking for sustainability science? What are models? How do we develop models? What is simulation? Why do we need modeling and simulation? What platforms, tools, and techniques can we learn to conduct modeling and simulation-based analysis? Alark Saxena

F&ES 614b, Environmental Governance and Justice Practicum: Case Studies in a Changing Climate 3 credits. The course covers how the practical and theoretical methods used in environmental policy and planning can assist city, county, and state governments address the immediate and long-term sustainability challenges posed by global and local environmental change (such as climate change). Particular attention is focused on social institutional practices, and how race, class, and gender impact environmental participation and justice in the distribution of natural resources, such as water and air. Students examine social theories of "nature," as well as a range of policy responses to address environmental inequities. An emphasis is placed on disadvantaged communities in the United States. Urban and sociological theories are complemented by real-world environmental controversies that require group collaboration to produce in-class presentations, role-playing negotiation case simulations, and the completion of client policy memos with regional and local policy makers that engage students critically with the course material. Michael A. Mendez

F&ES 628a, Understanding and Building Resistance in Developing Countries 3 credits. Resilience in the past decade has moved from a peripheral ecological idea to a central concept in major world debates: e.g., sustainable development goals, climate change adaptation, resilient infrastructure and ecosystems. What makes a person or a community resilient to the impacts of climate change? How has the resilience approach been operationalized in the fields of sustainability, disaster risk reduction, and climate change adaptation? What are the limitations and critiques of resilience thinking, and how might this concept evolve in the future? As development and government agencies increasingly adopt the resilience approach, students interested in pursuing careers across a range of business, environmental, and development sectors will increasingly find themselves faced

with these questions. This course prepares students to understand the theory of resilience and operationalize it in a given context. Alark Saxena

[**F&ES 738Eb, Himalayan Diversities: Environment, Livelihood, and Culture** 3 credits. An online introductory course that showcases Himalayan diversities from the perspective of three broad themes: environment, livelihood, and culture. The course is geared toward students and scholars interested in developing a broad understanding of the Himalayan region. Using subject experts in the region, the course provides insights on biological, cultural, and livelihood diversity within the vast region of the Eastern, Central, and Western Himalayas. It further engages the students to look at the impact of climate change in the region and what a sustainable future can look like for the Himalayas. The course also provides supplementary material for students who are interested in developing a more nuanced understanding of the region and provides direction to where they can find more information. Students gain a well-rounded understanding of the importance of Himalayan issues, current challenges, and how we can create long-term sustainability in the region. Alark Saxena]

F&ES 760b, Conservation in Practice: An International Perspective 3 credits. This seminar focuses on the practice of wildlife and wildlands conservation, examining key topics from the dual perspectives of academic literature and actual field experiences; bringing together interdisciplinary thinking; and drawing on examples from Africa, Asia, Latin America, and the United States. The thematic outline of the seminar is organized around three fundamental questions in nature conservation: What are we trying to save—and why? How is this being done—and how has it changed over time? What lessons are we learning—and what overarching issues remain problematic? Specific topics include how different players define and value wildness; selection and prioritization of conservation targets; comparisons of various species and landscape conservation approaches; and governance and decision making in conservation, including ties between conservation and development and community-based conservation. During the course of the term, six to eight guest conservation practitioners join the seminar, bringing tangible examples of current practice into the classroom via presentations and discussions. Student participation and leadership are key, as the seminar is discussion-based, centers on the sharing of ideas and experiences, demands challenging thinking, and is frequently led by students. Limited enrollment. Evaluation is based on participation, comments on assigned readings, and a final paper. Amy Vedder, A. William Weber

[**F&ES 763b, Translating the Science of Wildlife Conservation into Practice** 2 credits (successful completion of all discussion-based work), 3 credits (final paper). Focusing on the application of wildlife science to ongoing conservation initiatives, this advanced seminar examines selected, in-depth topics on wildlife conservation across the globe. It draws on students' strong background in ecology (including concurrent registration in F&ES 744) and prior examination of international conservation issues. Topics include determination of wildlife objectives, complications of temporal and geographical scales, wildlife in the context of culture, and the economics and financing of wildlife conservation. Each seminar session includes examination of case studies, and each general topic includes structured debate and/or role-playing to enhance the emphasis on applied conservation. Student participation and leadership are key, as sessions are discussion-based,

center on the sharing of ideas and experiences, demand challenging current thinking, and are frequently student-led. Prerequisite: F&ES 760. Enrollment limited to ten. Amy Vedder]

F&ES 764a, The North American West as an Environmental, Cultural, and Political Case Study 3 credits. The social and environmental context of the North American West provides fertile ground to examine important issues pertaining to culture, politics, environmental justice, social movements, and institutional structures. This course equips students to think critically and imaginatively about the social aspects of natural landscapes and the communities who inhabit them. This is not a history course, but it does examine stability and change across time. The course draws on empirical cases dealing with a range of interrelated issues, including economic change, environmental values, energy and water conflicts, native experiences, religion, American mythologies, gender, race, and the culture of individualism. Engaging with important theories, debates, and scholarly work around these exciting cultural and political issues is the primary goal of this course. Because of the importance of engaging these issues on the ground in real-life situations, the course includes a short (and optional) field trip during the October break. Justin Farrell

F&ES 767b, Tools for Conservation Project Design and Management 3 credits. As wildlife and wildland conservation programs have multiplied and grown in size, conservation organizations have sought methods to improve strategic project planning, assessment of progress, cross-project comparison, learning of lessons, and transparency for donors. To address these challenges, major nonprofit organizations have collaboratively designed a set of decision-support tools for planning field projects and programs and for monitoring their progress, summarized in the "Open Standards for the Practice of Conservation" (http://cmp-openstandards.org). Use of these tools has allowed organizations to more clearly articulate strategies, define priority actions, critically assess success, manage adaptively, and derive lessons—all of which help to improve effectiveness and respond to donor interests. Students in this course explore a mutually reinforcing suite of these project tools: their underlying principles are introduced, students practice the techniques, and current case studies from field conservation are examined to explore tool utility. Students synthesize use of these design tools in a final project or program proposal focused on a single case study of their choice. The suite of decision-support tools covered includes conceptual models for project design, situational and stakeholder assessments, threats and opportunities analysis, conservation target identification (particularly landscape species selection), and monitoring frameworks. Students gain experience in design of projects and their monitoring, as well as familiarity with budgeting. Enrollment limited to twelve. Amy Vedder, A. William Weber

F&ES 772a, Social Justice in the Sustainable Food System 3 credits. This course explores social justice dimensions of today's globalized food system and considers sustainability in terms of social, in addition to environmental, indicators. We develop an understanding of the food system that includes farmers and agroecological systems; farm and industry workers; business owners and policy makers; as well as all who consume food. Based on this understanding, we examine how phenomena such as racism, gender discrimination, structural violence, and neoliberalization surface within the food system both in

the United States and globally, drawing examples from agriculture, labor, public health, international governance bodies, and NGOs. We examine how contemporary policy debates surrounding global issues such as immigration and climate change affect social and environmental justice in the food system at multiple scales. We discuss conceptual frameworks – including food justice and food sovereignty – that farmers, activists, critical food scholars, humanitarian agencies, and policy makers are using to create food systems that are both sustainable and just. Throughout the term we explore our own position(s) as university-based stakeholders in the food system. The course includes guest speakers, and students are encouraged to integrate aspects of their own academic and/or scholar-activist projects into one or more course assignments. Kristin Reynolds

F&ES 774a/NELC 774a, Agriculture: Origins, Evolution, Crises 3 credits. Analysis of the societal and environmental causes and effects of plant and animal domestication, the intensification of agro-production, and the crises of agro-production: population pressure, land degradation, societal collapses, technological innovation, transformed social relations of production, sustainability, and biodiversity. From the global field, the best-documented eastern and western hemisphere trajectories are selected for analysis. Harvey Weiss

F&ES 783b, Field Course in Cultural Diversity, Environmental Politics, and Social Change 3 credits. This course provides students with the opportunity to engage environmental politics and social change through experiential field-based learning and immersive research. Using a case-study approach, the course emphasizes active learning and independent research about broad theoretical issues pertaining to culture, politics, environmental justice, values, social movements, and institutional structures. The central component of the course is a major field trip to Western Wyoming, which is an especially salient context for examining these theoretical issues through the lens of water scarcity, population growth, income inequality, energy development, local knowledge, and indigenous perspectives. The course meets throughout the term for instruction and discussion in preparation for the spring break trip, and it concludes with sessions where students present their research. Due to high demand, the course requires a short application. Justin Farrell

F&ES 783Ea/REL 903Ha, Introduction to Religions and Ecology 2 credits. This six-week hybrid course introduces the newly emerging field of religion and ecology and traces its development over the past several decades. It explores human relations to the natural world as differentiated in religious and cultural traditions. In particular, it investigates the symbolic and lived expressions of these interconnections in diverse religious texts, ethics, and practices. In addition, the course draws on the scientific field of ecology for an understanding of the dynamic processes of Earth's ecosystems. The course explores parallel developments in human-Earth relations defined as religious ecologies. Similarly, it identifies narratives that orient humans to the cosmos, namely, religious cosmologies. This is an online hybrid course; no shopping period. John Grim, Mary Evelyn Tucker

[**F&ES 784Ea, Western Religions and Ecology** 2 credits. This six-week hybrid course explores views of nature in the Abrahamic religions of Judaism, Christianity, and Islam. Students examine historical examples of human-Earth interactions expressed in

scriptures, traditions, and ritual practices. In particular, they explore the meaning of "dominion" in Judaism, "stewardship" in Christianity, and "trusteeship" in Islam. Having retrieved these examples, they evaluate them in light of present environmental insights and challenges. Students also explore contemporary examples of how these religions are engaged in environmental projects within their different communities. In these ways students come to reflect upon values inherent in these religions that have helped to shape and inform cultural interactions with nature in the West. This is an online hybrid course; no shopping period. Prerequisite: F&ES 783E. John Grim, Mary Evelyn Tucker]

[**F&ES 785Eb/REL 917Hb, East Asian Religions and Ecology** 2 credits. This six-week hybrid course explores views of nature in the East Asian religions of Confucianism, Daoism, and Buddhism. Students examine historical examples of human-Earth interactions expressed in scriptures, traditions, and ritual practices. In particular, they explore the meaning of "harmony" in Confucianism, "the Way" in Daoism, and "interdependence" in Buddhism. Having retrieved these examples, they evaluate them in light of present environmental insights and challenges. Students also explore contemporary examples of how these religions are engaged in environmental projects within their different communities. In these ways students come to reflect upon values inherent in these religions that have helped to shape and inform cultural interactions with nature in East Asia. This is an online hybrid course; no shopping period. Prerequisite: F&ES 783E. John Grim, Mary Evelyn Tucker]

F&ES 786Ea/REL 918Ha, Native American Religions and Ecology 2 credits. This six-week hybrid course explores a diversity of Native American peoples and examines their ecological interactions with place, biodiversity, and celestial bodies as religious realities. The dynamic interactions of First Nations' cultures and bioregions provide a lens for understanding lifeways, namely, a weave of thought and practice in traditional Native American life. Through symbolic languages, subsistence practices, and traditional rituals, lifeways give expression to living cosmologies, namely, communal life lived in relation to a sacred universe. This is an online hybrid course; no shopping period. John Grim, Mary Evelyn Tucker

F&ES 787E/REL 911Ha, Thomas Berry: Life and Thought 2 credits. This six-week hybrid course investigates the life and thought of Thomas Berry in relation to the field of religion and ecology as well as the *Journey of the Universe* project. Berry (1914–2009) was a historian of religions and a significant voice awakening religious sensibilities to the environmental crisis. He is particularly well known for articulating a "Universe Story" that explores the world-changing implication of evolutionary sciences. As an overview this course draws on his books, articles, and recorded lectures to examine such ideas as the Universe Story, the Great Work, and the Ecozoic era. In addition, the course explores his studies in world religions including Buddhism, Confucianism, and indigenous traditions. Finally the course highlights his challenge to Christianity to articulate theologies of not only divine-human relations, but also human-Earth relations. This is an online hybrid course; no shopping period. John Grim, Mary Evelyn Tucker

F&ES 789E/REL 912Ha, Journey of the Universe 2 credits. This six-week hybrid course draws on the resources created in the *Journey of the Universe* project—a film, a book, and a

series of twenty interviews with scientists and environmentalists. *Journey of the Universe* weaves together the discoveries of evolutionary science with cosmological understandings found in the religious traditions of the world. The authors explore cosmic evolution as a creative process based on connection, interdependence, and emergence. The *Journey* project also presents an opportunity to investigate the daunting ecological and social challenges of our times. This course examines a range of dynamic interactions and interdependencies in the emergence of galaxies, Earth, life, and human communities. It brings the sciences and humanities into dialogue to explore the ways in which we understand evolutionary processes and the implications for humans and our ecological future. This is an online hybrid course; no shopping period. John Grim, Mary Evelyn Tucker

[**F&ES 792Eb/REL 928Hb, South Asian Religions and Ecology** 2 credits. This six-week hybrid course introduces the South Asian religious traditions of Hinduism and Buddhism and, briefly, Jainism, in relation to the emerging field of religion and ecology. This overview course identifies developments in the traditions that highlight their ecological implications in the contemporary period. In particular, it relates religious concepts, textual analysis, ritual activities, and institutional formations to engaged, on-the-ground environmental projects. It investigates the symbolic and lived expressions in religious ethics and practices that can be defined as religious ecologies. Similarly, it identifies narratives in Hinduism, Buddhism, and Jainism that orient humans to the cosmos, namely, religious cosmologies. This interrelationship of narratives and religious environmentalism provides pathways into the study of religion and ecology. This is an online hybrid course; no shopping period. John Grim, Mary Evelyn Tucker]

F&ES 793b/ANTH 773b/ARCG 773b/NELC 588b, Abrupt Climate Change and Societal Collapse 3 credits. Collapse documented in the archaeological and early historical records of the Old and New Worlds, including Mesopotamia, Mesoamerica, the Andes, and Europe. Analysis of politicoeconomic vulnerabilities, resiliencies, and adaptations in the face of abrupt climate change, anthropogenic environmental degradation, resource depletion, "barbarian" incursions, or class conflict. Harvey Weiss

F&ES 831b, Society and Natural Resources 1–3 credits. This research seminar explores the relationship between society and natural resources in a genuinely interdisciplinary manner. This session focuses on the foundations (philosophic, methodological, and pragmatic) of social and integrative/interdisciplinary sciences/approaches to understanding and policy. We demonstrate a major case application. Although the specific topic of the seminar varies from year to year, the consistent underlying theme is an examination of how societies organize themselves, use natural resources, and affect their environment. In past years, the seminar focused on energy and the environment, interdisciplinary problem solving, and environmental psychology and sociology. We focus on leadership (the lead and leader's relationships), too. Guests and students make presentations and participate in discussions each week. Readings, active participation, and student papers are required. The seminar overall looks at people seeking values using natural resources through institutions. This relationship (people, values, natural resources, and institutions) has been extensively written about and discussed in diverse fields. A few years ago, the seminar examined the relationship of human dignity as a universal value goal,

professionalism and practice, and sustainability as an applied notion. Other versions of the seminar have looked at conceptual (theoretical) models about society and natural resources from policy sciences, social ecology, political ecology, and other knowledge areas. Still other seminars focused on "Bridging Local and Professional Knowledge in Environmental Sustainability" and "War and the Environment." Topic for this year's seminar to be determined. Susan G. Clark

F&ES 836a/ANTH 541a/HIST 965a/PLSC 779a, Agrarian Societies: Culture, Society, History, and Development 3 credits. An interdisciplinary examination of agrarian societies, contemporary and historical, Western and non-Western. Major analytical perspectives from anthropology, economics, history, political science, and environmental studies are used to develop a meaning-centered and historically grounded account of the transformation of rural society. Four hours lecture plus discussion sections. Peter Perdue, James C. Scott, Kalyanakrishnan Sivaramakrishnan

F&ES 839a/ANTH 597a, Social Science of Conservation and Development 3 credits. This course is designed to provide a fundamental understanding of the social aspects involved in implementing conservation and sustainable development projects. Social science makes two contributions to the practice of conservation and development. First, it provides ways of thinking about, researching, and working with social groupings—including rural households and communities, but also development and conservation institutions, states, and NGOs. This aspect includes relations between groups at all these levels, and especially the role of politics and power in these relations. Second, social science tackles the analysis of the knowledge systems that implicitly shape conservation and development policy and impinge on practice. The emphasis throughout is on how these things shape the practice of sustainable development and conservation. Case studies used in the course have been balanced as much as possible between Southeast Asia, South Asia, Africa, and Latin America; most are rural and Third World. The course includes readings from all noneconomic social sciences. The goal is to stimulate students to apply informed and critical thinking (which means not criticizing others, but questioning our own underlying assumptions) to whatever roles they may come to play in conservation and sustainable development, in order to move toward more environmentally and socially sustainable projects and policies. The course is also designed to help students shape future research by learning to ask questions that build on, but are unanswered by, the social science theory of conservation and development. No prerequisites. This is a requirement for the combined F&ES/Anthropology doctoral degree program and a prerequisite for some advanced F&ES courses. Open to advanced undergraduates. Three hours lecture/seminar. Carol Carpenter

F&ES 846b, Perspectives on Environmental Injustices 3 credits. In this seminar we explore domestic and global environmental issues from a perspective that foregrounds questions of social justice. This course is based on three fundamental premises: (1) all individuals and communities, regardless of their social or economic conditions, have the right to a clean and healthy environment; (2) there is a connection between environmental exploitation, human exploitation, and social justice; and (3) many environmental and social injustices are rooted in larger structural issues in society that must be understood. With these premises as a starting point, we turn to more difficult questions such as,

Why and through what political, social, and economic processes are some people denied this basic right to a clean and safe environment? What is the state of scientific evidence surrounding environmental injustice and what are the current scientific challenges in assessing environmental injustices in relationship to human health? What legal frameworks exist within the United States to address environmental injustice? Amity Doolittle, Michelle L. Bell

[**F&ES 854b, Institutions and the Environment** 3 credits. One of the most critically important questions facing those seeking to promote environmental stewardship of the world's biosphere is to understand better what types of local, domestic, global, and nonstate institutions might best promote meaningful and enduring environmental problem solving. The purpose of this seminar is to review key works in political science and related disciplines on institutions to assess their direct or indirect implications for environmental governance and effectiveness. The course assesses perspectives from rational choice, historical, and sociological institutionalism that have permeated comparative public scholarship; the treatment of institutions with international relations literature; the attention that common property scholars have placed on understanding the development of local institutions; and the emergence and proliferation of private governance institutions. We are curious about understanding the theoretical underpinnings and scholarly debates about how support for such systems occurs. We also assess the various theories against empirical evidence that assess their support and influence ameliorating key resource and environmental problems. Benjamin W. Cashore]

[**F&ES 857b, Urbanization, Global Change, and Sustainability** 3 credits. The conversion of land surface to urban uses is one of the most profound human impacts on the global biosphere. Urban growth and associated changes in human activities on the land and in the physical attributes of Earth's surface have profound environmental consequences, including local and regional climate change, loss of wildlife habitat and biodiversity, soil erosion, and a decline in ecosystem services. This seminar examines the interactions and relationships between urbanization and global change at local, regional, and global scales. Topics include urban land-cover change, cities and local climate, urban vulnerability, urban diets and the challenges for agriculture, and urban biodiversity. Karen Seto]

[**F&ES 869b/ANTH 572b, Disaster, Degradation, Dystopia: Social Science Approaches to Environmental Perturbation and Change** 3 credits. An advanced seminar on the long tradition of social science scholarship on environmental perception, perturbation, and disaster, the relevance of which has been heightened by the current global attention to climate change. Section I, introduction. Section II, central questions and debates in the field: social dimensions of natural disasters; discursive dimensions of environmental degradation; asymmetries between political power and resource wealth; and anthropological approaches to the study of climate and society. Section III, historic and comparative understandings of the environment: the twenty-first-century development of a posthumanist, multispecies ethnography; and then the half-millennium tradition of natural history studies. Section IV, classroom presentation of students' and teaching fellow's writings. One class is devoted to student selections of the most influential works in

the current literature, and there are two guest lectures by prominent scholars in the field. Prerequisite: F&ES 520/ANTH 581, ANTH 517, or F&ES 839/ANTH 597. Three hours lecture/seminar. Michael R. Dove]

F&ES 873a, Global Environmental History 3 credits. The dynamic relationship between environmental and social forces from the Pleistocene glaciations to the Anthropocene present: Pleistocene extinctions; transitions from hunting to gathering to agriculture; Old World origins of cities, states, and civilization; adaptations and collapses of Old and New World civilizations in the face of climate disasters; the destruction and reconstruction of the New World by the Old. In the foreground of each analysis are the issues of adaptation, resilience, and sustainability: what forced long-term societal changes? Harvey Weiss

F&ES 877b/ANTH 561b, Anthropology of the Global Economy for Conservation and Development 3 credits. This seminar explores topics in the anthropology of the global economy that are relevant to conservation and development policy and practice. Anthropologists are often assumed to focus on micro- or local-level research, and thus to have limited usefulness in the contemporary, global world of conservation and development policy. In fact, however, they have been examining global topics since at least the 1980s, and little current anthropological research is limited to the village level. More importantly, the anthropological perspective on the global economy is unique and important. This course examines the topics that make up this perspective, including using a single commodity to study the global economy, theorizing the transition to capitalism, the moral relation between economy and society, models for thinking about power in the global economy, articulations between rural households and the global economy, rural-urban relations in the global economy; the process of becoming a commodity, the commons debate, credit and debt, contracting and flexible accumulation, globalization and scale, and theorizing REDD. Readings for the course come from the subfields of environmental anthropology, economic anthropology, the anthropology of development, and the anthropology of conservation. This class is a prerequisite for F&ES 965. Though designed for master's and doctoral students, it is open to advanced undergraduates. Three hours lecture/seminar. Carol Carpenter

F&ES 878a, Climate and Society 3 credits. Seminar on the major traditions of thought—both historic and contemporary—regarding climate, climate change, and society, drawing on the social sciences and anthropology in particular. Section I, introduction. Section II, continuities from past to present: How have differences in climate been used since the classical era to explain differences among people? How does this vary between Western and non-Western intellectual traditions? What role has the ethnographic study of folk knowledge played in this? Section III, impact on society of environmental change: What shape did environmental determinism take in the nineteenth and twentieth centuries? Can historic cases of societal "collapse" be attributed to extreme climatic events? Can such events play a constructive as well as destructive role in the development of a society? Section IV, vulnerability and control: What are the means by which societies attempt to cope with extreme climatic events? How do such events reflect, reveal, and reproduce socioeconomic fault lines? Section V, knowledge and its circulation: How is knowledge of climate and its extremes constituted? How does such knowledge become an object of contestation between central and local authorities, as well as between the

global North and South? The main texts, *The Anthropology of Climate Change* (Dove, ed., 2014, Wiley-Blackwell) and *Climate Cultures* (Barnes and Dove, eds., 2015, Yale) were written especially for this course. Films and popular media utilized as appropriate. No prerequisites. Graduate students may enroll with the instructor's permission. Two hours lecture/seminar. Michael R. Dove

[**F&ES 882a/ANTH 582a, The Black Box of Implementation: Households, Communities, Gender** 3 credits. The implementation of development projects has been described as existing in a "black box": development and conservation policy (even participatory policy) is often not defined to inform effective implementation (Mosse 2004), and data on actual implementation is rarely incorporated into policy. This course examines the invisibility of implementation, and the common, mistaken assumptions about implementation targets (like households, communities, and gender) that take the place of absent data in policy. The course also makes an effort to use anthropology to shed light into this black box, to allow students to think more critically about the varied and dynamic social field in which project implementation occurs. Political and economic aspects of relations within households and communities, particularly gender relations, are examined in all of their complexity, variation, and dynamism. The real focus of the course, however, is not the contents of the black box, but the political and economic relations between households, communities, and gender, on the one hand, and the world of development and conservation, on the other. How do households and communities respond to the differential opportunities and restrictions that development and conservation introduce? What are the implications of the fact that those responses are often invisible to policy makers? Three hours lecture/seminar. Carol Carpenter]

F&ES 892a/ARCH 4021a, Introduction to Planning and Development 3 credits. This course demonstrates the ways in which financial and political feasibility determine the design of buildings and the character of the built environment. Students propose projects and then adjust them to the conflicting interests of the financial institutions, real estate developers, civic organizations, community groups, public officials, and the widest variety of participants in the planning process. Subjects covered include housing, commercial development, zoning, historic preservation, parks and public open space, suburban subdivisions, planned communities, and comprehensive plans. Alexander Garvin

HEALTH AND ENVIRONMENT

F&ES 727a, The Future of Food 3 credits. This seminar explores significant challenges posed by the global food supply to environmental quality and human health. The primary obligation is a research paper, dissertation chapter, master's project, or senior essay draft. We read critically 150–200 pages per week, and students should be prepared to discuss or present analyses. Challenges examined include fresh vs. processed foods, nutritional sufficiency and excess, radionuclides, pesticides, pharmaceuticals, fertilizers, animal feeds, plastics, flame retardants, flavors, fragrances, ingredient fraud, genetic modification, waste, energy input and yield, locality, processing technologies, packaging, and carbon emissions. Corporate case histories are considered in a number of sessions. Private innovations in the production and management of food are analyzed, including trends in certification and labeling initiatives. Most sessions examine one or several foods. Examples include cow's milk, human milk, infant formula, grapes, wine, corn, bananas, tomatoes, salmon, cod, tuna, sodas, fruit juice, water, coffee, and olive oil. John P. Wargo

F&ES 736Ea, Environmental Ethics 2 credits; graded pass/fail. Environmental issues are closely tied to ethical considerations such as the impacts on public health, future generations, less industrialized nations, and nonhuman entities. This course is designed to provide a broad overview of topics related to ethics and the environment including perspectives of environmental ethics (e.g., anthropocentrism), environmental justice, environmental economics, and climate change. The intersection of ethics and the environment could be studied from multiple disciplines such as philosophy, history, anthropology, medicine, or environmental science. All perspectives and backgrounds are welcome in this course. The purpose of this class is not to distinguish "right" from "wrong" but to encourage critical thinking and discussion on the ethical consequences of environmental decisions and to provide a better understanding of key topics on ethics and the environment. This course is conducted as a combination in-person/online class over a six-week period in the first part of the term. Michelle L. Bell

F&ES 765b, Technological and Social Innovation in Global Food Systems 1–3 credits. This course examines a range of social and technical innovations aimed at attaining more sustainable agri-food production and consumption patterns. It provides an in-depth exploration of different concepts of food systems and seeks to understand the relationships between these systems' underlying models, human values, and how they give rise to different aspirations for innovation, intervention, reform, or revolution. The first part of the course introduces different approaches to characterizing food systems, the values that drive these different approaches, and the attempts to find measurable indicators of sustainability of these systems. The remainder of the course features weekly invited guest speakers who discuss their perspectives on strategies for creating sustainable food systems. Speakers have been selected to reflect a wide range of approaches and experience with specific issues and innovations of importance to the global future of food and agriculture. Gordon T. Geballe

F&ES 893b/EHS 511b, Principles of Risk Assessment 3 credits. This course introduces students to the nomenclature, concepts, and basic skills of quantitative risk assessment (QRA). The goal is to provide an understanding necessary to read and critically evaluate QRA. Emphasis is on the intellectual and conceptual basis of risk assessment, particularly its dependence on toxicology and epidemiology, rather than its mathematical constructs and statistical models. Specific cases consider the use of risk assessment for setting occupational exposure limits, establishing community exposure limits, and quantifying the hazards of environmental exposures to chemicals in air and drinking water. Jonathan Borak, Cheryl Fields

F&ES 896b/EHS 503b, Public Health Toxicology 3 credits. This course is designed to serve as a foundation for understanding environmental toxicology. It includes basic principles of toxicology, mechanisms of toxicity and cellular defense, and the fundamental interactions between chemicals and biological systems. Human exposure to foreign chemicals and their adverse effects are considered, as is the importance of federal and state agencies in protecting public health. Through the use of case studies, the course provides insights into prevention of mortality and morbidity resulting from environmental exposure to toxic substances, the fundamentals of risk assessment and regulatory toxicology, and the causes underlying the variability in susceptibility of people to chemicals. Vasilis Vasiliou

F&ES 897b/EHS 508b, Environmental and Occupational Exposure Science 3 credits. This course examines the fundamental and practical aspects of assessing exposures to environmental agents, broadly defined, in the residential, ambient, and workplace environments. The course provides the knowledge and skills to design and conduct exposure assessments, and has a particular focus on applications to environmental epidemiology and risk assessment. Indirect and direct methods of assessing exposures, such as questionnaires, environmental sampling, biological monitoring, and spatial modeling, are reviewed; and case studies and hands-on projects are presented. Nicole C. Deziel

[**F&ES 898a/EHS 585a, The Environment and Human Health** 3 credits. This course provides an overview of the critical relationships between the environment and human health. The class explores the interaction between health and different parts of the environmental system including air pollution, assessment of environmental exposures, environmental justice, and occupational health. Other topics include case studies of environmental health disasters, links between climate change and health, and integration of scientific evidence on environmental health. Students learn about current key topics in environmental health and how to critique and understand scientific studies. The course incorporates lectures and discussion. Enrollment limited to twenty-five. Michelle L. Bell]

[**F&ES 899b, Sustainable Development in Post-Disaster Context: Haiti** 3 credits. Sustainable development is studied using the case of Haiti. Haiti suffers from chronic environmental disasters, most notably deforestation that leads to mudslides and therefore crop loss during the rainy season, and acute disasters, for example the earthquake of 2010. F&ES has been asked by L'Hôpital Albert Schweitzer in the Artibonite Valley (north of Port-au-Prince) to provide assistance to projects in villages surrounding the hospital. This course uses lectures, student presentations of scholarly work, project development, and field studies to explore our knowledge of sustainable development and to apply this knowledge. Enrollment limited to sixteen. Gordon T. Geballe]

INDUSTRIAL ECOLOGY, ENVIRONMENTAL PLANNING, AND TECHNOLOGY

F&ES 612b, Waste and Materials Management: Fundamentals and Frontiers 2 or 3 credits. This course introduces and formalizes concepts related to waste and materials management seen from perspectives of operations, policy, and business. Because there is no disposal-free society, learning about waste that remains waste is a key element of the class. Interest in using wastes as resources opens up other questions related to materials management, policy and regulation, and finance and economics. One goal is to examine fundamentals including generation, collection, processing (e.g., by recycling and composting), and landfilling. Key materials such as paper, plastic, industrial waste, and hazardous waste receive individual attention. A second goal is to describe and discuss alternative futures for waste and materials using ideas drawn from industrial ecology and technology. Half of each class session is devoted to structured learning of fundamentals, and the second half brings in frontiers through readings and student-led discussions. Students who wish to engage in and complete a waste and materials research project in conjunction with the research team can sign up for an additional credit. Enrollment limited to twenty. Marian R. Chertow, Reid J. Lifset

F&ES 782a/ARCH 4216a, Globalization Space: International Infrastructure and Extrastatecraft 3 credits. The course researches global infrastructure space as a medium of polity. It considers networks of trade, energy, communication, transportation, spatial products, finance, management, and labor as well as new strains of political opportunity that reside within their spatial disposition. Case studies include free zones and automated ports around the world, satellite urbanism in South Asia, high-speed rail in Japan and the Middle East, agripoles in Southern Spain, fiber optic submarine cable and mobile telephony in East Africa, spatial products of tourism in the DPRK, and the standards and management platforms of ISO. Keller Easterling

F&ES 838b, Life Cycle Analysis 3 credits. Life cycle assessment (LCA) is an analytical method that considers systemwide impacts along the entire life cycle of a product, from extraction or harvest of natural resources, through production and consumption, to final end-of-life disposal or recovery and reuse/recycle. LCA provides a quantitative evaluation of a comprehensive list of environmental issues and is intended to avoid shifting the burden to different life stages or different environmental concerns. The course uses a case-study format to introduce the LCA methodology and demonstrate its application to a variety of product sectors and environmental concerns. There are also hands-on exercises to learn the basic functionality of SimaPro, one of the available commercial LCA software packages, as well as exercises to build and validate unit process data sets using literature searches and/or customization of available processes in commercial databases, such as ecoinvent. The case studies are also used to demonstrate current and emerging developments in LCA methodology. The overall goal is to provide the skills necessary to design and manage a formal LCA project in the business, consulting, or government sectors. Prerequisites: F&ES 884 is recommended as a foundation for this course; in addition, F&ES 762 or F&ES 814 is recommended for students unfamiliar with constructing mass and energy balances, conducting dimensional analyses, etc. Thomas Swarr

F&ES 865b, Industrial Ecology Advanced Methods: Modeling the Socioeconomic Metabolism 3 credits. Humans have transformed Earth's surface to serve their production and consumption systems. While social sciences study the sphere of human decision making and behavior rooted in culture, organization, and preferences, and earth scientists study the effect of human actions on nature, industrial ecology studies the acquisition and transformation of natural resources to products, their use and disposal, and the ensuing emissions in biophysical terms. This course provides an in-depth treatment of the methods industrial ecologists have developed to study this socioeconomic metabolism. The course focuses on input-output analysis and dynamic stock-flow models of materials in products and infrastructures. It also addresses hybrid approaches, such as the combination of life-cycle assessment and input-output methods or the application of such methods in conjunction with prospective models rooted in stock-flow dynamics. The course is primarily focused on modeling tools, combining blackboard-based lectures with computer-based exercises. Modeling is conducted in MatLab. Grading is based on problem sets, a midterm, and a final exam. Edgar G. Hertwich

F&ES 870b, Climate Change Mitigation and Industrial Ecology 3 credits. This seminar examines the mitigation of greenhouse gas emissions from energy production, industry, buildings, transport, and land use. It focuses on the contribution of industrial ecology to

understanding the system that gives rise to the emissions, the interlinkages among sectors, and the driving forces behind recent increases in emissions. On this basis, the course addresses the analysis of options for emission reductions, using industry and electricity production as examples. It provides a background on selected research methods used to produce results used by the Intergovernmental Panel on Climate Change in its most recent assessment report on climate change mitigation and discusses the implications of methods and assumptions behind models for policy support statements. A few exercises serve to provide an insight into the methods. Students learn to synthesize the scientific literature, develop effective presentations of the findings, and lead discussions. Active participation in exercises and classes is required. Grading is based on class participation and a written exam. Enrollment limited to twenty. Edgar G. Hertwich

[**F&ES 872b, Introduction to Green Chemistry** 3 credits. Overview of the basic concepts and methods needed to design processes and synthesize materials in an environmentally benign way. Related issues of global sustainability. Case studies that suggest possible solutions for the serious environmental and toxicological issues currently facing industry and society. Paul T. Anastas]

[**F&ES 881a, FT: Field Experience in Industrial Operations** 1 credit. A series of one-day field trips designed to expose students to the various aspects of industrial ecology. In previous years, students have visited waste management facilities, utility providers, product manufacturers, clean tech start-ups, and green consultancies in New England and the surrounding regions. The field trips allow students to gain a better understanding of the concepts and themes of industrial ecology (such as material and process flows, life-cycle assessment, and closed-loop systems) in the context of existing operations. Marian R. Chertow and members of the Industrial Environmental Management and Energy Special Interest Group]

F&ES 884a/ENAS 645a, Industrial Ecology 3 credits. Industrial ecology studies (1) the flows of materials and energy in industrial and consumer activities, (2) the effects of these flows on the environment, and (3) the influences of economic, political, regulatory, and social factors on the flow, use, and transformation of resources. The goals of the course are to define and describe industrial ecology; to demonstrate the relationships among production, consumption, sustainability, and industrial ecology in diverse settings, from firms to cities to international trade flows; to show how industrial ecology serves as a framework for the consideration of environmental and sustainability-related aspects of science, technology, and policy; and to define and describe tools, applications, and implications of industrial ecology. Marian R. Chertow, Edgar G. Hertwich

F&ES 885b/ENAS 660b, Green Engineering and Sustainability 3 credits. This course provides a hands-on foundation in green engineering and the design and assessment of green products. Approaching sustainability from a design perspective requires a fundamental conceptual shift from the current paradigms of product toward a more sustainable system, based on efficient and effective use of benign materials and energy. Through course assignments, class exercises, and a term-long team project, students are challenged with the same issues facing production and consumption systems today. The course is organized around the "engineering design process" from opportunity definition; criteria

definition; ideation; alternatives assessment; and solution selection, implementation, and monitoring. To begin, the mega-trends driving sustainability discussions are presented and the case for new greener product systems is made. The course emphasizes quantitative and rigorous analysis of green design in addition to the tools needed to develop these designs. The foundational principles of the course can be summarized in the five I's: (1) Innovation—we can't solve problems at the same level of thinking used to create them, (2) Inherency—we can't solve problems without looking at the nature of the system that created them, (3) Interdisciplinary—we can't solve problems without looking at other aspects of the problem, (4) Integration—we can't solve problems without connecting segments at a system level, and (5) International—we can't solve problems without considering their context. The current approach to design, manufacturing, and end of life is discussed in the context of examples and case studies from various sectors, providing a basis for what and how to consider designing green products, processes, and systems. Fundamental engineering design topics include pollution prevention and source reduction, separations and disassembly, virtual and rapid prototyping, life cycle design, management, and assessment. Enrollment limited to thirty-two. Preference given to second-year M.E.M. students. Paul T. Anastas

F&ES 888b/ARCH 4226b, Ecological Urban Design 3 credits. This course lays the groundwork for students from the School of Architecture and the School of Forestry & Environmental Studies to collaboratively explore and define ecologically driven urban design. The goal is to work as an interdisciplinary group to cultivate a perspective on the developing field of urban ecology and approaches to implementing urban ecological design. The transformation of urban ecology from a role in studying a system to studying and shaping urban ecosystems is a primary focus for the course, which concentrates on the following questions: How do we define urban ecosystems? How do we combine science, design, and planning to shape and manage urban ecosystems? How do we implement effective and adaptable experimental and monitoring methods specific to urban sites and human subjects in order to conduct viable urban ecological research? The course uses the Earth Stewardship Initiative, a large land-planning project developed for the Ecological Society of America in Sacramento, Calif., to create a real-world project where interdisciplinary teams can work to combine ecological applications and design with the goal of shaping urban systems to improve the ecological, social, and infrastructural function of city components. Limited enrollment. Alexander J. Felson

F&ES 894a, Green Building: Issues and Perspectives 3 credits. Our built environment shapes the planet, our communities, and each of us. Green building seeks to minimize environmental impacts, strengthen the fabric of our cities and towns, and make our work and home lives more productive and fulfilling. This course is an applied course, exploring both the technical and the social-business-political aspects of buildings. Topics range from building science (hygrothermal performance of building enclosures) to indoor environmental quality; from product certifications to resilience (robust buildings and communities in the face of disasters and extended service outages). The purpose of this course is to build a solid background in the processes and issues related to green buildings, equipping students with practical knowledge about the built environment. Extensive use is made of resources from BuildingGreen, Inc., one of the leading information companies supporting green building and green building professionals. The course is

primarily a lecture-discussion one with some fieldwork, substantial emphasis on research and group project work, and online individual testing. The course is strengthened by several guest lectures by leading green building professionals from across the country and across many disciplines: from architecture to material science, from engineering to green building business. The class meets once a week, with the instructor available to students during that same day. Enrollment limited to twenty-four. Peter Yost

F&ES 895a, Green Building Intensive: How Buildings Work 1 credit. This course is designed to introduce students, through hands-on experience and site visits, to how buildings work: their design, their materials selections, their construction, and their operation. Content includes: (1) history of building design and construction; (2) professions and skills involved in the design and construction of buildings; (3) components and functions of buildings; (4) the science behind building performance; and (5) green certification programs. This course is a standalone half-term lab/practical course that is designed to also be a companion course with F&ES 894. F&ES 895 can be taken prior to, with, or after F&ES 894. Enrollment limited to twelve. Peter Yost

F&ES UNDERGRADUATE COURSES

Ecology

ECOSYSTEM ECOLOGY

[**F&ES 221/E&EB 230/EVST 221, Field Ecology** A field-based introduction to ecological research. Experimental and descriptive approaches, comparative analysis, and modeling are explored through field and small-group projects.]

WILDLIFE ECOLOGY AND CONSERVATION BIOLOGY

F&ES 315a/E&EB 115a, Conservation Biology An introduction to ecological and evolutionary principles underpinning efforts to conserve Earth's biodiversity. Efforts to halt the rapid increase in disappearance of both plants and animals. Discussion of sociological and economic issues. Linda Puth

[**F&ES 365a/E&EB 365a, Landscape Ecology** See F&ES 500a for description.]

[**F&ES 370a/E&EB 370a, Aquatic Ecology** See F&ES 738a for description.]

Physical Sciences

ENVIRONMENTAL CHEMISTRY

F&ES 261a/G&G 261a/EVST 404a, Minerals and Human Health Study of the interrelationships between Earth materials and processes and personal and public health. The transposition from the environment of the chemical elements essential for life. Prerequisite: one year of college-level chemistry or permission of the instructor; G&G 110 recommended. Ruth Blake

[**F&ES 307a/EVST 307a, Organic Pollutants in the Environment** See F&ES 706a for description.]

F&ES 344b/EVST 344b, Aquatic Chemistry See F&ES 707b for description.

WATER RESOURCES

[**F&ES 367b/EVST 367b, Water Resources and Environmental Change** The effects of variations in the hydrologic cycle on the global distribution of freshwater. The role of environmental change in regulating freshwater supply and quality. The influences of agriculture, industry, mining, urbanization, climate change, and energy-production alternatives on freshwater resources in the United States and abroad. James E. Saiers]

[**F&ES 440b/EVST 440b, Environmental Hydrology** See F&ES 714b for description.]

Quantitative and Research Methods

F&ES 290b/EVST 290b, Geographic Information Systems 3 credits. A practical introduction to the nature and use of geographic information systems (GIS) in environmental science and management. Applied techniques for the acquisition, creation, storage, management, visualization, animation, transformation, analysis, and synthesis of cartographic data in digital form. C. Dana Tomlin

[**F&ES 441a or b/EVST 441a or b/G&G 440a or b/MCDB 441a or b, Methods in Geomicrobiology** A laboratory-based course providing interdisciplinary practical training in geomicrobiological methods including microbial enrichment and cultivation techniques; light, epifluorescence, and electron microscopy; and molecular methods (DNA extraction, PCR, T-RFLP, FISH). Prerequisite: college-level chemistry. Ruth Blake]

G&G 362b/ARCG 362b/EVST 362b, Observing Earth from Space See F&ES 726b for description.

Social Sciences

ENVIRONMENTAL POLICY

[**F&ES 245b/EVST 245b/PLSC 146b, International Environmental Policy and Governance** See F&ES 829b for description.]

F&ES 255a/EVST 255a/PLSC 215a, Environmental Politics and Law Exploration of the politics, policy, and law associated with attempts to manage environmental quality and natural resources. Themes of democracy, liberty, power, property, equality, causation, and risk. Case histories include air quality, water quality and quantity, pesticides and toxic substances, land use, agriculture and food, parks and protected areas, and energy. John P. Wargo

F&ES 277b/EVST 277b, Environmental Science and Policy The synthesis of science, both for scientists and for policy makers. Usefulness of the two types of synthesis for developing scientific research and policy. Advancement of complementary practices between science and policy arenas. Concepts and data from ecological and biogeochemical disciplines are used to predict and manage the effects of environmental change on ecosystem services that underlie the provisioning of resources such as food and clean water. Mark A. Bradford

EVST 292a/GLBL 217a/PLSC 149a, Sustainability in the Twenty-First Century Sustainability as an overarching framework for life in the twenty-first century. Ways in which this integrated policy concept diverges from the approaches to environmental protection and economic development that were pursued in the twentieth century. The interlocking challenges that stem from society's simultaneous desires for economic, environmental, and social progress despite the tensions across these realms. Daniel C. Esty

SOCIAL AND POLITICAL ECOLOGY

[**F&ES 285b/EVST 285b, Political Ecology: Nature, Culture, and Power** Study of the relationship between society and the environment. Global processes of environmental conservation, development, and conflicts over natural resource use; political-economic contexts of environmental change; ways in which understandings of nature are discursively bound up with notions of culture and identity. Amity Doolittle]

[**F&ES 384a/ANTH 382a/ER&M 395a/EVST 345a, Environmental Anthropology** History of the anthropological study of the environment: nature-culture dichotomy, ecology and social organization, methodological debates, politics of the environment, and knowing the environment. Michael R. Dove]

F&ES 422a/ANTH 409a/ER&M 394a/EVST 422a, Climate and Society See F&ES 878a for description.

Centers and Programs at the School of Forestry & Environmental Studies

Teaching, research, and outreach at the Yale School of Forestry & Environmental Studies are greatly enhanced by the centers and programs that have been initiated by faculty over the years. The centers and programs, each with a different concentration, are a key component of a student's learning experience. They allow students to gain hands-on clinical and research experience through funded student internships and projects, coordination of faculty research in areas of common interest, and creation of symposia, conferences, newsletters, and outreach programs.

Centers and programs are funded primarily through private foundations, nongovernmental organizations, state and federal agencies, international granting agencies, and private corporations. The nature and number of centers and programs evolve over time, reflecting faculty and student interest. Under the current organizational structure, each program falls under the umbrella of a center, which enables further collaboration and resource sharing.

YALE CENTER FOR ENVIRONMENTAL LAW & POLICY

The Yale Center for Environmental Law & Policy, a joint undertaking with Yale Law School, advances fresh thinking and analytically rigorous approaches to environmental decision making across disciplines, across sectors, and across boundaries. In addition to its research activities, the center aims to serve as a locus for connection and collaboration by all members of the Yale University community interested in environmental law and policy issues. The center supports a wide-ranging program of education, research, and outreach on national and global environmental issues. These efforts involve faculty, staff, and student collaboration and are aimed at shaping academic thinking and policy making in the public, private, and NGO sectors. One of the center's flagship products is the biennial Environmental Performance Index, which ranks countries on performance indicators tracked across policy categories covering both environmental public health and ecosystem vitality.

The center facilitates a joint-degree program in which master's students at the School of Forestry & Environmental Studies can additionally pursue a law degree from Yale Law School, Vermont Law School, or Pace Law School. Undertaken separately, these two degrees would take five years to complete. Together, students can earn both degrees in four years. The center provides research, educational, career development, and social opportunities for students enrolled in the joint program as well as others affiliated with the center.

For additional information, visit http://envirocenter.yale.edu.

YALE CENTER FOR BUSINESS AND THE ENVIRONMENT

The Yale Center for Business and the Environment (CBEY) joins the strengths of two world-renowned graduate schools—the Yale School of Management (SOM) and the Yale School of Forestry & Environmental Studies (F&ES)—together with a global network of thought leaders and practitioners at the business-environment interface. Home to the oldest and nationally preeminent joint-degree program in business and the environment, CBEY addresses the need for both environmentally minded business leaders and skilled managers in environmental organizations. Graduates of the joint-degree program assume leadership roles in the private, nonprofit, and public sectors and are addressing one of the central management challenges of the twenty-first century: our transition to a sustainable economy.

Driven by student interest, we develop partnerships to (1) build and support a community of curious and resourceful individuals who are finding pathways to action; (2) incubate and multiply transformative solutions that address big societal challenges; and (3) provide a connective platform to accelerate learning and collaboration in targeted professional networks. Our core program areas include finance and markets, innovation and entrepreneurship, intrapreneurship and systems change, and technology-enabled learning.

The center's activities include, but are not limited to:

- Providing support for the three-year joint M.B.A.-Environment degree program and advancing joint programs between F&ES and SOM
- Hosting speaker series and seminars on leadership in sustainability, entrepreneurship, ecosystem services, energy efficiency, and environmental economics
- Coordinating research fellowships or internships in corporate environmental management and strategy, renewable energy finance, conservation finance, and community-based marketing
- Developing case studies, new courses, and research publications
- Producing high-quality news publications focused on financing for renewable energy and environmental conservation
- Sponsoring speaker series, workshops, grants, and prizes to support environmental entrepreneurship

To learn more, visit http://cbey.yale.edu.

CENTER FOR GREEN CHEMISTRY AND GREEN ENGINEERING AT YALE

The mission of the Center for Green Chemistry and Green Engineering at Yale is to advance sustainability by catalyzing the effectiveness of the Green Chemistry and Green Engineering community. Green Chemistry and Green Engineering represent the fundamental building blocks of sustainability. Working in these disciplines, chemists and engineers are creating the scientific and technological breakthroughs that will be crucial to the future success of the human economy.

The Center for Green Chemistry and Green Engineering at Yale works to stimulate and accelerate these advances. Guided by four core operating principles—(1) Insist on scientific and technical excellence and rigor, (2) Focus on generating solutions rather than characterizing problems, (3) Work with a diverse group of stakeholders, and (4) Share information and perspectives broadly—we seek to accomplish four key objectives:

- Advance the science
- Prepare the next generation
- Catalyze implementation
- Raise awareness

The center concentrates on five focus areas, outlined below.

Research The center supports and advances research in Green Chemistry and Green Engineering (GC&GE), a critical component to building the community, designing and discovering innovative solutions, and achieving a sustainable future. The center serves as a catalyst to both Yale and the greater GC&GE communities for discipline-specific and cross-disciplinary research collaborations focused on key areas of GC&GE within science, technology, and policy for sustainability.

Policy and outreach The center engages in policy, communication, and outreach initiatives that raise awareness of—and support for—GC&GE. In this dialogue the center engages with a wide network of stakeholders, including NGOs, industry, academia, and government, as well as local communities and the general public.

Education A robust educational program is an essential element of the center. Center activities are focused on educating undergraduate and graduate students in the principles and practice of GC&GE. The center also serves the wider academic community by providing opportunities for faculty training and by developing and disseminating GC&GE curriculum materials.

International collaborations GC&GE are rapidly spreading through both industrialized nations and the emerging economies. In all regions, the center engages with the network of scientists, engineers, policy makers, business people, and public health and environmental experts focused on sustainability science on behalf of the greater good.

Industrial collaborations GC&GE can only provide meaningful impact on the challenges of global sustainability when implemented on a large scale. For this reason, collaboration with industry is a key part of the center's work. Direct engagement creates a dialogue that informs industry of the latest research breakthroughs in the field of sustainable science and technology. Likewise, such engagement informs academic researchers on industry's most important concerns. This dialogue facilitates a direct line for implementation of these innovations.

CENTER FOR INDUSTRIAL ECOLOGY

The Center for Industrial Ecology (CIE) is dedicated to the development and promotion of research, teaching, and outreach in industrial ecology. The field is focused on the concept that an industrial system should be viewed not in isolation from its surrounding systems, but in concert with them. It is a systems approach that seeks to optimize the

total resource cycle from the perspective of the environment and sustainability. Among the programs and goals of the center are the following:

- Conducting pathbreaking research in industrial ecology
- Master's, doctoral, and postdoctoral study and research in industrial ecology
- Hosting of visiting domestic and international scholars in industrial ecology

Major foci include (1) the Clean Energy Choices project, which assesses different options to mitigate greenhouse gas emissions from our energy system in terms of their feasibility, resource requirements, and environmental impacts; (2) leadership of the systems node of REMADE Institute, which seeks to reduce energy use and greenhouse gas emissions of materials production through recycling and remanufacturing; CIE's role addresses both understanding the stocks and flows of materials, developing scenarios, and analyzing benefits; (3) the Industrial Symbiosis Project, in which multiyear research has been conducted, including examination of the environmental and economic rationale for intra-industry exchange of materials, water, and energy; (4) the Criticality and Scenarios Project, which aims to understand the supply, demand, and future prospects for metals based on stocks and flows; (5) the Program on Industrial Ecology in Developing Countries, which adapts industrial ecology theory and practice to issues related to energy access, water quality and quantity, waste and material management, and global warming in industrializing countries with a current focus on a study of low-carbon and sustainable cities in China, India, and the United States; and (6) Extended Producer Responsibility (EPR) research, which analyzes the conceptual, political, and legal foundations of EPR, including investigation of how, when, and why local government units might adopt EPR, the conditions necessary for the implementation of individual producer responsibility, and governance of EPR systems.

Journal of Industrial Ecology

CIE is home to a highly regarded international journal. Published by Wiley-Blackwell and owned by Yale University, the *Journal of Industrial Ecology* is a peer-reviewed, multidisciplinary bimonthly on industry and the environment that is aimed at both researchers and practitioners in academe, industry, government, and advocacy organizations. It is indexed in Science Citation Index Expanded (ISI), and it is the official journal of the International Society for Industrial Ecology. See www.wileyonlinelibrary.com/journal/jie.

Industrial Environmental Management Program

The Industrial Environmental Management (IEM) program at Yale aims to equip students with an integrated set of skills with which to tackle the complex, multifaceted environmental problems facing industrial and corporate managers. Within the master's program, IEM students take foundations courses in natural science, social science, and quantitative methods, followed by courses in environmental policy and management. The core intellectual framework for IEM is the systems science of industrial ecology, which examines materials, water, and energy in a common framework. Students can pursue specialization and certification through the M.E.M. program in Industrial Ecology and Green Design.

An active Industrial Environmental Management and Energy Student Interest Group sponsors field trips to industrial sites, on-campus talks by visiting managers, and symposia on current topics of interest.

Program on Solid Waste Policy

The program has two principal goals: (1) to inform contemporary policy discussions about solid waste and materials management and the circular economy by applying the methods and findings of social and environmental science and industrial ecology; and (2) to develop workable policy solutions that address the impediments to safe, cost-effective solid waste management and the complexities of comprehensive materials and life-cycle management.

HIXON CENTER FOR URBAN ECOLOGY

The Hixon Center for Urban Ecology provides an interdisciplinary forum for scholars, students, and practitioners to work collaboratively on integrated research, teaching, and outreach to improve our understanding and management of urban environmental systems within the United States and around the globe.

The ecological health and integrity of urban ecosystems have a profound impact on urban economic productivity and quality of life. Pioneering research, new theoretical understanding, and innovative practice will be required to provide the knowledge and tools necessary to foster healthy natural systems essential for the future well-being of the modern city and the people who live there. This need has never been greater than today, when a majority of the world's population either resides in or is rapidly migrating to urban areas.

To accomplish its mission, the center builds upon and strengthens the work of several programs at the School, including the Urban Resources Initiative and the Urban Watershed Program.

The Hixon Center has a strong focus on collaboration within the School, across the University, and beyond. The center sponsors lectures and symposia as a means to disseminate ideas about and understanding of the critical issues confronting urban ecosystems.

The Hixon Center also supports Yale faculty initiatives to optimize sustainability and resilience through observational and experimental research on the urban water cycle, green infrastructure, vegetation, urban green spaces, and people. In addition, the center supports students' basic and applied research through fellowships connected to current Hixon Center priorities in the realm of urban ecology. The center will continue to build the urban environmental focus at Yale while strengthening the School's urban dimension, creating new models and approaches for addressing urban environmental challenges.

Yale Program on Strategies for the Future of Conservation

The purpose of the Yale Program on Strategies for the Future of Conservation is to support the efforts of the Maine Coast Heritage Trust, the Land Trust Alliance, and similar private organizations to develop and apply new, innovative strategies for land conservation by linking the convening, research, and teaching activities at the Yale School of Forestry & Environmental Studies ever more closely to the needs of the land conservation community.

Established by a gift from Forrest Berkley and Marcie Tyre, the program has two parts:

- Sponsoring student internships and research projects (through the Berkley Conservation Scholars program), to bring the passion, experience, and creativity of Yale graduate students to bear on these issues; and
- Convening workshops and other conversations across sectors and perspectives in the search for new approaches to expanding the resources applied to land conservation in the United States.

Berkley Conservation Scholars are students of high potential who receive funding for their research and professional experiences at the cutting edge of land conservation. Support is available during both the school year and the summer, creating a virtual "R&D Department" for the U.S. land conservation community. Berkley Conservation Scholars play a critical role in helping to bring together practitioners and academics in the search for new conservation tools.

The Program on Strategies for the Future of Conservation is a major extension of F&ES's continuing efforts to enhance the effectiveness of land conservation. Working with an advisory group of land conservation leaders, the program hosts workshops, training programs, and other activities around the themes of engaging new communities in conservation; expanding the conservation toolkit; and ensuring the permanence of conservation gains.

Urban Resources Initiative

The Urban Resources Initiative (URI) is a not-for-profit/university partnership dedicated to community participation in urban ecosystem management. A substantial body of learning suggests that sustainable urban ecosystem management depends on the meaningful participation of local residents. Those who know local conditions and whose daily actions influence the health and quality of urban ecosystems must play a central role in designing and implementing rehabilitation strategies. Sustainable natural resource management and conservation cannot be achieved by technical, scientific solutions alone. Conservation efforts, especially in urban areas where people represent a significant element of the ecosystem, must emphasize social revitalization alongside environmental restoration.

Yale's URI program draws on these essential elements to facilitate community participation in urban ecosystem management. "Community" is defined quite broadly: it includes the group of neighborhood leaders with whom interns work to restore abandoned lands near their homes. Community is a group of teens who are learning how to assess the tree canopy of their city. Community is the staff and leadership of city agencies who have the responsibility and resources to become the environmental stewards of their city. URI's approach responds to and engages all of these communities.

URI offers a number of clinical learning opportunities that allow F&ES students to gain real-world practice in their field. Listening to local concerns and developing environmental programs in cooperation with schools, neighborhood groups, and city agencies are the cornerstones of our work. Through these programs F&ES students can apply theory learned in the classroom with supervised clinical training to enrich their academic

work while making a real contribution to the New Haven community. These programs include the Community Greenspace program, Green Skills, environmental education/job training program, research opportunities, and training in urban forestry practices.

Community Greenspace Each summer F&ES students work as community foresters as part of the Community Greenspace program, a citywide initiative to revitalize New Haven's neighborhoods by restoring vacant lots, planting trees along streets and in parks, remediating lead from soil in front yards, and building community. Each intern works with community groups to develop restoration goals and to design an implementation strategy for the summer. The interns help neighbors conduct an inventory of existing trees, select and prepare sites for new plantings, and plant perennials, shrubs, and trees.

The Greenspace program is an opportunity for Yale students to learn urban forestry practices. Neighbors initiate the process by identifying their environmental priorities in their community. URI looks to the local experts—the people who live in inner-city neighborhoods—as partners in defining and then assessing, designing, implementing, and sustaining urban restoration sites.

Environmental education Since 1991 URI education interns have taught hands-on environmental education programs to New Haven public school students. For many years, URI staff and interns worked directly within the New Haven school system, teaching thousands of elementary school students about environmental stewardship through the exploration of the city's open spaces. During the 2009–2010 academic year, the City of New Haven officially incorporated the pond and rivers units from URI's Open Spaces as Learning Places curriculum into the district's science curriculum. Now, students in every sixth-grade classroom have the opportunity to learn about watersheds as they canoe New Haven's rivers and explore local ponds.

URI's newest environmental education program, GreenSkills, creates opportunities for teens to learn about New Haven's tree canopy and to gain practical job skills. Launched in 2007, our GreenSkills program creates an opportunity to address a critical predicament—a growing deficit in New Haven's street tree canopy that can be countered by a career development program bringing together Yale and high school interns. In 2010 the GreenSkills program was expanded to include adults recently released from incarceration, as well as those recovering from drug addiction. Our goals are to improve New Haven's street tree canopy by engaging vulnerable adults and urban high school students in the planting effort, thereby providing them with job skills and mentoring opportunities in environmental careers, and to foster a sense of environmental stewardship.

Research URI activities provide valuable research opportunities in community organizing and development, urban forestry management, environmental education and monitoring, and evaluation of community-managed ecosystems. Some examples of student research activities are a community survey to determine human health impacts of vacant lands; measurement of biological communities found in Greenspace sites and abandoned lots; and measurement of how children's behavior at play is affected by the design of schoolyards. URI and partners at the U.S.D.A. Forest Service, and the University of Vermont Spatial Analysis Laboratory have carried out a satellite imagery analysis of New Haven's tree canopy cover. This analysis served as a basis for the City of New

Haven's Mayor launching an aggressive tree-planting campaign. Most recently, student-led research is studying how community group dynamics affect urban street-tree survival.

Urban Watershed Program

The Urban Watershed Program promotes faculty and student research on the unique relationships, impacts, and demands of watersheds in urban areas.

Watersheds in urban areas encounter unique stresses, while sharing common characteristics and following natural laws of all water systems. Urban watersheds are often polluted, heavily engineered, and little understood by nearby residents. Stream courses are often transferred to pipes running underground. Population density exacerbates stresses on waterways.

As cities emerge from a period when they ignored their rivers and harbors, new relationships are being developed with adjacent waterways. Past practices that marginalized waterscapes from the urban environment are being reevaluated. Now, with more attention to urban environmental quality, there is a greater understanding of the vital role waterways play as sources of open space, transportation, recreation, and habitat.

The Urban Watershed initiative currently has two major activities. One is a study of an urban ecosystem restoration project situated in an urban park. For nearly a century, flow in the West River, on the New Haven–West Haven border, has been regulated by tide gates that allow the outward flow of freshwater, but restrict flushing by seawater. These restrictions are being replaced by self-regulating tide gates, which close only in the rare event of potentially hazardous storm surges. As a result, the current degraded tidal freshwater marsh will evolve into a healthier salt marsh, the ecosystem type that existed there in the past. This restoration is being monitored, using a nearby, gated marsh that will not be restored. Monitored parameters are water quality, hydrology, vegetation, fish populations, bird communities, and the attitudes, values, and recreational and stewardship behaviors of people who use the park. This before-after-control-impact (BACI) experiment is almost unprecedented at this scale.

The second project involves experiments on flood-control structures being built at a housing development in Bridgeport. A decades-old residential area near the harbor has experienced chronic flooding because of poor drainage. Working with the homeowners' association, the city, and the state, Professor Alexander Felson is comparing the effectiveness of a range of structural measures designed to channel and treat the polluted runoff.

Yale Experimental Watershed

The Yale Experimental Watershed (YEW) is a living laboratory of urban ecology located adjacent to the School. The YEW, a 5.5 acre site between Prospect and Mansfield streets, is being transformed from an underutilized and overgrown site to one that is of great value to the University and the community—where academic research and teaching are conducted, and community members can learn and explore.

Fieldwork and research projects have included tree identification and mapping, coarse woody material assessment, soil sampling and analysis, land cover mapping, bird habitat investigation, and site hydrology and groundwater monitoring. The site has also been used as an educational resource for graduate courses in the School of Forestry &

Environmental Studies, for high school students in the Common Ground Green Jobs Corps and the Yale SCHOLAR program, and for interns from high schools such as Achievement First Amistad and Hopkins School.

TROPICAL RESOURCES INSTITUTE

The mission of the Tropical Resources Institute (TRI) is to support interdisciplinary student research on the most complex challenges confronting the conservation and management of tropical environments worldwide. TRI was created in 1983 to strengthen the School's involvement in the study and management of tropical resources. The institute recognizes that the problems surrounding the conservation and management of tropical resources are rapidly increasing in complexity, while demands on those resources continue to grow. Emerging structures of global environmental governance and local conflicts over land use require new strategies and leaders able to function across diverse disciplines and sectors, and at multiple scales. TRI seeks to train students to be leaders in this new era, equipping them with the resources and tools this new generation will require to equitably address the challenges ahead.

TRI serves as the nexus within F&ES through which students conduct interdisciplinary research and outreach activities throughout the tropics. Within the broader Yale community, TRI serves as a clearinghouse for research and educational activities pertaining to tropical countries, societies, and environments.

TRI is run by a director, student program assistants, and a faculty steering committee. Its directorship and its student grant program are supported by its own endowments.

Research TRI administers the TRI Fellowship, an endowed fellowship program that supports several dozen master's and doctoral students conducting natural and social science research in the tropics each year. Following the mission of TRI, these research projects are typically interdisciplinary and problem-oriented and cover a wide range of issues concerning the management and conservation of tropical resources. TRI also administers a small grants program focused on Sri Lanka. More information on both programs can be found at http://tri.yale.edu.

Education Throughout the academic year, TRI sponsors workshops, discussions, and speakers that focus on timely conservation and development issues in the global tropics.

TRI provides mentoring and training to graduate students in research design, proposal writing, and field methods; after research, it helps them develop articles for *Tropical Resources,* TRI's annual journal of student research.

Outreach TRI supports partnerships with international organizations in many tropical regions in order to create innovative research opportunities for F&ES students. TRI works to build networks among scholars and international institutions to facilitate research and the dissemination of knowledge on tropical resource issues. TRI distributes its annual *Bulletin* to an international list of practitioners and academics, and it hosts a website, http://tri.yale.edu.

Publications TRI publishes *Tropical Resources: The Bulletin of the Tropical Resources Institute,* an annual journal of student research funded by grants from TRI. This publication is disseminated both internationally and domestically to a list that includes practitioners,

academics, and institutions that focus on tropical issues; it can also be read online at http://tri.yale.edu/tropical-resources-bulletin. The *Bulletin* typically contains articles by a dozen or more students based on a wide range of field research experiences.

FORUM ON RELIGION AND ECOLOGY AT YALE

The Forum on Religion and Ecology at Yale is the largest international multireligious project of its kind. With its conferences, publications, and website (http://fore.yale.edu), it is engaged in exploring religious worldviews, texts, and ethics in order to broaden understanding of the complex nature of current environmental concerns. The forum recognizes that religions need to be in dialogue with other disciplines (e.g., science, economics, and policy) in seeking comprehensive solutions to both global and local environmental problems. The cofounders and codirectors of the forum and the series editors for the World Religions and Ecology series are John Grim and Mary Evelyn Tucker.

The forum arose from a series of ten conferences on the world's religions and ecology held at Harvard from 1996 to 1998, which resulted in ten volumes distributed by Harvard University Press. Several of these volumes have been translated into other languages, including Chinese.

One of the principal objectives of the Forum on Religion and Ecology was to help create a new field of study that will assist environmental policy. Since its creation, the forum has played an active role in promoting the study of religion and ecology as an emerging field of study and a force for transformation. Courses are now taught at colleges and high schools across North America and in some universities in Europe. Canada, Australia, and Europe now have their own forums on religion and ecology. Moreover, a new force of religious environmentalism is growing in churches, synagogues, temples, and mosques around the world. Now every major religion has statements on the importance of ecological protection, and hundreds of grassroots projects have emerged. The Forum on Religion and Ecology has played an active role in these developments. The work of the forum includes:

Joint master's degree program at Yale The Yale School of Forestry & Environmental Studies (F&ES) and Yale Divinity School (YDS) offer a joint master's degree program in religion and ecology—the first of its kind in North America. It is aimed at students who wish to integrate the study of environmental issues and religious communities in their professional careers and at those who wish to study the cultural and ethical dimensions of environmental problems. The joint degree is supported by co-appointed faculty and by the forum.

This degree program provides an opportunity to study in two independent schools at Yale University, each with its own integrity. Students work toward both a Master of Environmental Management (M.E.M.) degree at F&ES and either a Master of Arts in Religion (M.A.R.) or Master of Divinity (M.Div.) degree at YDS. Within these schools, they are encouraged to take courses in environmental ethics and in religion and ecology. Students have the opportunity to work with faculty in both schools, as well as with a number of co-appointed faculty members.

Publications The forum has helped to create a new field of research and teaching in religion and ecology that has implications for environmental policy.

- The forum, with its scholarly network, published the ten-volume World Religions and Ecology series from Harvard.
- In 2014 the forum published the book *Ecology and Religion,* by John Grim and Mary Evelyn Tucker, in an F&ES series from Island Press.
- The forum has supported the first journal in the field, *Worldviews: Global Religions, Culture, and Ecology*.
- It produced a *Daedalus* volume, *Religion and Ecology: Can the Climate Change?,* which was the first discussion of world religions and the ethics of climate change.
- The forum's founders have also served as editors for the twenty-volume Ecology and Justice series from Orbis Books.
- The encyclopedia *The Spirit of Sustainability* (Berkshire Publishers, 2009), edited by Willis Jenkins of the University of Virginia and Whitney Bauman of Florida International University, was also a project of the forum.
- Tucker and Grim have also edited a number of volumes by the late cultural historian Thomas Berry: *The Sacred Universe* (Columbia University Press, 2009), *The Christian Future and the Fate of Earth* (Orbis Books, 2009), *Evening Thoughts* (Sierra Club Books, 2006), and *The Great Work* (Random House, 1999).

Conferences The forum has organized many conferences, including "Renewing Hope: Pathways of Grassroots Religious Environmentalism" (F&ES and YDS, 2007), the Forum on Religion and Ecology's 10th Anniversary Symposium (Yale Club of New York, 2008), and the Thomas Berry Memorial (Cathedral of St. John the Divine, New York, 2009). The forum cosponsored the conference "Environmental Dis/locations: Environmental Justice and Climate Change" (F&ES & YDS, 2010) and organized an interdisciplinary conference for the premiere of the film *Journey of the Universe* at F&ES (2011). It has also assisted in organizing the Thomas Berry Award and Lecture since 1998. The forum organized with TERI University an interdisciplinary workshop focused on the Yamuna River and held in Delhi and Vrindavan in north India (2011). In 2012 the forum organized a conference between F&ES and YDS titled "Religion and Environmental Stewardship."

In addition, the forum participates in interdisciplinary conferences worldwide, including conferences with the United Nations Environment Programme (UNEP); United Nations Educational, Scientific and Cultural Organization (UNESCO); the International Union for Conservation of Nature (IUCN); the Dialogue of Civilizations; the Earth Dialogues led by Gorbachev; the Earth Charter; the Religion, Science, and the Environment Symposia, led by the Greek Orthodox Patriarch, Bartholomew; and the Parliament of World Religions.

Website The forum's website is a world-class international site for research, education, engagement, and outreach in the field of religion and ecology. It contains detailed information on the world's religions and their ecological contributions; resources that address environmental issues related to ethics, economics, policy, and ecological sciences; syllabi and lists of educational videos and CD-ROMs; links to programs and institutions related to environmental education; and a variety of other resources for educators. The site provides current information on news, publications, and events related to world religions and ecology. This is available in a monthly online newsletter that is distributed to some 12,000 people. See http://fore.yale.edu.

Films The forum was a principal adviser for the film *Renewal: Inspiring Stories from America's Religious Environmental Movement* (2007), and it collaborated with evolutionary philosopher Brian Swimme on the Emmy Award-winning film *Journey of the Universe* (2011), which was broadcast on PBS. The latter project includes a book published by Yale University Press, a twenty-part DVD series of interviews, curricular materials, and a website, www.journeyoftheuniverse.org.

THE ENVIRONMENTAL LEADERSHIP AND TRAINING INITIATIVE

In April 2006 the Environmental Leadership and Training Initiative (ELTI)—http://elti.yale.edu—was launched, thanks to a generous grant from the Arcadia Fund. For the execution of the project, F&ES has partnered with the Smithsonian Tropical Research Institute (STRI) in Panama and the National University of Singapore (NUS), as well as a range of other in-country partners. ELTI's mission is to enhance environmental management and leadership capacity in the tropics by offering cutting-edge learning, leadership, and networking opportunities aimed at improving efforts to conserve and restore tropical forests, native tree cover, and ecological integrity in human-dominated landscapes. Through complementary, applied, action-oriented training and leadership-building activities, ELTI aims to promote and affect on-the-ground conservation and restoration actions.

ELTI was created to strengthen the conservation and restoration of tropical forests in Asia and the Neotropics by offering field-based and online training courses, as well as workshops, conferences, and symposia, to policy makers, natural resource practitioners, community members, and other key actors in these regions. Focal countries with long-term field-based training and research programs include Brazil, Colombia, Indonesia, Panama, and the Philippines. The goal is to provide participants with the knowledge, tools, skills, and networking opportunities to advance the conservation and restoration of forests and biodiversity. Alumni of ELTI's training events also are able to participate in ELTI's Leadership Program, which supports their efforts to share and apply what they learn during an ELTI course and provides opportunities for further professional and personal development. ELTI involves faculty, staff, and students from F&ES and research scientists from STRI in various aspects of the program, as well as scientists, practitioners, and land managers in the countries where ELTI works.

YALE PROGRAM ON CLIMATE CHANGE COMMUNICATION

The Yale Program on Climate Change Communication conducts scientific research on public climate change knowledge, attitudes, policy preferences, and behavior, and on the underlying psychological, cultural, and political factors that influence them. We also engage the public in climate change science and solutions, in partnership with governments, media organizations, companies, and civil society, and with a daily national radio program, Yale Climate Connections.

THE SEARCH CENTER: SOLUTIONS FOR ENERGY, AIR, CLIMATE, AND HEALTH

The SEARCH Center (Solutions for Energy, AiR, Climate, and Health), funded by a five-year Air, Climate and Energy (ACE) Center grant from the U.S. Environmental Protection Agency, aligns cutting-edge scientific research and technology to support the EPA's strategic goals of protecting human health and the environment. Based at Yale University, with major participation by Johns Hopkins University, the SEARCH Center involves more than two-dozen researchers across a number of institutions including North Carolina State University, Stanford University, Northeastern University, University of Chicago, University of Michigan, and the Pacific Northwest National Laboratory.

The center's main objectives are to: (1) investigate energy-related transitions under way across the United States by combining state-of-the-science modeling of energy systems, air quality, climate, and health; (2) characterize factors contributing to emissions, air quality, and health associated with key energy-related transitions in order to understand how these factors affect regional and local differences in air pollution and public health effects today and in the future; and (3) identify key modifiable factors (e.g., transportation, land use, power generation) and how those factors and their air pollution impacts are likely to change over time. The center has four research projects, two support units, and an administrative core.

- Project 1 (*Modeling Emissions from Energy Transitions*) encompasses economic modeling of national emissions and air quality under different energy policy scenarios.
- Project 2 (*Assessment of Energy-Related Sources, Factors, and Transitions Using Novel High-Resolution Ambient Air Monitoring Networks and Personal Monitors*) measures and examines real-world exposure to air pollution using stationary and personal monitors.
- Project 3 (*Air Quality and Climate Change Modeling*) draws upon projects 1 and 2 to model relationships between air quality, policy, and health under various climate change scenarios using air quality and climate change modeling.
- Project 4 (*Human Health Impacts of Energy Transitions*) estimates the health impacts of various air quality scenarios from the other SEARCH projects and identifies populations most vulnerable to air pollution.
- The Support Unit on Policy and Decision Making bridges the divide that often separates science and policy through iterative processes bringing SEARCH scientists and real-world policy makers together.
- The Support Unit on Quantitative Methods provides statistical support for all four projects. This unit is developing statistical methods to address the scientific questions of interest and will facilitate integration across different projects. This unit will also encourage reproducible research through dissemination of data and statistical code, where feasible.

THE GLOBAL INSTITUTE OF SUSTAINABLE FORESTRY

Since its founding in 1900, the Yale School of Forestry & Environmental Studies has been in the forefront in developing a science-based approach to forest management and in training leaders to face their generation's challenges to sustaining forests.

The School's Global Institute of Sustainable Forestry continues this tradition in its mission to integrate and strengthen the School's forestry research, education, and outreach to address the needs of the twenty-first century and a globalized environment. The Global Institute fosters leadership through dialogue and innovative programs, creates and tests new tools and methods, and conducts research to support sustainable forest management worldwide.

Forestry at Yale is broadly defined to include all aspects of forest management and conservation. The Global Institute works primarily through faculty-led programs and partnerships with other Yale centers and forestry institutions in the United States and abroad. Students participate as research assistants, interns, and School Forests field crew; are encouraged to take on high levels of leadership in planning activities and events; and regularly contribute to published documents that emerge from program activities.

The Global Institute coordinates the School's participation in regional, national, and international forestry events such as the Society of American Foresters and IUFRO (International Union of Forest Research Organizations) Conferences and the World Forestry Congresses, and coordinates activities with other institutions throughout the world.

Research Through its research programs, the Global Institute brings world-class scholarship to bear on the challenges facing the world's forests. Programs represent the diverse interests and expertise of the F&ES faculty, who conduct applied research in both ecological and social dimensions of forests and forestry.

Yale Forest Forum (YFF) The Yale Forest Forum (YFF) serves as the dialogue and convening function of the Global Institute of Sustainable Forestry. YFF was established in 1994 by a diverse group of leaders in forestry to focus national attention on broader public involvement in forest policy and management in the United States. In an attempt to articulate and communicate a common vision of forest management to diverse stakeholders, the first initiative of YFF was to convene the Seventh American Forest Congress (SAFC). After a series of local roundtables, the SAFC culminated in a 1,500-person citizens' congress in Washington, D.C. The principles discussed during the congress remain part of YFF's core philosophy of how forest policy discussions should take place: "collaboratively, based on the widest possible involvement of stakeholders."

YFF's activities are centered on bringing individuals together for open public dialogues to share experiences, explore emerging issues, and debate varying opinions constructively. In that light YFF sponsors many issues forums and leadership seminars throughout the academic year. YFF forums and seminars not only focus on emerging issues in forest management, they also give students exposure to leaders in the NGO, industry, landowner, and government sectors in forest conservation and sustainable forestry. They provide an opportunity for diverse parties to meet and exchange ideas and have led to ongoing dialogue concerning forestry problems and solutions. YFF publishes the *YFF Review* to disseminate to a wide audience the outcomes and lessons learned from its work.

Midcareer short courses The Global Institute offers short courses that bring the latest thinking on sustainable forestry management to working professionals. Courses range from executive level for management professionals to field-based courses for forestry practitioners.

Global Forest Atlas The Global Forest Atlas is a website that brings together issues facing forests in the twenty-first century: forest management, deforestation, land use, governance, and conservation. Launched in 2014, the Global Forest Atlas currently highlights the two largest tropical forest regions of the world, the Amazon basin and the Congo basin; the boreal forest region; and the Himalayas. Introducing forest issues in these regions, the forest atlas describes the scientific foundation, trends, and breaking news and research, including research and advocacy of Yale F&ES researchers, students, and graduates. The Global Forest Atlas plans to expand coverage of forest issues to all of the important forest regions of the world.

Ucross High Plains Stewardship Initiative

The Ucross High Plains Stewardship Initiative (UHPSI) is a research program at Yale F&ES, with a field station at the Ucross Ranch, a 22,000-acre working cattle and sheep operation in northern Wyoming. Providing a comprehensive resource for Western studies at Yale F&ES, UHPSI specializes in science-based solutions to issues of rangeland management. Working in close coordination with a network of ranchers, nonprofits, government organizations, and academics, UHPSI hosts devoted faculty and doctoral and master's students, supported by a full-time research staff. While much of our research takes place through the lens of spatial ecology and remote sensing, we are engaged in projects ranging from grazing-system analysis to hydrology and biogeochemistry, to best practice development for wool markets, to K–12 education.

Student education and experiential learning are the top priority of UHPSI. Our staff specialize in connecting students across all disciplines with applied research and learning opportunities in the high plains of the Northern Rockies. On campus, UHPSI students work throughout the academic year to bring in exemplary Western speakers and top educators for lectures, short courses, and workshops.

Led by postdoctoral, doctoral, and research staff, UHPSI has become a hub for geospatial analysis at F&ES, offering expertise in GIS, remote sensing, spatial statistics, and cartography. In addition to our strong emphasis on master's student education, UHPSI staff researchers work on long-term cutting-edge research and publication relevant to the management of large landscapes in the American West and beyond.

UHPSI is run by a staff director, program and research staff, and a team of student project and research assistants. Programming is supported by grant writing and generous alumni contributions.

Western Research Fellowship Begun in summer 2016, the Western Research Fellowship (WRF) funds F&ES and Yale College students interested in issues pertinent to land management in the Rocky Mountain West, targeting high-impact biophysical or social questions. In addition to a generous financial award, fellows are given access to a broad network of partner organizations and properties across the West, as well as technical, logistical, and publication support. Great emphasis is placed on a final deliverable at the end of the summer field season, with the WRF cohort required to take part in a publication methods course in the fall term following their fellowship.

For more information about UHPSI, visit http://highplainsstewardship.org.

Program on Landscape Management

Ecosystems can be defined at a variety of scales—a stand, a landscape, a region, a continent. At all scales, they are dynamic, constantly changing from one condition to another. Ecosystems contain forests and other resources that interact both competitively and synergistically. Managing ecosystems requires an understanding and appreciation of the biological, social, and economic dynamics of ecosystems.

Experience in forest management has shown that managing at small scales is difficult, because many different values need to be provided. Consequently, diverse conditions need to be coordinated across the landscape. This is the basis of the landscape approach to forest and other resource management.

The Program on Landscape Management works cooperatively with other organizations throughout the world. It develops the scientific basis, concepts, and tools needed to help people provide a wide range of resource values, including commodities, wildlife habitat, fire safety, employment, and carbon sequestration.

The program applies local knowledge, science, and technical tools to achieve practical results. Recent and ongoing projects include developing a sustained harvest level for Connecticut state forests; mitigating the fire danger in the irradiated forests around the Chernobyl nuclear reactor, Ukraine; developing ways to increase habitats for the Amur (Siberian) tiger in northeastern China; developing a decision tool for conversion between agriculture and forest land in Mississippi; developing land stewardship practices in the High Plains of Wyoming; examining the potential of expanded wood use to substitute for steel and brick construction, and thus reduce greenhouse gas emissions and fossil fuel consumption; and developing computer software (see http://landscapemanagementsystem.org).

The Program on Landscape Management is housed in Greeley Laboratory. Students have a range of opportunities to work with the program, from technical development of the modeling software to field data collection and synthesis.

Sustaining Family Forests Initiative

The Sustaining Family Forests Initiative (SFFI) is a collaboration among the School of Forestry & Environmental Studies, the U.S. Forest Service, and the Center for Nonprofit Strategies, aimed at gaining and disseminating comprehensive knowledge about family forest owners throughout the United States. SFFI conducts research on U.S. family forest owners and has developed a practical set of tools to help conservation and forestry professionals reach these landowners with effective stewardship messages and to develop programs that serve the needs and values of the landowners. The basis of SFFI's work is to apply a social marketing approach—the use of commercial marketing techniques to affect positive social change—as a promising means by which to influence family forest owners to take steps to conserve and sustainably manage their land. Since 2010 SFFI has trained more than nine hundred natural resource professionals in landowner outreach. These professionals work in twenty-six states and represent more than three hundred organizations, primarily state forestry agencies and their conservation and stewardship partners. More information about SFFI is available at http://sffi.yale.edu.

Yale School Forests

The Yale School of Forestry & Environmental Studies owns and manages 10,852 acres of forestland in Connecticut, New Hampshire, and Vermont. Maintained as working forests deriving income from timber and other products, the Yale School Forests provide educational, research, and professional opportunities for the students and faculty of the School; they are used as a laboratory for teaching, management, and research. For more information, see Yale School Forests and the Quiet Corner Initiative in the chapter Life at the School of Forestry & Environmental Studies.

GOVERNANCE, ENVIRONMENT, AND MARKETS INITIATIVE

The Governance, Environment, and Markets (GEM) Initiative is an action-oriented network of scholars and practitioners who collaborate on the study, development, and implementation of effective, durable, and equitable solutions to complex problems in environmental policy and governance. The GEM Initiative provides Yale students an opportunity to work as researchers and assist in the coordination and delivery of worldwide activities that address three cross-cutting themes: the management of complex governance arrangements; the fostering of learning among multiple stakeholders; and the determinants of effective, durable policy pathways.

Embracing a future of multiparty collaboration, GEM's research, teaching, and outreach activities bridge scholarship and practice and encourage long-term and collaborative approaches to some of the most important questions facing the planet, including forest policy and governance, climate policy, and the role of private governance. GEM identifies and promotes viable pathways for government officials, the private sector, environmental groups, and other stakeholders to effect positive change in environmental governance.

The GEM Initiative accomplishes this objective through a "governing for global environmental problems" approach in which innovative governance/policy proposals are assessed by their ability to develop enduring solutions to global environmental challenges. In order to uncover new opportunities, we focus on understanding and disseminating knowledge about:

- Interactions among government and market mechanisms that produce innovative, effective, and efficient results that are not achieved through single interventions or institutions;
- The evolution of policies and institutions that foster durable results.

GEM focuses on four key themes:

Forest Policy and Governance The mission of the Yale Program on Forest Policy and Governance is to foster innovations in sustainable forestry management and policy. It is a core program within the Global Institute of Sustainable Forestry at F&ES. The program focuses on three interrelated efforts: (1) research designed to understand the development of state and non-state forest policies and their impacts on sustainable forestry; (2) teaching and training on forest governance and policy; and (3) outreach activities to the

broader forestry community. The program hosts visiting speakers at Yale and participates in key certification and sustainable forest-policy conferences globally.

Private Authority and Environmental Governance This program focuses on the emergence and evolution of "non-state, market-driven" global governance, particularly certification systems. The use of these systems to address environmental problems has the potential to shift the prevailing regulatory paradigm. Our work explores under what circumstances market mechanisms, such as certification systems, effectively address problems where governments have failed. We focus on several sectors, including timber legality verification and forest certification, fisheries and the ornamental fish trade, organic agriculture, climate mitigation, and electronic waste recycling.

Climate Policy and Governance GEM's substantive focus on climate departs from existing international relations research, which focuses primarily on why states do or do not cooperate in exploring policy interventions outside of this model. GEM applies key mechanisms to assess climate in three ways: (1) How climate, as the leading case of a "super wicked problem," might benefit from attention to "path-dependency" policy analysis; (2) How symbiotic interaction among intergovernmental approaches, such as the CDM mechanisms, might interact with non-state, market-driven global governance, such as the CDM gold standard certification, to produce authoritative approaches in ways that neither intervention by itself could; and (3) How the intersection of climate and forests might shape the definition of problems and solutions unimaginable a generation earlier.

Law, Rights, and Environmental Governance Numerous jurisdictions have developed new procedural and substantive environmental rights and have sought to provide enhanced access to decision making, information, and justice in environmental matters. Private rights also continue to play an important role in how environmental issues and problems are addressed in different jurisdictions. These rights raise critical issues about the role of legal norms in different systems, modes, and levels of environmental governance.

GEM's Program on Law, Rights, and Environmental Governance seeks to understand and explain the implications of law and rights for efforts to improve environmental governance at the local, national, and international levels. The program aims to generate innovative interdisciplinary knowledge that assesses the emergence, spread, and effectiveness of rights norms across political, institutional, and social contexts, processes, and actors. It also seeks to share this analytical research with practitioners and policy makers working at the intersection of law, rights, and environmental governance.

THE FORESTS DIALOGUE

The Forests Dialogue (TFD) was created in 1998 to provide international leaders in the forest sector with an ongoing, multi-stakeholder dialogue (MSD) platform and process focused on developing mutual trust, a shared understanding, and collaborative solutions to challenges in achieving sustainable forest management and forest conservation around the world. TFD is an autonomous, unincorporated organization hosted by Yale University and with a Secretariat based at F&ES since 2000.

The goal of TFD is to reduce conflict among stakeholders over the use and protection of vital forest resources. Over the past seventeen years, TFD has brought together more than 2,500 diverse leaders to work through eighteen key compelling forest issues. Current TFD initiatives include: Understanding Deforestation-Free (UDF) commitments, Sustainable Wood Energy (SWE), Tree Plantations in the Landscape (TPL), and Land Use Dialogues (LUD). TFD uses the MSD model to progress from building trust among participants to achieving substantive, tangible outcomes so that participants are committed to advocate for and work to implement those consensus-based outcomes.

TFD is governed by a steering committee composed of a diverse group of individuals representing key stakeholder perspectives from around the world. TFD hires F&ES students as program associates each term to work with the Secretariat and steering committee members. Duties include background research, Secretariat support, dialogue planning, and implementation.

Partnerships

The School of Forestry & Environmental Studies is a multidisciplinary learning center with tremendous resources, both within and outside the School. The School is engaged in partnerships that range from alliances with other Yale programs and schools to formal agreements with many external organizations and universities. These relationships enrich the School and add important dimensions to the F&ES learning experience.

WITHIN YALE

Students of the School of Forestry & Environmental Studies often take advantage of the faculty and resources of other schools and departments within the Yale system. F&ES has several types of arrangements that enable students to fully benefit from the University.

The School has joint-degree agreements with the School of Architecture, Divinity School, Law School, School of Management, School of Public Health, and Graduate School of Arts and Sciences. For further information on joint degrees, please refer to Joint Master's Degree Programs in the chapter Master's Degree Programs, and to Combined Doctoral Degree in the chapter Doctoral Degree Program.

The School has also cultivated relationships with key faculty members of other divisions of the University who have research and teaching interests that overlap with the School's foci. These faculty hail from the schools of Architecture, Engineering & Applied Science, Management, and Medicine, as well as the departments of Geology and Geophysics, Ecology and Evolutionary Biology, Economics, and Anthropology, among others. For a full list of the faculty with joint appointments, see Secondary Appointments.

Yale Institute for Biospheric Studies

Established in May 1990, the Yale Institute for Biospheric Studies (YIBS) serves as a key convener for Yale University's research and training efforts in the environmental sciences. YIBS is committed to the teaching of environmental studies to future generations and provides physical and intellectual centers and programs for research and education that address fundamental questions that will inform the ability to generate solutions to the biosphere's most critical environmental problems. There are currently three YIBS programs: Program in Spatial Biodiversity Science and Conservation; Program in Eco-Evolutionary Interactions; and Program in Phosphorus Analysis. The YIBS Environmental Analytics Core Facilities include the Center for Earth Observation, the Earth System Center for Stable Isotopic Studies, and the Center for Genetic Analysis of Biodiversity. YIBS also provides master's and doctoral student research support through various small-grant initiatives and a doctoral dissertation-enhancement grant program. For full information on YIBS and its associated programs and centers, see http://yibs.yale.edu.

Yale Peabody Museum of Natural History

The Yale Peabody Museum of Natural History, founded in 1866, contains one of the great scientific collections in North America. Numbering more than thirteen million objects and specimens, the collections are used for exhibition and for research by scholars

throughout the world. Each year, an increasing number of specimens from the collection are available online at http://peabody.yale.edu.

The mission of the Peabody Museum is to advance understanding of Earth's history through geological, biological, and anthropological research, and by communicating the results of this research to the widest possible audience through publication, exhibition, and educational programs.

Fundamental to this mission is stewardship of the museum's collections, which provide a remarkable record of the history of Earth, its life, and its cultures. Conservation, augmentation, and use of these collections become increasingly urgent as modern threats to the diversity of life and culture continue to intensify.

The museum's collections are a major component of the research and teaching activities of the Peabody and Yale. The curators and staff are engaged in contributing new knowledge based on the museum's research materials. All collections are used in undergraduate and graduate teaching and research, as well as in public programs and exhibitions. The Yale Peabody Museum fills many important roles on the Yale University campus, particularly as it has expanded its role in the community and the region, thereby offering a "front door" to the University for the general public.

In 1995, a formal collaboration was established among the Peabody Museum, the Yale Institute for Biospheric Studies, and the School of Forestry & Environmental Studies. This environmental partnership recognizes the Peabody Museum as a resource and catalyst for interdisciplinary research on Earth's history and environment, and seeks to strengthen the intellectual ties between the museum and other groups with a shared interest in environmental research at Yale. The School of Forestry & Environmental Studies maintains a close association with the Peabody. Among other activities involving F&ES faculty, staff, and students, the Peabody Field Station in Guilford, Connecticut, is used collaboratively for research on coastal and estuarine systems.

Coastal Field Station A research facility is available to students and faculty of the School of Forestry & Environmental Studies at the Peabody Museum Field Station on Long Island Sound in Guilford. The station is a thirteen-mile drive east of Yale and provides centrally located access to one of the country's most important estuaries. The station includes a boat ramp, deep-water moorings, and a small boat. There is also simple laboratory space within the field station building, Beattie House. Nearby research lands available to F&ES students include an island (Horse Island), coastal pond (Guilford Pond), and salt marsh complex (the Richards Property).

EXTERNAL PARTNERSHIPS

The School of Forestry & Environmental Studies has partnership agreements with numerous local, national, and international organizations beyond the Yale campus. The following are a few examples of these arrangements.

National University of Singapore

The National University of Singapore is a top research university with a far-reaching faculty and a multinational student body. The university offers a Master of Science in Environmental Management that provides environmental management education for

senior and mid-level managers in corporations, institutions, and government and nongovernmental organizations. This program is multidisciplinary, with the combined resources of seven of the university's faculties, and also draws on the expertise of established environmental agencies and institutions both locally and globally.

In 2001 the Yale School of Forestry & Environmental Studies entered into an official agreement with the National University of Singapore School of Design and Environment to share scientific, academic, and technical resources; exchange faculty and students; and cooperate in research, outreach, and conferences. There is an active faculty exchange and a joint research program examining industrial ecology and urban metabolism in Singapore.

New York Botanical Garden

The School of Forestry & Environmental Studies has enjoyed a reciprocal relationship with the Graduate Studies Program at the New York Botanical Garden for many years. Begun in 1896, the Botanical Garden program currently enrolls about a dozen students who are carrying out studies in systematic and economic botany and applied plant ecology at field sites around the world. The program's expertise spans the spectrum of both systematic and economic botany. It is operated in conjunction with several other academic institutions, including the Yale School of Forestry & Environmental Studies.

The resources of the New York Botanical Garden include one of the largest botanical libraries in the world, an herbarium and 10,000 species of living plants housed in several greenhouses, as well as an electron microscope, environmental chambers, and instrumentation for radiobiological, biochemical, anatomical, molecular, phytochemical, chemosystematic, numerical taxonomy, and vegetational studies. The School of Forestry & Environmental Studies offers a combined doctoral degree with the New York Botanical Garden, which is funded by the Lewis B. Cullman Fellowship. NYBG faculty teach courses at F&ES in tropical plant taxonomy, applied plant ecology, and ethnobotany.

External Joint-Degree Programs

The Yale School of Forestry & Environmental Studies also has joint-degree agreements with the Pace University School of Law, the Vermont Law School, Tsinghua University School of Environment, and Universidad de los Andes. Further information on these programs is available through the Office of Admissions.

Admissions: Master's Degree Programs

The School of Forestry & Environmental Studies offers four two-year master's degrees: the professionally oriented Master of Environmental Management (M.E.M.) and Master of Forestry (M.F.), and the research-oriented Master of Environmental Science (M.E.Sc.) and Master of Forest Science (M.F.S.). For individuals with seven or more years of professional experience related to the environment or forestry, a one-year midcareer option is available for the Master of Environmental Management and Master of Forestry degrees.

LEARNING ABOUT F&ES

The best way to learn about the School is to visit New Haven before submitting an application. An on-campus open house for prospective students will be held in the fall (November 10, 2017), and an open house for admitted students will be held on April 5–6, 2018. Participants will meet faculty, students, and staff to become familiar with the mission and goals, degree requirements and courses, opportunities for research and applied projects, career development, and life at Yale. F&ES faculty and staff also conduct outreach events around the United States and abroad, including attending graduate school fairs, hosting off-campus information sessions, and visiting schools and universities. To learn whether a representative will be coming to your area, please visit the admissions event schedule at http://environment.yale.edu/admissions.

The Office of Admissions offers a formal campus visit program throughout the year, and we encourage prospective students to visit during one of these events for the most comprehensive view of F&ES. Individual appointments are also available based on staff availability. Please note that it is best to visit Monday through Thursday, as few classes are held on Fridays, which are generally reserved for field trips and research. Weekend visits are not available. Visitors are welcome to sit in on classes of interest with no advance notice; the class schedule each term is posted at http://environment.yale.edu/courses. Feel free to contact directly any faculty member whose work is of interest to you; e-mail is best. We do not conduct formal interviews. To schedule a visit, please contact us at fesinfo@yale.edu.

The Admissions website, http://environment.yale.edu/admissions, has extensive information about the School. Should you have additional questions, we are pleased to correspond with you by e-mail, or you may schedule a telephone conversation with our Admissions staff. The Admissions office can be reached by e-mail at fesinfo@yale.edu or telephone at 800.825.0330.

APPLICATION PROCEDURES

The application form for admission to the F&ES professional and research master's degrees (M.E.M., M.E.Sc., M.F., or M.F.S.) may be acquired online at https://apply.environment.yale.edu/apply. This form includes complete instructions for the application requirements.

Questions concerning admission or the application process should be directed to fesinfo@yale.edu, or 800.825.0330.

Admissions to F&ES is for a fall-term only start date. The priority deadline for master's application consideration is December 15. Completed individual admissions files submitted by midnight EST on this date are guaranteed to receive a review by the Admissions Committee. Application materials may be submitted after this date until mid-January, but there is no guarantee that they will be acted upon this year. Therefore we encourage serious applicants to submit all required items to the Office of Admissions prior to the December 15 deadline.

Previous applicants planning to reapply to F&ES must submit a new application form and current application fee, an updated résumé/curriculum vitae, and transcripts depicting all academic work not included in the previous application. We also recommend that applicants consider submitting an updated personal statement. Admissions records including application forms and supplemental materials are held for two years by the Office of Admissions. Provided reapplication occurs within two admissions cycles, all required materials previously submitted to the Office of Admissions will be incorporated into the new application as requested. Documents submitted prior to the admissions cycle for a fall 2016 entry are no longer available.

PREPARATION FOR ADMISSION

The School welcomes individuals from a variety of undergraduate backgrounds including the biological and physical sciences, engineering, social sciences, mathematics, humanities, or interdisciplinary programs. A disciplinary focus with some interdisciplinary breadth is valuable. Introductory course work in the biological and physical sciences, the social sciences, and college mathematics allows students to take greater advantage of courses at the graduate level. Students with adequate undergraduate breadth also have better access to graduate course offerings in other professional schools and departments of the University.

Experience has demonstrated the special value of a short list of selected courses that provide a good foundation for all master's programs in the School. Therefore the Admissions Committee favors applicants who have successfully completed a combination of the courses listed below prior to beginning a degree program at the School. For this reason, it is highly recommended that applicants have at least (a) two college courses in mathematics, (b) two college courses in the biological sciences, (c) two college courses in the physical sciences, and (d) two college courses in the social sciences.

The specific courses listed under each distribution area are judged to be most suitable for helping students gain the maximum benefit from Yale course offerings. Students wishing to fulfill these recommendations can take courses at any accredited institution and must have been awarded a final grade of C or better (courses taken pass/fail do not count in this review). Advanced Placement (AP) and International Baccalaureate (IB) courses are not considered during our transcript review process. Courses listed below can serve as a guide; however, this list is not comprehensive.

1. College mathematics—two courses selected from:
   a. calculus
   b. statistics
   c. linear algebra
   d. discrete mathematics

2. Biological science – two courses selected from:
   a. evolutionary biology
   b. ecology
   c. botany
   d. zoology
3. Physical science – two courses selected from:
   a. general chemistry
   b. general physics
   c. geology/earth science
   d. hydrology/soil science
4. Social science – two courses selected from:
   a. anthropology
   b. economics (micro and macro)
   c. political science
   d. sociology

APPLICATION REQUIREMENTS

Candidates for admission must hold a four-year baccalaureate degree or an equivalent international degree, and are required to provide the following materials:

1. A completed online application form.
2. A résumé/curriculum vitae. Indicate full- or part-time for each job/internship/volunteer position.
3. A personal statement discussing career plans and the reasons for applying to F&ES (650-word maximum).
4. One transcript or mark sheet from each college and/or university attended. Official transcripts are not required; however, all transcripts submitted must include the applicant's name and institution (not to be added by the applicant).
   - Applicants who have completed a degree outside of the United States or Canada are strongly encouraged to submit a transcript evaluation. If submitting a transcript evaluation, applicants should use EducationUSA advisers (https://educationusa.state.gov/find-advising-center), World Education Services (www.wes.org), or Educational Credential Evaluators (https://ece.org) for course-by-course or ICAP evaluation of all transcripts (undergraduate and graduate). Those who secure WES or ECE evaluations should submit their official transcripts directly to WES or ECE, not to the Office of Admissions. An additional copy of the transcript beyond the official evaluation is not required. Evaluations must be received in the Office of Admissions by the December 15 deadline for an application to be considered complete. The applicant is strongly encouraged to begin this process early, as evaluations can take more than a month to complete.
   - Admitted students submitting transcripts and degree certificates from Chinese universities must arrange for a verification report of their university transcript with the China Academic Degrees and Graduate Education Development Center (CDGDC; www.cdgdc.edu.cn). Do not request your verification report from the CDGDC until your degree has been awarded. Verification reports should only be sent after accepting an offer of admission. The report must be mailed directly to the Office of Admissions by the CDGDC, rather than by the admitted student or any third party. Any transcript not mailed by the CDGDC will not be considered as a final official transcript.
5. Three letters of reference (academic and/or professional). Submission of the recommendation form and a one- to two-page letter is expected. Please note that

we are unable to accept any additional recommendations beyond the required three. It is strongly recommended that the applicant submit at least one academic letter of reference.

6. An official GRE, GMAT, or LSAT score report. Applicants must complete the exam by the December 15 deadline. We only accept LSAT scores for those applicants currently applying to the joint law programs with Pace, Vermont, or Yale Law Schools. If submitting LSAT scores, please contact the Office of Admissions for instructions. We do not accept unofficial copies of score reports or other test formats such as MCAT or MAT.
7. An official TOEFL or IELTS score report if English is not a native or customary language of instruction (copies will not be accepted). Applicants must achieve at least a 100 on the iBT version of the TOEFL or a 7.0 on the IELTS examination (minimum of 6.5 in each section) to be given full consideration for admission.
8. The $80 application fee (a need-based fee waiver is available online).
9. If applying to the M.E.Sc. or M.F.S. program, please be sure to include a list of three potential advisers on the application form. Please also attach as an addendum to the personal statement a short paragraph for each of the listed advisers describing why you would like them to serve as your adviser on your intended research. Please be sure to link your research interests with theirs to help connect how they may be able to best advise you on your project.
10. An optional supplemental statement on your "Contribution to the F&ES Community" (no more than 300 words). In its mission, the Yale School of Forestry & Environmental Studies aspires to be a global leader in addressing "society's evolving and urgent environmental challenges" and to "identify pathways to a sustainable future that respects diverse values." How do your life experiences/background enhance F&ES's commitment to a diverse set of perspectives and to training individuals in an increasingly varied society?

    Note: Additional documents beyond those listed above will not be reviewed and may be discarded at the end of the admissions cycle.

All application materials should be uploaded to the electronic application form. Materials cannot be returned, copied, or forwarded to third parties.

All applicants must hold a bachelor's-level degree and demonstrate satisfactory academic achievement, but there are no arbitrary standards or cutoffs for test scores or grade-point averages, with the exception of English language ability (TOEFL and IELTS). Letters of reference from individuals who can evaluate the applicant's scholarship, professional activities, leadership skills, and career goals are especially valuable. Letters from undergraduate professors and/or professional supervisors are preferred. The School looks for students capable of making effective contributions to scientific knowledge or to professional service in addressing environmental problems. Special weight is given to relevant experiences obtained subsequent to graduation from college. Clarity regarding professional career goals is a critically important part of the applicant's personal statement. Faculty review teams read the applications submitted to the master's degree programs. Final admissions decisions rest on an integrated assessment of the components described above.

When taking the Graduate Record Examination (GRE) or Graduate Management Admissions Test (GMAT), applicants should indicate the School's Institution Code Number 3996 or 3TJ-WT-45; no department code is necessary. Applicants taking the Law School Admissions Test (LSAT) must contact the Office of Admissions for special instructions. For further information, please visit the following websites: www.ets.org/gre, www.mba.com, or www.lsac.org. Official GRE and GMAT test results will be sent directly to the School by the testing services and generally arrive two to three weeks after the examination date. Please plan ahead so that you are able to take the exam by the December 15, 2017, application deadline.

ENGLISH AS A SECOND LANGUAGE TRAINING REQUIREMENT

Applicants for whom English is not a native or customary language of university instruction must take the Test of English as a Foreign Language (TOEFL) or the International English Language Testing System (IELTS). We require a minimum TOEFL score of 100 on the Internet test. A minimum overall score of band 7.0 is required for the IELTS, with a minimum of 6.5 in each section. Please note that we will only accept the iBT version of the TOEFL examination. When taking either test, applicants should indicate the School's Institution Code Number 3996; no department code is necessary. Additional information about TOEFL can be found at www.ets.org/toefl. Information about IELTS can be found at www.ielts.org. Official test results will be sent directly to the School by the testing service and generally take two to three weeks to arrive.

Applicants who are required to submit the TOEFL or IELTS must also submit a supplemental essay (300 words maximum) detailing all educational, research, and/or work and internship experience related to the English language. The Admissions Committee may follow up with a phone interview to assist in determining English proficiency. As a condition of acceptance, it may be required that applicants for whom English is a second language, whose undergraduate degree work has not been conducted in English, or whose application suggests such a need, complete a six-week instructional program in written and spoken English conducted by Yale Summer Session. More information will be provided to those students who may qualify for this requirement.

Admissions: Doctoral Degree Program

The doctoral program is designed to develop the broad knowledge, analytical powers, technical skills, and creative thinking demanded of leaders in environmental and natural resources disciplines. Applicants should hold a bachelor's or master's degree in a field related to their intended program of study as expressed in the application.

APPLICATION PROCEDURES

The Doctor of Philosophy (Ph.D.) degree is administered jointly by the School of Forestry & Environmental Studies and the Yale Graduate School of Arts and Sciences.

Applications for the Ph.D. program can be obtained from the website of the Yale Graduate School of Arts and Sciences at http://gsas.yale.edu/admission-graduate-school. The application deadline for the Ph.D. program is January 2, 2018. Doctoral education involves a close pairing between the student and a faculty adviser. Before applying to the doctoral program, applicants must identify and contact one or two faculty members who would serve as their major adviser if accepted to the program.

The Graduate Record Examination (GRE) general test is required of all applicants. For more information on the GRE, visit www.ets.org/gre.

The Test of English as a Foreign Language (TOEFL) is required of all applicants whose native language is not English. This requirement is waived only for applicants who, prior to matriculation at Yale, will have received a baccalaureate degree or its international equivalent from a college or university where English is the primary language of instruction. The applicant must have studied in residence at the baccalaureate institution for at least three years to receive a waiver. If you do not qualify for a waiver but have taken the TOEFL within the past two years, you will need to have your TOEFL scores released to the Yale Graduate School of Arts and Sciences (code 3987). The International English Language Testing System (IELTS) may be substituted for the TOEFL. For more information and the latest updates on the TOEFL and IELTS, visit www.ets.org/toefl and www.ielts.org.

Tuition, Fees, and Other Expenses

TUITION AND FEES, 2017–2018

Master's Programs

The 2017–2018 tuition for master's degrees (M.E.M., M.F.S., M.E.Sc., and M.F.) is $41,065. Tuition for special students is based on the number of courses taken. The School reserves the right to revise tuition as it deems appropriate. Tuition does not include hospitalization/specialty insurance as required by the University, or materials fees charged by other schools and departments in the University.

Two-year master's students must pay full tuition for two years, regardless of the number of courses taken.

For 2017–2018, a single student should also anticipate estimated expenses of $500 for books and supplies; $1,500 for transportation, $2,360 for hospitalization/specialty insurance; living expenses of $14,985 for room, board, and personal expenses for the nine-month academic year; $350 for the mandatory Student Activity Fee; and $120 for the mandatory Student IT Fee.

Doctor of Philosophy Program

The 2017–2018 tuition for the Ph.D. program is $41,000. Most doctoral students receive a School fellowship that covers the cost of their tuition and provides a twelve-month stipend for the first five years of their program. In 2017–2018 the stipend is $30,250. Doctoral students must pay a nominal continuous registration fee (CRF) for no more than three years thereafter. In 2017–2018 the continuous registration fee is $600 per term.

REGISTRATION

All students in the master's programs must register for courses using the online registration system (available at www.yale.edu/sis) within the normal shopping period. The shopping period is the first two weeks of classes for the fall and spring terms (see academic calendar). A penalty of $35 will be charged for any changes made to a student's course registration after the Add/Drop period.

International students are required to complete a nonacademic registration at the Office of International Students and Scholars prior to their regular academic registration.

TUITION FEES FOR SPECIAL STUDENTS

The tuition charge for special students is 25 percent of tuition for one course, 50 percent for two courses, 75 percent for three courses, and full tuition for four or more courses for each term of attendance.

CONTINUOUS REGISTRATION

Master's degree students who wish to pursue their research through a six-month or one-year internship are permitted to do so and are considered enrolled on a full-time basis (student is entitled to continue membership in Yale Health and defer student loans).

Upon return, the student will register as a full-time student and pay tuition for the period needed to complete the degree requirements. Students may not register for regular course work, or work as a teaching assistant, while on continuous registration status. The fee for continuous registration is $3,250 per term. Students are permitted to be on continuous registration for a maximum of two terms.

TUITION DEPOSIT

Upon acceptance of admission, a deposit of $500 payable directly to the Yale School of Forestry & Environmental Studies is required to hold a place in the entering class. If a decision is made not to matriculate, the deposit will not be refunded.

TUITION REBATE AND FINANCIAL AID REFUND POLICY

On the basis of the federal regulations governing the return of federal student aid (Title IV) funds for withdrawn students, the rebate and refund of tuition are subject to the following policy.

1. For purposes of determining the refund of federal student aid funds, any student who withdraws from the School of Forestry & Environmental Studies for any reason during the first 60 percent of the term will be subject to a pro rata schedule that will be used to determine the amount of Title IV funds a student has earned at the time of withdrawal. A student who withdraws after the 60 percent point has earned 100 percent of the Title IV funds. In 2017–2018, the last days for refunding federal student aid funds will be November 1, 2017, in the fall term and March 30, 2018, in the spring term.
2. For purposes of determining the refund of institutional aid funds and for students who have not received financial aid:
   a. 100 percent of tuition will be rebated for withdrawals that occur on or before the end of the first 10 percent of the term: September 8, 2017, in the fall term and January 25, 2018, in the spring term.
   b. A rebate of one-half (50 percent) of tuition will be granted for withdrawals that occur after the first 10 percent but on or before the last day of the first quarter of the term: September 23, 2017, in the fall term and February 9, 2018, in the spring term.
   c. A rebate of one-quarter (25 percent) of tuition will be granted for withdrawals that occur after the first quarter of a term but on or before the day of midterm: October 23, 2017, in the fall term and March 5, 2018, in the spring term.
   d. Students who withdraw for any reason after midterm will not receive a rebate of any portion of tuition.
3. The death of a student shall cancel charges for tuition as of the date of death, and the bursar will adjust the tuition on a pro rata basis.
4. If the student has received student loans or other forms of financial aid, funds will be returned in the order prescribed by federal regulations; namely, first to Federal Direct Unsubsidized Loans, if any; then to Federal Perkins Loans; Federal Direct Graduate PLUS Loans; next to any other federal, state, private, or institutional scholarships and loans; and, finally, any remaining balance to the student.

5. Recipients of federal and/or institutional loans who withdraw are required to have an exit interview before leaving Yale. Students leaving Yale receive instructions on completing this process from Yale Student Financial Services.

STUDENT ACCOUNTS AND BILLS

Student accounts, billing, and related services are administered through the Office of Student Financial Services, which is located at 246 Church Street. The office's website is http://student-accounts.yale.edu.

Bills

Yale University's official means of communicating monthly financial account statements is through the University's Internet-based system for electronic billing and payment, Yale University eBill-ePay. Yale does not mail paper bills.

Student account statements are prepared and made available twelve times a year at the beginning of each month. Payment is due in full by 4 p.m. Eastern Time on the first business day of the following month. E-mail notifications that the account statement is available on the University eBill-ePay website (http://student-accounts.yale.edu/ebep) are sent to all students at their official Yale e-mail addresses and to all student-designated proxies. Students can grant others proxy access to the eBill-ePay system to view the monthly student account statements and make online payments. For more information, see http://sfas.yale.edu/proxy-access-and-authorization.

Bills for tuition, room, and board are available during the first week of July, due and payable by August 1 for the fall term; and during the first week of November, due and payable by December 1 for the spring term. The Office of Student Financial Services will impose late fees of $125 per month (up to a total of $375 per term) if any part of the term bill, less Yale-administered loans and scholarships that have been applied for on a timely basis, is not paid when due. Nonpayment of bills and failure to complete and submit financial aid application packages on a timely basis may result in the student's involuntary withdrawal from the University.

No degrees will be conferred and no transcripts will be furnished until all bills due the University are paid in full. In addition, transcripts will not be furnished to any student or former student who is in default on the payment of a student loan.

The University may withhold registration and certain University privileges from students who have not paid their term bills or made satisfactory payment arrangements by the day of registration. To avoid delay at registration, students must ensure that payments reach Student Financial Services by the due dates.

Payments

There are a variety of options offered for making payments. Yale University eBill-ePay (http://student-accounts.yale.edu/ebep) is the *preferred* means for payment of your monthly student account bill. The ePayments are immediately posted to the student account. There is no charge to use this service. Bank information is password-protected and secure, and a printable confirmation receipt is available. On bill due dates, payments using the eBill-ePay system can be made up to 4 p.m. Eastern Time in order to avoid late fees.

For those who choose to pay the student account bill by check, a remittance advice and mailing instructions are included with the online bill available on the eBill-ePay website. All bills must be paid in U.S. currency. Checks must be payable in U.S. dollars drawn on a U.S. bank. Payments can also be made via wire transfer. Instructions for wire transfer are available on the eBill-ePay website.

Yale does *not* accept credit card payments.

A processing charge of $25 will be assessed for payments rejected for any reason by the bank on which they were drawn. In addition, the following penalties may apply if a payment is rejected:

1. If the payment was for a term bill, late fees of $125 per month will be charged for the period the bill was unpaid, as noted above.
2. If the payment was for a term bill to permit registration, the student's registration may be revoked.
3. If the payment was given to settle an unpaid balance in order to receive a diploma, the University may refer the account to an attorney for collection.

Yale Payment Plan

The Yale Payment Plan (YPP) is a payment service that allows students and their families to pay tuition, room, and board in ten equal monthly installments throughout the year based on individual family budget requirements. It is administered by the University's Office of Student Financial Services. The cost to enroll in the YPP is $100 per contract. The deadline for enrollment is June 25. Additional details concerning the Yale Payment Plan are available at http://student-accounts.yale.edu/ypp.

MASTER'S FINANCIAL AID, 2017–2018

Policies and Procedures

In general, students must apply for financial aid in order to be considered for an F&ES scholarship. Since financial aid awards are based primarily on financial need, information about student finances that is not available in the application for admission is required. F&ES is need-blind. Therefore, applying for financial aid and having financial need in no way affect the decision to offer admission.

The deadline for prospective students to apply for need-based financial aid is February 15. If that deadline is missed, the student will not be considered for need-based financial aid. This can be a costly oversight, as what is received in the second year is generally the same as what is received in the first year. The deadline for current students to apply for financial aid is April 15.

If a student is a U.S. citizen or permanent resident, two forms must be submitted, the F&ES Financial Aid Application and the Free Application for Federal Student Aid (FAFSA). If a student is an international student, only one form must be submitted, the F&ES Financial Aid Application. Students must reapply for financial aid for the second year, although the amount of F&ES scholarship will most likely remain the same as in the first year.

A limited number of merit-based scholarships are available, for which no separate financial aid application is required. Examples include merit awards to the top applicants

to the Master of Environmental Science and Master of Forest Science programs and the Paul D. Coverdell Fellowships for qualifying Returned Peace Corps Volunteers.

F&ES scholarships, work study, and federal loans (Direct Stafford and Grad PLUS) are available to U.S. citizens and permanent residents. F&ES scholarships, work study, and Yale International Loans are available to international students.

The primary factor in determining the amount of a need-based F&ES scholarship is financial need as determined by the review of the student's (and spouse's, if applicable) income and assets and any third-party funding that the student expects to receive. Merit is a secondary factor.

Students are considered to be financially independent of their parents. Therefore, information about parent income and assets is not required. Students have the option of providing that information, however, which may yield a higher need-based scholarship award. Under no circumstances will it yield a lower scholarship award. On the other hand, students must report any direct financial support that they expect to receive from their parents, such as money for tuition or rent.

Approximately three-quarters of F&ES students receive scholarships in any given year from an annual scholarship budget in excess of $5 million.

SATISFACTORY ACADEMIC PROGRESS

To be eligible for financial aid, a student must be making Satisfactory Academic Progress (SAP) in the degree program. Financial aid includes all federal student aid funds (Federal Direct Stafford Loan, Federal Direct Grad PLUS Loan, and/or Federal Work Study) as well as institutional funds. For a complete explanation of the F&ES SAP policy, please see the F&ES Student Handbook, chapter Rules & Regulations, section Academic Regulations and Policies.

LESS THAN HALF-TIME ENROLLMENT, INCLUDING CONTINUOUS REGISTRATION

Students enrolled less than half-time (i.e., for less than 6 credits in a term) and students who are not actively working toward a degree, such as those in continuous registration status, are not eligible for federal or institutional financial aid. Furthermore, financial aid awards are based on an assumption of full-time enrollment and will be revised proportionately should a student choose to enroll less than full-time. Students considering enrolling less than full-time should first consult with the assistant dean of student services and director of financial aid to understand the academic and financial consequences, respectively, of that decision.

JOINT-DEGREE STUDENTS

In most joint-degree programs, students split their time between the two joint schools, spending one and one-half years at each school for a total program length of three years.

Each school at Yale is financially independent, which means that the financial aid award a student receives at one school is not transferrable to the joint school. The joint-degree student should follow the financial aid application procedures of the school to which the student will be paying tuition. If the student is paying tuition at F&ES, the student should apply for financial aid through F&ES. If the student is paying tuition at the joint school, the student should apply for financial aid through that school.

If the joint-degree student is applying for admission to two schools simultaneously, the student should apply for financial aid at both schools, also simultaneously.

FIFTH-YEAR STUDENTS

During their senior year at Yale College, students may apply for admission to the F&ES Fifth Year program. These students sometimes defer their enrollment in the F&ES master's program for a year of outside volunteer work or employment. To be considered for financial aid for their enrollment at F&ES, these students must submit their financial aid application materials by the February 15 deadline prior to their matriculation into the program. This could mean that the student submits the financial aid application materials during the student's deferral or "gap" year. It is the student's responsibility to submit all documents by the February 15 deadline.

SCHOLARSHIPS

Most of the School's scholarship budget is funded by private donors. Scholarship recipients are automatically considered for all named scholarships. The named scholarships listed below are *not* in addition to any generic scholarship a student receives in the financial aid award notification but may be matched to a scholarship recipient once the student matriculates.

The School is delighted to recognize the generosity of the donors who have helped make the following scholarships possible:

Jonah Meadows Adels Memorial Scholarship
Anne Armstrong-Colaccino Scholarship
Bataua Scholarship
Beinecke/FES Scholarship
Flora and John Berbee Scholarship Fund
Berkley Scholarship
Jabe Blumenthal Scholarship
George Brett Memorial Fund
Broad Arrow Scholarship
Nelson C. Brown (B.A. 1906, M.F. 1908) Scholarship
Sara Shallenberger Brown Scholarship
Coleman P. Burke Scholarship
Leland H. Burt ('30 B.S.) Endowed Scholarship
Burt-Pfeiffer Fund
Philip Laurance Buttrick (M.F. 1911) Scholarship
Paul Douglas Camp Memorial Scholarship
Leonard G. Carpenter (B.A. 1924) Scholarship
Class of 1980 Scholarship
Class of 2017 Scholarship
Crane Family Scholarship
Trammell S. Crow (1974) Scholarship
Crown Zellerbach Foundation Fund
Strachan and Vivian Donnelley Scholarship
Michael P. Dowling Scholarship

Enid Storm Dwyer Scholarship
Environmental Scholars Fund
Frederick V. Ernst (1960) Gift Fund
Boyd Evison Scholarship Fund
F&ES Alumni Association Board Scholarship
Forestry YAF Scholarship Fund
Edith and Johannes Frondt Scholarship
Gonzalez Family Scholarship
James Lippincott Goodwin (B.A. 1905, M.F. 1910)
Charles W. Goodyear Memorial Fund
John S. Griswold (B.A. 1937) Scholarship
Leah Hair Scholarship
H. Stuart Harrison (B.A. 1932) Fellowship
Vira I. Heinz Endowment Scholarship
John and Catha Hesse Fund
Adelaide Hixon Scholarship
Joseph Hixon FES Scholarship
Jacqueline C. and John P. Hullar Scholarship
Jesse D. Johnson Scholarship
Stephen and Betty Kahn Scholarship
Peggy King Memorial Scholarship
Marvin Klemme (M.F. 1935) Fellowship
Carl W. Knobloch, Jr. Fellowship
Kroon Environmental Studies Scholarship
Fred Krupp Scholarship in Environmental Studies
Charles Chacey Kuehn (M.F. 1934) Fund
Robert H. Kuehn, Jr. ’64 B.A., ’68 M.U.S., ’68 M.Arch. Scholarship
Leadership Scholars Fund
Urey Lisiansky Scholarship Fund
John A. MacLean ’27S Scholarship
Alan N. Mann (1908) Memorial Fellowship
Margaret K. McCarthy and Robert Worth Scholarship
Dorothy S. McCluskey Scholarship
Thomas McHenry Scholarship
Preston R. Miller, Jr. ’71 F&ES Scholarship
Arthur N. Milliken Scholarship
Mary P. Moran Scholarship
John M. Musser Fellowship
Carl F. Norden Family Scholarship
Obernauer Family Scholarship
Gilman Ordway (B.A. 1947) Family Scholarship
Parklands Scholarship
PETAL Foundation Scholarship
Joanne Polayes Scholarship
Kushok Bakula Rimpoche Scholarship
Rockefeller-Underhill Scholarship for Tropical Conservation

Heather L. Ross and Edward L. Strohbehn, Jr. Scholarship
Andrew Sabin International Environmental Fellowship
William Henry Sage Memorial Fund
Ralph C. Schmidt and Susan M. Babcock Scholarship
Drs. Poh Shien and Judy Young International Scholarship
Simeone Entomology Scholarship
David M. Smith, Morris K. Jesup Professor of Silviculture Scholarship
David and Karen Sobotka Scholarship
Sobotka Joint F&ES-Jackson Institute Fellowship
Cameron and Gus Speth Scholarship
Gillian and Stuart W. Staley '95 M.P.P.M., '95 M.E.S. Scholarship
Stapleton Scholarship
Student Conservation Association Fellowship in honor of John R. Twiss '60
VIEW Scholarship
Rodney B. Wagner Class of 1954 International Scholarship
William D. Waxter III Fellowship
Marianne Welch Scholarship
William Egbert Wheeler Fund
Mr. and Mrs. James Wiley Endowed Scholarship for Conservation Biology
Hubert Coffing Williams (Ph.D. 1906, M.F. 1908)
Joseph H. Williams Scholarship
Charles F. Wilson (B.A. 1939) Memorial Fund
Ray L. Wilson Scholarship
Frank & Lynne Wisneski F&ES Scholarship
Charles Boughton Wood Fund
Wyss Foundation Scholarship for Conservation of the American West
Yale Club of New Haven

EMPLOYMENT OPPORTUNITIES

F&ES work study These positions vary from clerical to research to editorial work. Eligible students must have financial need, as confirmed by the F&ES Office of Admissions & Financial Aid. Applications are available on the Yale Student Employment Office website (www.yalestudentjobs.org) beginning in August. The pay rate is fixed at $14.25 per hour. At least eighty positions are available annually and only to students with an F&ES affiliation.

Regular student jobs and teaching fellowships Financial need is not required. Interested students should contact centers, departments, professors, and programs directly beginning in late spring or summer. Pay rates begin at $12.25 per hour for regular student jobs. Pay rates for teaching fellowships are either $4,000 or $8,000 per term depending on the effort level. At least seventy positions are available annually.

Community service jobs Eligible students must be U.S. citizens or permanent residents and have financial need, as confirmed by the F&ES Office of Admissions & Financial Aid. Applications are available on the Yale Student Employment Office website beginning in August. Pay rates begin at $12.25 per hour. At least 100 positions are available annually to students across the University.

Other on-campus jobs Financial need is not required. Applications are available on the Yale Student Employment Office website beginning in August. Pay rates begin at $12.25 per hour. At least 400 positions are available annually to students across the University.

LOANS

Federal Direct Stafford Loan (U.S. citizens and permanent residents only) In general, the maximum annual loan amount is $20,500. The interest rate is fixed at 5.31% with an origination fee of 1.069%. There is no credit check required. The standard repayment term is ten years. A six-month grace period immediately follows separation from school or otherwise dropping below half-time enrollment status, at which time repayment is required. The loan is requested by completing and returning a loan request form available on the School's financial aid forms Web page: http://environment.yale.edu/aid/forms. After initial processing, the loan will be assigned to a servicer contracted with the U.S. Department of Education, such as FedLoan, Great Lakes, Navient, or Nelnet.

Federal Direct Grad PLUS Loan (U.S. citizens and permanent residents only) In general, the maximum annual loan amount is the cost of attendance less all other resources. The interest rate is fixed at 6.31% with an origination fee of 4.276%. A credit check is required. Repayment terms are similar to Federal Direct Stafford Loans. The loan is requested by completing and returning a loan request form available on the School's financial aid forms Web page. After initial processing, the loan will be assigned to a servicer contracted with the U.S. Department of Education, such as FedLoan, Great Lakes, Navient, or Nelnet.

Yale International Loan (international students only) In general, the maximum annual loan amount is $30,000 or the cost of attendance less all other resources, whichever is less. The interest rate is fixed at 7.75% with an origination fee of 5%. There is no credit check required. Repayment terms are similar to Federal Direct Stafford Loans. The loan is requested by completing and returning loan request and self-certification forms available on the School's financial aid forms Web page. The Yale Student Loan Billing and Payment Office is responsible for the management and collection of the loan.

Private education loan (U.S. citizens and permanent residents as primary borrowers or co-borrowers only) In general, the maximum annual loan amount is the cost of attendance less all other resources. The interest rate is fixed or variable and dependent on the credit rating of the primary borrower and co-borrower, if applicable. Origination fees from zero to 3%, repayment terms, and servicing are dependent on the lender. A credit check is required. The loan is requested by applying directly to a lender. A list of lenders from whom students have borrowed recently is available at www.elmselect.com/?schoolid=156#/results.

INTERNATIONAL STUDENTS — CERTIFICATION OF FINANCES FOR VISA

International students must certify full funding for their entire two-year course of study before visa documents can be issued. Instructions and forms are mailed after an admitted student accepts the offer of admission (deadline April 15). More information is available from Yale's Office of International Students and Scholars: http://oiss.yale.edu.

VETERANS

Eligible students are strongly encouraged to seek specific information about Veterans Administration benefits from their local Veterans Administration office by calling 800.827.1000 or visiting www.benefits.va.gov/gibill. The School also participates in the Yellow Ribbon Program, with a maximum contribution amount of $7,500 per student per year. The assistant dean of student services and the director of financial aid coordinate the administration of Veterans Administration benefits at F&ES.

Life at the School of Forestry & Environmental Studies

EDUCATIONAL FACILITIES

Kroon Hall, the ultra-green home of F&ES, expresses in physical form the School's best traditions, values, and aspirations. The building, which opened in January 2009, achieves its remarkable energy savings from a host of design elements and technical strategies molded to fit the weather and climate of its New England location. Situated in the area of the University known as Science Hill, Kroon Hall is named for the family of benefactor and Yale College alumnus Richard Kroon, B.A. 1964. With its high barrel-vaulted gable ends, simple lines, and curved rooftop, Kroon Hall is a modernist blend of cathedral nave and Connecticut barn.

Kroon Hall provides office space for fifty faculty and staff members and has three classrooms. The 175-seat Burke Auditorium is used for lectures and classes, and commands beautiful views of West Rock and the David S. Ingalls Rink across the street. The Knobloch Environment Center is meant for socializing, but students have also embraced it as a study space. The Ordway Learning Center on the ground floor also has ample space for quiet study. The $43.5 million building was designed by Hopkins Architects of Great Britain in partnership with Connecticut-based Centerbrook Architects and Planners and holds the highest rating—platinum—in the green-building certification program, Leadership in Energy and Environmental Design (LEED). Kroon Hall provides 56,467 square feet and is designed to use 67 percent less energy than a typical building of its size. Its tall, thin shape and east-west orientation play a big role in heating and cooling. The lowest floor is set into a hillside, with only its south side exposed, providing thermal insulation, minimizing northern exposure, and increasing the amount of natural light that enters the building from adjacent courtyards. The long south facade maximizes solar gain during the winter, and Douglas fir louvers covering glass facades on the east and west ends keep out unwanted heat and glare. The building's shape, combined with the glass facades, enables daylight to provide much of the interior's illumination. Light and occupancy sensors dim artificial lighting when it is not needed.

A 100-kilowatt rooftop array of photovoltaic panels provides 25 percent of the building's electricity. Four 1,500-foot-deep wells use the relatively constant 55-degree (F) temperature of underground water for heating and cooling, replacing the need for conventional boilers and air conditioning. Four solar panels embedded in the southern facade provide hot water. Exposed concrete walls and ceilings provide thermal stability by retaining heat in winter and cold in summer. Instead of air being forced through overhead ducts, an energy-saving displacement ventilation system moves warm and cool air through an air plenum and multiple diffusers in elevated floors. Low-velocity fans in the basement keep the air circulating throughout the building. In winter, the ventilation system also transfers the heat from exhaust to incoming fresh air, and in summer, air handling units spray water on incoming fresh air, reducing its temperature by up to 18° through evaporation.

In mild weather, Kroon's occupants assist in the energy savings by opening windows in response to an electronic, color-coded prompt system. A pair of green and amber lights

in each hallway indicate whether it's a "Green Day": i.e., when the green indicator light is on, the ventilation and cooling/heating systems shut down, and the windows should be opened for natural ventilation.

A rainwater-harvesting system channels water from the roof and grounds to a garden in the south courtyard, where aquatic plants filter out sediment and contaminants. The gray water, held in underground storage tanks, is used for irrigation and pumped back into Kroon for flushing toilets. The system is designed to save 300,000 gallons of potable city water annually and to reduce the burden on city sewers by lessening the amount of storm runoff. Half of Kroon Hall's red oak paneling—15,000 board feet—came from the 7,840-acre Yale Myers Forest in northern Connecticut, which is managed by the School. The building's pale yellow exterior, composed of sandstone from Ohio, echoes other Yale buildings. The north and south courtyards were constructed to create a community among disparate buildings on Science Hill. The south courtyard, landscaped by Olin Studio of Philadelphia, is a raised platform, with a green roof of soil one-foot deep and surrounded by twenty-five varieties of native plantings. Underneath the courtyard is a service node, centralizing all trash and recycling pickups as well as deliveries for the southwest corner of Science Hill and accessible by a single driveway off Sachem Street.

Sage Hall, a four-story building located at 205 Prospect Street and a gift of William H. Sage, B.A. 1865, in memory of his son, DeWitt Linn Sage, B.A. 1897, was completed in 1923. Administrative, development, alumni, and program offices of the School are housed in Sage Hall, along with four classrooms. Sage Hall is home to a computer cluster with twenty-four computers for student use. Sage also houses a 490-square-foot student lounge, appointed with a large table and comfortable couches, which students use for studying, special events, and weekly social events. Bowers Auditorium is designed to handle large lectures and seminars as well as small group projects. Bowers, which has a seating capacity of one hundred with tables and chairs, was built onto Sage Hall in 1931 with funds provided by the bequest of Edward A. Bowers, B.A. 1879. In 2011 the original Bowers floor was replaced using beautiful red oak flooring harvested from Yale Myers Forest, and in 2016 energy-efficient LED lights were installed.

Facilities for research and instruction in silviculture, natural resource and forest economics, forest policy, and biometry are in Marsh Hall at 360 Prospect Street in the Marsh Botanical Garden. A classroom, meeting space, kitchen, and accessible bathroom are available on the first floor. This large, four-story mansion was originally the residence of Professor Othniel C. Marsh, B.A. 1860, a distinguished paleontologist and Western explorer of the nineteenth century. He bequeathed the building to the University in 1899, and for twenty-five years it housed the entire Forest School. Marsh Hall was designated a National Historic Landmark by the United States Department of the Interior in 1965.

The William B. Greeley Memorial Laboratory at 370 Prospect Street, named in honor of William Buckhout Greeley, M.F. 1904, houses a recently renovated social space in the main lobby; laboratories for research into the ecology and management of landscapes and ecosystems, urban sustainability, the biology of trees, and environmental chemistry; and doctoral program spaces. The wood shop is available for students—after receiving tool and safety training—to work on projects that require the use of power tools. The building was designed by renowned architect Paul Rudolph and is a classic example of "Brutalist" architecture. Adjacent to the Greeley lab is a 3,800-square-foot greenhouse, which is used for hands-on learning and research. Greeley Laboratory and its greenhouse were built in

1959 with funds from the forest industries, the John A. Hartford Foundation, and other benefactors.

The Class of 1954 Environmental Science Center at 21 Sachem Street is dedicated to the Class of 1954 in honor of the $70 million the class donated in 2000 to support new science buildings and other major University priorities. It is an interdisciplinary facility built by the University with the aim of further fostering leadership in teaching and research of science and engineering. The building was designed to encourage collaboration among faculty and students pursuing environmental studies. Four natural science faculty members from F&ES have their laboratories in the Environmental Science Center, which also houses research laboratories for the Yale Science Departments of Ecology and Evolutionary Biology, Geology and Geophysics, and Anthropology as well as the Yale Institute for Biospheric Studies.

The restored former residences at 301 Prospect Street and 380 Edwards Street house the offices of many of the School's programs, as well as doctoral student offices; each building has a classroom.

Library Collection

The Henry S. Graves Memorial Library Collection for the School of Forestry & Environmental Studies, one of the oldest and largest collections of forestry publications in the United States, is located in the Center for Science and Social Science Information (CSSSI) in Kline Biology Tower (http://csssi.yale.edu). The collection is named in honor of the School's first dean, Henry S. Graves, who purchased the initial collection of German forestry books and continued to support a strong library serving the School's graduate forestry program.

Current holdings in the Graves Collection consist of more than 100,000 books, documents, technical reports, and serial publications dealing with forestry, forest science, natural resource management, and environmental sciences and management. The collection receives many print journal, periodical, and other serial titles, in addition to providing access to electronic titles. Older materials in the Graves Collection are housed in the Library Shelving Facility. All materials are accessible through the Yale Library electronic catalog, ORBIS.

The Graves Collection is committed to acquiring whatever books and journals are needed to support the School's teaching and research activities. In addition, students have access to the enormous holdings of the Yale University Library, described below.

Reference and information services are provided locally, with the F&ES librarian having office hours in both Sage and Kroon Halls while maintaining a permanent office in the nearby CSSSI. Access to electronic databases covering the wide range of subjects of interest within the School (e.g., ProQuest Environmental Science Collection, CAB Abstracts, BIOSIS, and Web of Science) is provided through the library's website at http://web.library.yale.edu. These research tools and others, on such subjects as international affairs, water, soils, fish, wildlife, policy affairs, and law, are accessible throughout the campus. As a part of Yale University Library system, the Graves Collection participates in all library services offered to Yale patrons: paper-based, electronic, local, and through interlibrary loan services.

Computer Resources

The mission of the F&ES Information Technology Department (FES-IT) is to support all aspects of computing for every member of the Yale School of Forestry & Environmental Studies community. We use and support multiple platforms, including Windows and Macintosh operating systems. Students are strongly encouraged, but not required, to bring their own computers. Admitted students may contact the FES-IT Helpdesk by e-mailing feshelpdesk@yale.edu for advice on the selection of appropriate hardware and software. We strongly encourage the purchase of Apple Macintosh or Lenovo ThinkPad T, W, and X series laptop computers. A robust campus network provides wireless access within all F&ES buildings and throughout the Yale campus.

FES-IT, along with trained student technicians from Yale's Student Technology Collaborative, provides drop-in technical support for students to assist with any academic or research computer needs they may have while on campus. After-hours student support is also available at Bass Library, within easy walking distance of the School. FES-IT provides secure, centralized backup services for all F&ES faculty, staff, and students, as well as an FES-provisioned Dropbox account.

FES-IT maintains a computing cluster in Sage Hall, Room 39, with twenty-four computers that feature a mixture of 21.5-inch and 27-inch displays, 2.7 GHz Intel i5 and 3.2 i7 quad-core processors, and at least 8 GB of RAM that were replaced in January 2015. The FES Cluster iMacs also dual-boot into both MacOS 10.10 and Windows 10x64 for maximum flexibility. Three 27-inch high-definition monitors are provided for students who would like to utilize their own laptops.

The computing cluster houses multifunction copy/scan/fax/print devices. Additional wireless student printing is available in each F&ES building and throughout the Yale campus via the BluePrint Printing System. Three-dimensional and wide-formatting printing is also available at the Yale Center for Engineering Innovation & Design (CEID) and the Yale School of Architecture.

FES-IT maintains an inventory of equipment that students may borrow for short periods of time through an online equipment checkout system (http://environment.yale.edu/myfes/computing/equipment). Equipment may be borrowed at no charge (late and replacement fees apply if equipment is returned late, lost, or damaged). Included are iPads, GPS units, digital cameras, walkie-talkies, compact audio recorders, and other equipment.

The Yale University Library is also very active in the integration of information resources in digital format. Students and faculty have online access to an extensive variety of journals and databases as well as innovative research resources such as the Digital Humanities Lab (http://digitalhumanities.yale.edu/yale-dh).

The Center for Science and Social Science Information (http://csssi.yale.edu) offers an array of digital media technologies and operates several important digital resources, including the Statistical Classroom ("StatLab"), featuring thirty machines with dual monitors, and a variety of software and databases, such as a Bloomberg Terminal. CSSSI is also home to a full-time GIS librarian who is available to assist students in obtaining and working with GIS datasets to support their work in any part of the globe. CSSSI also employs two full-time data librarians who are available for questions or consultation

about finding, using, and managing research data in the sciences and social sciences. CSSSI is located in nearby Kline Biology Tower, and all resources are available to F&ES students.

Faculty members have also developed many special computer applications for their projects, and some of these are available for student use in the Sage Hall computing cluster.

Yale School Forests and the Quiet Corner Initiative

The Yale School of Forestry & Environmental Studies owns 10,852 acres of forestland in Connecticut, New Hampshire, and Vermont that are managed by the Yale School Forests Program. The program manages seven discrete forests that were donated to the School between 1913 and 1986 that range in size and geography from the 75-acre Crowell Ravine in Vermont to the 7,860-acre Yale Myers Forest in Connecticut. The composition of the Yale Forests reflects a latitudinal gradient ranging from a central hardwood cover type in Connecticut to a northern hardwood cover type in New Hampshire and Vermont. Extensive stands of pine and hemlock exist in both regions. The area encompassed by the forests includes almost all of the topographical and soil conditions, site classifications, and cover types found in New England.

The management of the Yale School Forests comprises four goals: (1) provide opportunities for research; (2) provide educational and professional opportunities for the faculty and students; (3) create an asset to the School's investment portfolio that demonstrates financial sustainability; and (4) maintain the forests' ecological resiliency through increasing their structural and compositional diversity. Faculty and students use the Yale Forests as a laboratory for teaching, management, demonstration, and research. A member of the faculty serves as director and a recent F&ES graduate serves as the manager and School Forest Fellow. Graduate professional students working as apprentices or coordinators carry out the bulk of the on-the-ground management and administration. The forests are maintained as working forests, and thus the tasks include selling timber and nontimber forest products from the land. The Yale Myers Forest is the largest and most heavily utilized parcel managed by the Yale School Forests Program and is certified by the Forest Stewardship Council.

Students working on the Yale Forests receive training that covers aspects of hydrology and soils, taxonomy, forest and community ecology, silviculture, forest operations, forest finance and policy, and sociology in order to prepare them for careers as foresters and land managers. Every summer ten to twelve students are chosen for the apprentice forester program at the Yale Forests, which includes hands-on training in maintenance of infrastructure, property boundary research and delineation, geographic information systems (GIS), mapping and classification, sampling and inventory, and the design and implementation of silvicultural prescriptions. Several students from the apprentice program are selected to work for the School Forests Program the following academic year, where they receive additional training in forest administration and management.

Research performed at the Yale Forests is conducted under the supervision of any faculty member of the School and encompasses forest ecology, silviculture, aquatic and wildlife community ecology, hydrology, and economic, legal, and social studies. The

forest is used for both doctoral and master's student research, the latter performed either as an independent project or in conjunction with student involvement with existing forest management.

The Yale Forests are used for both academic field trips and workshops held for professional or community organizations. Field trip and workshop topics include forest certification, wildlife habitat manipulation, ecosystem restoration, prescribed fire management, timber harvesting operations, silvicultural research, and pathways of forest stand development. Lastly, the Quiet Corner Initiative (QCI) has been developed as a method of engaging with the surrounding working landscape around Yale Myers Forest. QCI works by developing programs that connect master's-level courses and University research to real environmental assessment and management challenges on private lands surrounding the forest. Current programs focus on forest and open space conservation and management; watersheds and rivers; renewable energy; and sustainable agriculture. In designing each QCI program, the initiative seeks to advance three separate but related sets of goals: (1) to enrich the applied curriculum for professional students at the School of Forestry & Environmental Studies, providing reliable and consistent opportunities to bring learned skills to tangible problems that are in easy reach of the classroom; (2) to provide and cultivate a high-quality natural and social science research environment for students and faculty to investigate and analyze the drivers of environmental change and adaptive management at a landscape scale; and (3) to leverage the traditional strengths of Yale University in research, education, and leadership in working toward landscape-scale sustainability goals in our own backyard.

In addition to the forestland owned and managed by the School, close working relationships exist with other forests that are also used for education and research by faculty and students: the 6,800-acre Great Mountain Forest in northwestern Connecticut is available to the School through the courtesy of Edward C. Childs, B.A. '28, M.F. '32, and his family; and the 20,000-acre forestland owned and managed by the South Central Connecticut Regional Water Authority in New Haven County is one of the oldest managed forests in the western hemisphere. The University also owns approximately 370 acres of ecological preserves that are available to faculty and students.

COMMUNICATIONS

The goal for the School's strategic communications is, in part, to contribute to public understanding and discourse on environmental issues and to encourage the integration of environmental issues into strategies for business, international development, government, and nongovernmental organizations.

The communications office publicizes faculty and student research and School-sponsored events through traditional and digital media.

School news, alumni profiles, and other items are regularly published through the School's website (http://environment.yale.edu), e-mail newsletters, Facebook (http://facebook.com/YaleFES), Twitter (http://twitter.com/YaleFES), Instagram (YaleFES), and LinkedIn.

To contact the F&ES communications office, e-mail communications.fes@yale.edu or call 203.436.4805.

Other communications vehicles include the award-winning online magazine *Yale Environment 360;* reports from the School's centers and programs; and the student-edited publications *Sage Magazine* and *Yale Environment Review*.

Yale Environment 360 (http://e360.yale.edu) features reporting, analysis, and opinion on global environmental issues from leading writers, scientists, policy makers, and journalists in the field. Launched in 2008, *Yale Environment 360* has established a broad global audience and received numerous awards and honors. Selected *Yale Environment 360* articles are now translated and republished in Spanish and Portuguese through a partnership with Universia (http://e360yale.universia.net).

For newsletters and reports of the individual centers and programs, refer to their individual websites, listed online at http://environment.yale.edu/centers.

Sage Magazine (http://sagemagazine.org) is a student-run environmental arts and journalism publication. Through creative and informative journalism, *Sage* seeks to expand popular notions of environmentalism and widen the debate around pressing and important environmental issues.

Yale Environment Review (http://environment-review.yale.edu) is a student-run online publication that provides concise summaries of peer-reviewed research from around the world, with a focus on topics of general interest to those engaged in environmental and natural resource management.

Recording Policy Acknowledgment

In order to capture the breadth of activities that occur at F&ES—and integrate the expertise of our faculty, students, and visitors into the broader environmental dialogue—Yale University frequently photographs, videotapes, and/or records events, lectures, and activities (including during alumni events) at F&ES. By attending and/or participating in classes and in other F&ES and University activities, those in attendance agree to the University's use and distribution of their image and/or voice in photographs, audio, and video capture, or in electronic reproductions of such classes and activities. These images, recordings, or excerpts may be included, for example, in Yale University websites, publications, and online courses, and otherwise used to support the University's mission.

STUDENT ORGANIZATIONS

The School has many student-run interest groups. Current student groups include the Africa SIG; Asia (ASIA) SIG; Built Environment and the Environment (BE2); the Climate Change SIG; the Coalition for Agriculture, Food, and Environment (CAFÉ); Commons Collective (CoCo); Conservation Investing; Energy SIG; Environmental and Social Entrepreneurship Club (ESEC); Environmental Justice at Yale (EJAY); Environmental Media & Arts; Ethnobotany and Economic Botany Student Interest Group (STIGMA); Fire Ecology & Management; the Forestry Club (FC); Fresh & Salty SIG; Health and Environment at Yale (HEY); the Industrial Environmental Management and Energy Group (IEME); International Development and Environment (IDE); a student chapter of the International Society of Tropical Foresters (ISTF); the Latin American SIG (La SIG); Lucy-StUDS; Natural Resources Extraction (NRX) SIG; On the Margin; Out in the Woods (OIW); PhD SIG; Risk Reduction, Adaptation, and Disaster

Student Interest Group (RRAD); ROOTS SIG; SCOPE; the Yale chapter of the Society for Conservation Biology (CONBIO); a student chapter of the Society of American Foresters (SAF); the Spatial Collective; WESTIES; Yale Environmental Law Association (YELA); Yale Environment Women (YEW); Yale Extractive Industries Working Group (YaleXWG); and the Student Affairs Committee (SAC). The activities of these groups include sponsoring guest and student lectures, organizing field trips, sponsoring workshops, organizing social events, holding conferences, and interacting with regional divisions of their respective societies.

FUNDING FOR MASTER'S STUDENT PROJECTS AND ACTIVITIES

Master's students often seek funding for research, professional activities, and social events. Sometimes the request is for individual activity, sometimes on behalf of a group. Our School and Yale University have many funds to which students can apply. Among the most useful are the Master's Student Travel fund to support attendance at a conference or symposium at which a student is giving a talk; the Carpenter-Sperry Fund for travel and research; the MacMillan Center for International and Area Studies, which can help bring international visitors to Yale for a lecture or a conference; grants and contracts to faculty and centers for research; the School's Student Affairs Committee (SAC), which supports activities by our many student interest groups (SIGs) and supports "big-ticket items" each term; and the Class of '80 Student Project Fund, administered by the School's Office of Development and Alumni Services, to enrich the quality of life of the student body.

ALUMNI ASSOCIATION

The F&ES Alumni Association, led by an elected board of twenty-five alumni who meet in person or by phone ten times a year to conduct the business of the association, represent the School's more than 4,700 alumni around the world. The board regularly hosts alumni on campus, at regional gatherings around the country and globally, and at annual meetings of select professional societies. The board functions both as a committee of the whole and through several standing committees. Standing committees oversee nominations of members, select recipients of the Distinguished Alumni Award, host the annual reunion, and assist staff with the Annual Fund. The F&ES Alumni Association Board Scholarship is awarded annually to two current F&ES students who demonstrate outstanding community engagement and volunteer leadership. The *CANOPY* alumni magazine, e-CANOPY newsletter, and regular e-mail notices keep alumni throughout the world in touch with each other and the School.

The F&ES Alumni Association is also affiliated with the Association of Yale Alumni (AYA), which serves all alumni of Yale University. The F&ES Office of Development and Alumni Services works directly with the AYA to provide three services for F&ES alumni: *YaleMail,* a fully functional, Web-based e-mail service on the Gmail platform; the Online Alumni Directory, a resource for connecting with Yale friends, classmates, or colleagues; and the Yale Career Network, a database of alumni who are interested in professional networking with fellow alumni and current students. Alumni may contact the Office of Development and Alumni Services at alumni.fes@yale.edu.

JOB SEARCH SKILLS DEVELOPMENT

Career Development Office

http://environment.yale.edu/cdo

The mission of the Career Development Office (CDO) is to support students in their overall career and professional development and to build relationships with hiring organizations in order to provide students access to top opportunities fitting their career interests.

Our diverse resources, programs, and services enable users to develop key skills needed to present themselves professionally on the job market, develop and refine meaningful career goals, and chart a strategy for conducting effective job and internship searches.

We work with students on an ongoing basis through individual advising appointments as well as through workshops conducted by staff and other career development professionals.

Career Planning Resources

Individual Counseling and Peer Review
General career advising (strategy, focus, vision)
Résumé reviews
Cover letter reviews
Personal statement reviews
Networking advice
Online tools orientation (FESNext, LinkedIn, Yale Career Network)
Interview skills review
Internship planning guidance
Internship funding advice
Salary negotiations strategies
Mock interviews

FESNext Online Career Development System
RSVP for upcoming events
Maintain an up-to-date profile to receive targeted e-mail announcements
Upload résumés, cover letters, writing samples, and other documents to send to employers
View more than 150 F&ES-focused jobs and internships added each month
Apply directly online for jobs/internships of interest
Publish your résumé to multiple résumé books for review by alumni and employers
Create and save quick searches for locating jobs/internships
Schedule appointments with career advisers

FES Résumé Book
We provide students a downloadable official template and *Résumé Content, Style, and Format Guidelines*. The pdf version of the book is distributed to employers (including alumni/employers), faculty, and relevant staff.

Workshops
Résumé writing, networking, and LinkedIn
Writing the personal statement and cover letters
Job and internship search strategy
Applying for the Ph.D.
Interviewing and telling your story
Locating grants and fellowships
Salary negotiations

Treks
CDO provides logistical support to groups of F&ES students interested in visiting employers in New York City, San Francisco, and Washington, D.C.

On-Campus Recruiting
Connect with employers during on-campus information sessions, informational interviews, and interview opportunities.

Alumni Connections
F&ES LinkedIn Group: The Office of Development and Alumni Services and the CDO maintain the *Yale School of Forestry & Environmental Studies* LinkedIn group.
F&ES Alumni Database: You can download from the CDO website the most current F&ES alumni information available through the Association of Yale Alumni.
Yale Career Network (YCN): You have access to 13,000 alumni who are available to give tips and advice on their industry, employer, or job.

ELM: Environmental Leadership Mentoring Program
All returning second-year F&ES students have the opportunity to be matched with an alumni mentor in their chosen career sector.

Internships and Summer Research

Internships and summer research have long been an important part of the educational program at Yale. They provide a unique opportunity to combine academic knowledge with practical experience, to enhance skills, and to gain professional confidence.

Students are assisted by the CDO, faculty, alumni, and other students in their search for internships and summer research experiences. Attention is given to students to help them locate opportunities that meet their individual needs and interests.

Given the School's strong ties with natural-resource, environmental, and conservation organizations worldwide, internship and research possibilities are virtually unlimited. Typical internships and research projects occur between the first and second years of the program; occasionally, however, they last for longer periods.

F&ES 006, Summer Internship/Research 0 credits. The summer internship or research project is an important opportunity for students to apply knowledge and skills gained during their first year of study, to gain professional experience and build networks, and to investigate potential career paths. Consists of a research project or internship experience between ten and twelve weeks, typically in the summer between the first and second years of the program. Students have latitude in designing a summer practicum closely

aligned with individual academic and career goals. Students are responsible for securing their own internship or developing a relevant research project with appropriate faculty supervision, applying for and securing their own summer funding, and filing appropriate paperwork with the CDO before and after the internship or research experience in order to receive course credit. Required of all master's candidates.

Summer 2016 Internships and Research Projects

The following list shows the rich and diverse experiences that F&ES students had during a recent summer. Data for other years is available online at http://environment.yale.edu/careers.data.

BUSINESS AND INDUSTRY

AES Energy Storage (subsidiary of AES Corporation), Market Development Summer Intern, D.C.
Aramco Services Company, Summer Intern, Mich.
Barclays, Summer Associate, N.Y.
Beartooth Capital Partners/Deborah Spalding, Summer Acquisitions and Strategy Analyst, Mont.
Boston Consulting Group, Summer Associate, Sydney, Australia
Carbon Pricing Leadership Coalition/World Bank, International Finance Corporation, CPLC Intern and Yale CBEY Presenter, D.C.
Cascade Designs, Summer Intern, Wash.
Comcast, Energy Strategy & Analysis M.B.A. Intern, Pa.
Environmental Defense Fund Climate Corps Fellow, Jackson Family Wines, Calif.
Environmental Defense Fund Climate Corps Fellow, Univision Communications, Fla.
Facebook, Sustainability Intern, Calif.
Greenwood Resources, Economics/Finance Intern, Ore.
IKEA Food Services AB, Health & Sustainability Intern, Malmo, Sweden
Klabin, Summer Intern, Telemaco Borba, Brazil
Mithun, Summer Intern, Wash.
New York Mercantile Exchange (CME Group), Summer Analyst—Energy Research & Product Development, N.Y.
NorthStar Recycling, Commodity Sales Associate, Mass.
Olympia Provisions, Summer Intern—Sustainable Sourcing, Ore.
Organic Valley (CROPP cooperative), Sustainability Special Projects Intern, Wis.
Rabobank, Summer Associate, N.Y.
SunPower Corporation, Supply Chain Sustainability Intern, Calif.
Tetra Tech International Development, Summer Intern, Va.
Vans (VF Corporation), Sustainability Intern, Calif.
VOX Global, Sustainability Fellow, Mass.

EDUCATION

Environmental Defense Fund Climate Corps Fellow, Huston-Tillotson University, Tex.
The Inn at East Hill Farm, Conservation Enhancement and Education in the New England Mixed Forest, N.H.
University of California, Davis, Graduate Student Researcher, Calif.

ENTREPRENEURIAL

Kitchen Table, Inc., Co-Founder of Kitchen Table, Conn.
Persistent Energy Ghana, Rural Electrification Interventions in Africa, Accra, Ghana

GOVERNMENT AND PUBLIC SECTOR

Athi Water Board, Summer Intern, Nairobi, Kenya
Bengawan Solo River Basin Office, Water Resources Intern for Sediment Countermeasure Project, Solo, Indonesia
Environmental Defense Fund Climate Corps Fellow, Massachusetts Bay Transportation Authority, Mass.
Environmental Defense Fund Climate Corps Fellow, Port of Baltimore, Md.
Environmental Protection Agency, Honors Law Clerk, D.C.
Global Environment Facility (GEF), Summer Intern, D.C.
Grand Teton National Park, GIS Specialist, Wyo.
House Committee on Natural Resources/Karen Seto and Josh Galperin, Congressional Fellow, D.C.
National Oceanic and Atmospheric Administration (NOAA), Summer Intern, D.C.
National Oceanic and Atmospheric Administration/National Park Service, Summer Intern, Calif.
National Park Service/Net Impact, Business Management Consultant, Mass.
New York Attorney General, Environmental Protection Bureau, Law Student Intern, N.Y.
New York Green Bank, Summer Investment Associate, N.Y.
Office of Energy Demand, Bureau of Energy and Technology and Policy/Ryan Ensling, Summer Intern, Conn.
Office of the Assistant Secretary of Defense, U.S. Department of Defense, Summer Intern, D.C.
U.S. Department of State/Amity Doolittle, Intern in the Political and Economic Section, Luanda, Angola
United Nations Development Programme, Summer Intern, Bangkok, Thailand
United Nations Development Programme, Summer Intern, Bridgetown, Barbados
United Nations Development Programme, Global Climate Change Alliance Summer Intern, Paramaribo, Suriname
United Nations Development Programme and the OECS, Summer Intern, Barbados
White House Internship Program, Intern, Office of Energy & Climate Change, D.C.
White House Office of Science and Technology Policy, Summer Intern, D.C.

LEGAL

Cascadia Wildlands, Legal Intern, Ore.
Environmental Protection Agency Region 2 – Office of Regional Counsel, Legal Intern, N.Y.
Spiegel & McDiarmid, Summer Associate, D.C.

NGOS AND OTHER NONPROFITS

Coalition for Green Capita, Summer Intern, N.Y.
Cradle to Cradle Products Innovation Institute, Summer Intern, Calif.

EcoAgriculture Partners, Summer Intern, D.C.
Ecotrust Forest Management, Summer Intern, Ore.
Environmental Defense Fund, Global Climate Summer Intern, D.C.
Mercy Corps (M.E.Sc. Adviser Amity Doolittle), ACCCRN Urban Climate Resilience Network (URCN) Analysis Intern, Jakarta, Indonesia
National Parks Conservation Association, Research Fellow, Mid-Atlantic Regional Office, D.C.
Natural Resources Defense Council, Cameron Speth Fellow, D.C.
Natural Resources Defense Council, Summer Intern, D.C.
New England Forestry Foundation, Land Protection Intern, Calif.
NextGen Climate America, Policy Intern, Calif.
Organización Regional de los Pueblos Indígenas del Oriente/Amity Doolittle, Indigenous Land Rights Intern, Iquitos, Peru
PolicyLink, All-in Cities Intern, Calif.
Resources for the Future, Kailin Kroetz, Summer Intern—Network Analysis of the Dynamic Evolution of Fishing Permit Portfolios, D.C.
Rural Voices for Conservation Coalition, Summer Intern, Ore.
SPREP, Climate Change Division Intern (2), Apia, Samoa
Trust for Public Land, Trust for Public Lands Fellow—Climate Smart Cities, Mass.
United States Business Council for Sustainable Development (USBCSD), Industrial Ecologist, Tex.
Urban Resources Initiative, Community Foresters (2), Conn.
Urban Resources Initiative, Summer intern, Conn.
Winrock International, Summer Intern, Chengdu, China
Woods Whole Research Center, Summer Intern, Mbandaka, Democratic Republic of Congo
World Food Programme, Summer Fellow, Climate Change Adaptation, Rome, Italy
World Resources Institute, Summer Intern, São Paulo, Brazil
WWF Korea, Summer Associate, Seoul, Republic of Korea
Yale School Forests, Apprentice Forester (2), Conn.

NON-U.S. INDEPENDENT RESEARCH

Pathways and consequences of human and chimpanzee interaction around Nyungwe National Park, Rwanda
Perceptions of autonomy and conservation in the certified community conserved areas of Oaxaca, Mexico
Researcher in diffusion of agricultural innovations and rural development, Tamale, Ghana
Researcher in expansion of oil palm plantations through collection of oral narratives, Peru
Researcher in silvopastoral systems, Colombia
Researcher in silvopastoral systems, Panama
Researcher in tropical agroforestry, Brazil
Researcher in wildlife management, Botswana

U.S. INDEPENDENT RESEARCH

Adaptation of agricultural land use to climate change, Conn.
An examination of ectomycorrhizal communities associated with eastern hemlock under varying types and levels of duress, Conn.
Comparing methods for the measurement of evapotranspiration, Conn.
Conducting a participatory mapping survey, Md.
Creating a mathematical model for stream surface light availability given stream order and riparian land cover type, Conn.
Documentary filmmaker, Wash. and Alaska
Empowering at-risk students to shape environmental challenges with design, Calif.
Examine the pre-planting and maintenance techniques that encourage natural regeneration in urban NYC forests, N.Y.
Impact of residential racial/ethnic segregation on airborne fine particulate matter in the United States, Conn.
Principal investigator, Wash.
Research and journalistic writing on land management conflicts and the conflicts that arise from them, Wyo.
Researcher in energy economics, Conn.
Researcher in social dynamics of the built environment, Calif.
Researcher in urban environmental health, Md.
Researcher in watershed biogeochemistry, Conn.
Researching efficient clean energy promotion strategies for governments and environmental organizations, Conn.
Researching the chemical effect of snowmelt in alpine lakes of the Wind River Range, Wyo.
Researching the factors that lead to the establishment and regeneration of Hickory, Conn.
Social context and stakeholder analysis of the Red Desert to Hoback mule deer migration, Wyo.
Student applicant to the Geneva challenge, Conn.

The above list was compiled by the Career Development Office, Yale School of Forestry & Environmental Studies. For more information, please contact Kathryn Douglas, Associate Director, at 203.436.4830 or kathryn.douglas@yale.edu.

The School and its students thank donors, host organizations, and supervisors for making these valuable professional experiences possible.

Immediately Following Graduation

Each year Yale F&ES graduates enjoy employment success in environmental science, policy, and management within the United States and around the world, or they pursue admission for further academic study. Details including salary information on the most recent as well as previous classes can be found at http://environment.yale.edu/careers/data.

Summary data from the class of 2016 master's graduates six months after graduation (109 responses):

Academic (K–Higher Education)	8%
Nonprofit/Nongovernmental	25%
Government/Public Sector	15%
Further Study	18%
Private (Business/Consulting)	29%
Private (Law)	3%
Entrepreneurial	2%

LEAVE OF ABSENCE

Students are expected to follow a continuous course of study at the School of Forestry & Environmental Studies. However, a student who wishes or needs to interrupt study temporarily may request a leave of absence. There are three types of leave—personal, medical, and parental—all of which are described below. The general policies that apply to a leave of absence are:

1. Any student who is contemplating a leave of absence should see the assistant dean for student services to discuss the necessary application procedures.
2. All leaves of absence must be approved by the assistant dean for student services and the associate dean for academic affairs. Medical leaves also require the written recommendation of a physician on the staff of Yale Health, as described below.
3. A student may be granted a leave of absence of one to two years. Any leave approved by the assistant dean for student services and the associate dean for academic affairs will be for a specified period.
4. International students who apply for a leave of absence must consult with OISS regarding their visa status.
5. A student on a leave of absence may complete outstanding work in courses for which extensions have been granted. The student may not, however, fulfill any other degree requirements during the time on leave.
6. A student on a leave of absence is not eligible for financial aid, including loans; and in most cases, student loans are not deferred during periods of nonenrollment.
7. A student on a leave of absence is not eligible for the use of any University facilities normally available to enrolled students.
8. A student on leave of absence may continue to be enrolled in Yale Health by purchasing coverage through the Student Affiliate Coverage plan. In order to secure continuous coverage from Yale Health, enrollment in this plan must be requested prior to the beginning of the term in which the student will be on leave. If a leave of absence is granted during the term, the student must request Yale Health Affiliate Coverage enrollment within thirty days of the date the registrar was notified of the leave. Coverage is not automatic; enrollment forms are available from the Member Services Department of Yale Health, 203.432.0246, or can be downloaded from the Yale Health website (http://yalehealth.yale.edu).
9. A student on a leave of absence does not have to file a formal application for readmission. However, the student must notify the assistant dean for student services in writing of the intention to return at least eight weeks prior to the end of

the approved leave. In addition, a returning student who wishes to be considered for financial aid must submit appropriate financial aid applications to the School's financial aid office to determine eligibility.

10. A student on a leave of absence who does not return at the end of an approved leave, and does not request and receive an extension from the dean, is automatically dismissed from the School.

Personal leave of absence A student who wishes or needs to interrupt study temporarily because of personal exigencies may request a personal leave of absence. The general policies governing all leaves of absence are described above. A student who is current with degree requirements is eligible for a personal leave after satisfactory completion of at least one term of study. Personal leaves cannot be granted retroactively and normally will not be approved after the tenth day of a term.

To request a personal leave of absence, the student must apply in writing before the beginning of the term for which the leave is requested, explaining the reasons for the proposed leave and stating both the proposed start and end dates of the leave, and the address at which the student can be reached during the period of the leave. If the assistant dean for student services and the associate dean for academic affairs find the student to be eligible, the leave will be approved. In any case, the student will be informed in writing of the action taken. A student who does not apply for a personal leave of absence, or whose application for a leave is denied, and who does not register for any term, will be considered to have withdrawn from the School.

Medical leave of absence A student who must interrupt study temporarily because of illness or injury may be granted a medical leave of absence with the approval of the director of student services and the associate dean for academic affairs, on the written recommendation of a physician on the staff of Yale Health. The general policies governing all leaves of absence are described above. A student who is making satisfactory progress toward degree requirements is eligible for a medical leave any time after matriculation. The final decision concerning a request for a medical leave of absence will be communicated in writing by the assistant dean for student services.

The School of Forestry & Environmental Studies reserves the right to require a student to take a leave for medical reasons when, on recommendation of the director of Yale Health or the chief of the Mental Health and Counseling department, the dean of the School determines that the student is a danger to self or others because of a serious medical problem, or that the student has refused to cooperate with efforts deemed necessary by Yale Health to determine if the student is such a danger. An appeal of such a leave must be made in writing to the dean of the School no later than seven days from the date of withdrawal.

A student who is placed on medical leave during any term will have tuition adjusted according to the same schedule used for withdrawals (see Tuition Rebate and Refund Policy). Before re-registering, a student on medical leave must secure written permission to return from a Yale Health physician.

Leave of absence for parental responsibilities A student who wishes or needs to interrupt study temporarily for reasons of pregnancy, maternity care, or paternity care may be granted a leave of absence for parental responsibilities. The general policies governing

all leaves of absence are described above. A student who is making satisfactory progress toward degree requirements is eligible for parental leave any time after matriculation.

Any student planning to have or care for a child is encouraged to meet with the assistant dean for student services to discuss leaves and other short-term arrangements. For many students, short-term arrangements rather than a leave of absence are possible. Students living in University housing units are encouraged to review their housing contract and the related polices of the Graduate Housing Office before applying for a parental leave of absence. Students granted a parental leave may continue to reside in University housing to the end of the academic term for which the leave was first granted, but no longer.

U.S. MILITARY LEAVE READMISSIONS POLICY

Students who wish or need to interrupt their studies to perform U.S. military service are subject to a separate U.S. military leave readmissions policy. In the event a student withdraws or takes a leave of absence from the School of Forestry & Environmental Studies to serve in the U.S. military, the student will be entitled to guaranteed readmission under the following conditions:

1. The student must have served in the U.S. Armed Forces for a period of more than thirty consecutive days;
2. The student must give advance written or oral notice of such service to the assistant dean for student services and the associate dean for academic affairs. In providing the advance notice the student does not need to indicate an intention to return. This advance notice need not come directly from the student, but rather, can be made by an appropriate officer of the U.S. Armed Forces or official of the U.S. Department of Defense. Notice is not required if precluded by military necessity. In all cases, this notice requirement can be fulfilled at the time the student seeks readmission, by submitting an attestation that the student performed the service.
3. The student must not be away from the School to perform U.S. military service for a period exceeding five years (this includes all previous absences to perform U.S. military service but does not include any initial period of obligated service). If a student's time away from the School to perform U.S. military service exceeds five years because the student is unable to obtain release orders through no fault of the student or the student was ordered to or retained on active duty, the student should contact the assistant dean for student services to determine if the student remains eligible for guaranteed readmission.
4. The student must notify the School within three years of the end of the U.S. military service of the intention to return. However, a student who is hospitalized or recovering from an illness or injury incurred in or aggravated during the U.S. military service has up until two years after recovering from the illness or injury to notify the School of the intent to return.
5. The student cannot have received a dishonorable or bad conduct discharge or have been sentenced in a court-martial.

A student who meets all of these conditions will be readmitted for the next term, unless the student requests a later date of readmission. Any student who fails to meet one of

these requirements may still be readmitted under the general readmission policy but is not guaranteed readmission.

Upon returning to the School, the student will resume education without repeating completed course work for courses interrupted by U.S. military service. The student will have the same enrolled status last held and with the same academic standing. For the first academic year in which the student returns, the student will be charged the tuition and fees that would have been assessed for the academic year in which the student left the institution. Yale may charge up to the amount of tuition and fees other students are assessed, however, if veteran's education benefits will cover the difference between the amounts currently charged other students and the amount charged for the academic year in which the student left.

In the case of a student who is not prepared to resume studies with the same academic status at the same point where the student left off or who will not be able to complete the program of study, the School of Forestry & Environmental Studies will undertake reasonable efforts to help the student become prepared. If after reasonable efforts, the School determines that the student remains unprepared or will be unable to complete the program, or after the School determines that there are no reasonable efforts it can take, the School may deny the student readmission.

FREEDOM OF EXPRESSION

The Yale School of Forestry & Environmental Studies is committed to the protection of free inquiry and expression in the classroom and throughout the school community. In this, the School reflects the University's commitment to and policy on freedom of expression as eloquently stated in the Woodward Report (Report of the Committee on Freedom of Expression at Yale, 1974). See http://studentlife.yale.edu/guidance-regarding-free-expression-students-yale.

Yale University Resources and Services

A GLOBAL UNIVERSITY

Yale continues to evolve as a global university, educating leaders and advancing the frontiers of knowledge across the entire world. The University's engagement beyond the United States dates from its earliest years. Yale has drawn students from abroad for nearly two centuries, and international topics have been represented in its curriculum for the past hundred years and more.

This year, Yale welcomed the largest number of international students and scholars in its history. The current enrollment of approximately 2,500 international students from more than 115 countries comprises 20 percent of the student body. Yale is committed to attracting the best and brightest from around the world by offering generous international financial aid packages, conducting programs that introduce and acclimate international students to Yale, and fostering a vibrant campus community. The number of international scholars (visiting faculty, researchers, and postdoctoral fellows) has also grown to nearly 2,500 each year.

Yale's globalization is guided by three overarching goals: prepare students for leadership and service in an increasingly interdependent world, attract the most talented students and scholars to Yale from around the world, and position Yale as a global university of consequence. These efforts are coordinated by several University-wide organizations, in addition to the work being done within the individual schools and programs.

The Whitney and Betty MacMillan Center for International and Area Studies (http://macmillan.yale.edu) is the University's focal point for teaching and research on international affairs, societies, and cultures.

The Jackson Institute for Global Affairs (http://jackson.yale.edu) seeks to institutionalize the teaching of global affairs throughout the University and to inspire and prepare Yale students for global citizenship and leadership.

The Office of International Affairs (http://world.yale.edu/oia) provides administrative support for the international activities of all schools, departments, centers, and organizations at Yale; promotes Yale and its faculty to international audiences; and works to increase the visibility of Yale's international activities around the globe.

The Office of International Students and Scholars (http://oiss.yale.edu) hosts orientation programs and social activities for the University's international community and is a resource for international students and scholars on immigration matters and other aspects of acclimating to life at Yale.

The Yale World Fellows Program (http://worldfellows.yale.edu) hosts fifteen emerging leaders from outside the United States each year for an intensive semester of individualized research, weekly seminars, leadership training, and regular interactions with the Yale community.

The Association of Yale Alumni (http://aya.yale.edu) provides a channel for communication between the alumni and the University and supports alumni organizations and programs around the world.

Additional information may be found on the "Yale and the World" website (http://world.yale.edu), including resources for those conducting international activities abroad and links to international initiatives across the University.

HOUSING

The Yale Housing Office has dormitory and apartment units available for graduate and professional students. Dormitories are single occupancy of varying sizes and prices. They are located across the campus, from Edward S. Harkness Memorial Hall, serving the medical campus, to the Hall of Graduate Studies and Helen Hadley Hall, serving the central/science campus. Unfurnished apartments consisting of efficiencies and one-, two-, and three-bedroom apartments for singles and families are also available. The office's website (http://housing.yale.edu) is the venue for graduate housing information and includes procedures, facility descriptions, floor plans, and rates. Applications for the new academic year are available beginning April 1 and can be submitted directly from the website.

The Yale Housing Office also manages the Off Campus Living listing service (http://offcampusliving.yale.edu; 203.436.2881), which is the exclusive Yale service for providing off-campus rental and sales listings. This secure system allows members of the Yale community to search rental listings, review landlord/property ratings, and search for a roommate in the New Haven area. On-campus housing is limited, and members of the community should consider off-campus options. Yale University discourages the use of Craigslist and other third-party nonsecure websites for off-campus housing searches.

The Yale Housing Office is located in Helen Hadley Hall (HHH) at 420 Temple Street. It is open from 9 a.m. to 4 p.m., Monday through Friday; 203.432.2167.

DINING AT YALE

Yale Hospitality has tailored its services to meet the particular needs of graduate and professional school students by offering meal plan options that allow flexibility and value. The HGS 150 Plan is a block meal plan that gives graduate and professional school students 150 meals to use anytime during the term. The plan is required for all Hall of Graduate Studies residents as a minimum meal plan; it is one of several optional meal plans available to students who live off-campus. For up-to-date information on all options, costs, and residential and retail dining locations, visit http://hospitality.yale.edu. Inquiries concerning food services should be addressed to Yale Hospitality, 246 Church Street, PO Box 208261, New Haven CT 06520-8261; e-mail, yale.dining@yale.edu; tel, 203.432.0420.

SECURITY

As with most universities in urban settings, the security of persons and property is a primary concern of the School of Forestry & Environmental Studies. The University police and the fire marshal, in cooperation with the police and fire services of the City of New Haven, strive constantly to maintain a safe environment for the Yale community. At an orientation session during the summer modules, incoming students receive detailed information on emergency communications, personal safety tips, and other ways to protect themselves, equipment, and buildings.

HEALTH SERVICES

The Yale Health Center is located on campus at 55 Lock Street. The center is home to Yale Health, a not-for-profit, physician-led health coverage option that offers a wide variety of health care services for students and other members of the Yale community. Services include student medicine, gynecology, mental health, pediatrics, pharmacy, laboratory, radiology, a seventeen-bed inpatient care unit, a round-the-clock acute care clinic, and specialty services such as allergy, dermatology, orthopedics, and a travel clinic. Yale Health coordinates and provides payment for the services provided at the Yale Health Center, as well as for emergency treatment, off-site specialty services, inpatient hospital care, and other ancillary services. Yale Health's services are detailed in the *Yale Health Student Handbook,* available through the Yale Health Member Services Department, 203.432.0246, or online at http://yalehealth.yale.edu.

Eligibility for Services

All full-time Yale degree-candidate students who are paying at least half tuition are enrolled automatically for Yale Health Basic Coverage. Yale Health Basic Coverage is offered at no charge and includes preventive health and medical services in the departments of Student Health, Gynecology, Student Wellness, and Mental Health & Counseling. In addition, treatment for urgent medical problems can be obtained twenty-four hours a day through Acute Care.

Students on leave of absence or on extended study and paying less than half tuition are not eligible for Yale Health Basic Coverage but may enroll in Yale Health Student Affiliate Coverage. Students enrolled in the Division of Special Registration as nondegree special students or visiting scholars are not eligible for Yale Health Basic Coverage but may enroll in the Yale Health Billed Associates Plan and pay a monthly fee. Associates must register for a minimum of one term within the first thirty days of affiliation with the University.

Students not eligible for Yale Health Basic Coverage may also use the services on a fee-for-service basis. Students who wish to be seen fee-for-service must register with the Member Services Department. Enrollment applications for the Yale Health Student Affiliate Coverage, Billed Associates Plan, or Fee-for-Service Program are available from the Member Services Department.

All students who purchase Yale Health Hospitalization/Specialty Coverage (see below) are welcome to use specialty and ancillary services at Yale Health Center. Upon referral, Yale Health will cover the cost of specialty and ancillary services for these students. Students with an alternate insurance plan should seek specialty services from a provider who accepts their alternate insurance.

Health Coverage Enrollment

The University also requires all students eligible for Yale Health Basic Coverage to have adequate hospital insurance coverage. Students may choose Yale Health Hospitalization/Specialty Coverage or elect to waive the plan if they have other hospitalization coverage, such as coverage through a spouse or parent. The waiver must be renewed annually, and it is the student's responsibility to confirm receipt of the waiver by the University's deadlines noted below.

YALE HEALTH HOSPITALIZATION/SPECIALTY COVERAGE

For a detailed explanation of this plan, which includes coverage for prescriptions, see the *Yale Health Student Handbook,* available online at http://yalehealth.yale.edu.

Students are automatically enrolled and charged a fee each term on their Student Financial Services bill for Yale Health Hospitalization/Specialty Coverage. Students with no break in coverage who are enrolled during both the fall and spring terms are billed each term and are covered from August 1 through July 31. For students entering Yale for the first time, readmitted students, and students returning from a leave of absence who have not been covered during their leave, Yale Health Hospitalization/Specialty Coverage begins on the day the dormitories officially open. A student who is enrolled for the fall term only is covered for services through January 31; a student enrolled for the spring term only is covered for services through July 31.

Waiving Yale Health Hospitalization/Specialty Coverage Students are permitted to waive Yale Health Hospitalization/Specialty Coverage by completing an online waiver form at https://www.yhpstudentwaiver.yale.edu that demonstrates proof of alternate coverage. It is the student's responsibility to report any changes in alternate insurance coverage to the Member Services Department. Students are encouraged to review their present coverage and compare its benefits to those available under Yale Health. The waiver form must be filed annually and must be received by September 15 for the full year or fall term or by January 31 for the spring term only.

Revoking the waiver Students who waive Yale Health Hospitalization/Specialty Coverage but later wish to be covered must complete and send a form voiding their waiver to the Member Services Department by September 15 for the full year or fall term, or by January 31 for the spring term only. Students who wish to revoke their waiver during the term may do so, provided they show proof of loss of the alternate insurance plan and enroll within thirty days of the loss of this coverage. Yale Health fees will not be prorated.

YALE HEALTH STUDENT TWO-PERSON AND FAMILY PLANS

A student may enroll the student's lawfully married spouse or civil union partner and/or legally dependent child(ren) under the age of twenty-six in one of two student dependent plans: the Two-Person Plan or the Student Family Plan. These plans include services described in both Yale Health Basic Coverage and Yale Health Hospitalization/Specialty Coverage. Coverage is not automatic, and enrollment is by application. Applications are available from the Member Services Department or can be downloaded from the website (http://yalehealth.yale.edu) and must be renewed annually. Applications must be received by September 15 for full-year or fall-term coverage, or by January 31 for spring-term coverage only.

YALE HEALTH STUDENT AFFILIATE COVERAGE

Students on leave of absence or extended study, students paying less than half tuition, or students enrolled in the Eli Whitney Program prior to September 2007 may enroll in Yale Health Student Affiliate Coverage, which includes services described in both Yale Health Basic and Yale Health Hospitalization/Specialty Coverage. Applications are available from the Member Services Department or can be downloaded from the website

(http://yalehealth.yale.edu) and must be received by September 15 for full-year or fall-term coverage, or by January 31 for spring-term coverage only.

Eligibility Changes

Withdrawal A student who withdraws from the University during the first fifteen days of the term will be refunded the fee paid for Yale Health Hospitalization/Specialty Coverage. The student will not be eligible for any Yale Health benefits, and the student's Yale Health membership will be terminated retroactive to the beginning of the term. The medical record will be reviewed, and any services rendered and/or claims paid will be billed to the student on a fee-for-service basis. Assistance with identifying and locating alternative sources of medical care may be available from the Care Management Department at Yale Health. At all other times, a student who withdraws from the University will be covered by Yale Health for thirty days following the date of withdrawal. Fees will not be prorated or refunded. Students who withdraw are not eligible to enroll in Yale Health Student Affiliate Coverage. Regardless of enrollment in Yale Health Hospitalization/Specialty Coverage, students who withdraw will have access to services available under Yale Health Basic Coverage (including Student Health, Athletic Medicine, Mental Health & Counseling, and Care Management) during these thirty days to the extent necessary for a coordinated transition of care.

Leaves of absence Students who are granted a leave of absence are eligible to purchase Yale Health Student Affiliate Coverage for the term(s) of the leave. If the leave occurs on or *before* the first day of classes, Yale Health Hospitalization/Specialty Coverage will end retroactive to the start of the coverage period for the term. If the leave occurs anytime after the first day of classes, Yale Health Hospitalization/Specialty Coverage will end on the day the registrar is notified of the leave. In either case, students may enroll in Yale Health Student Affiliate Coverage. Students must enroll in Affiliate Coverage prior to the beginning of the term unless the registrar is notified after the first day of classes, in which case, the coverage must be purchased within thirty days of the date the registrar was notified. Fees paid for Yale Health Hospitalization/Specialty Coverage will be applied toward the cost of Affiliate Coverage. Coverage is not automatic, and enrollment forms are available at the Member Services Department or can be downloaded from the website (http://yalehealth.yale.edu). Fees will not be prorated or refunded.

Extended study or reduced tuition Students who are granted extended study status or pay less than half tuition are not eligible for Yale Health Hospitalization/Specialty Coverage. They may purchase Yale Health Student Affiliate Coverage during the term(s) of extended study. This plan includes services described in both Yale Health Basic and Yale Health Hospitalization/Specialty Coverage. Coverage is not automatic, and enrollment forms are available at the Member Services Department or can be downloaded from the website (http://yalehealth.yale.edu). Students must complete an enrollment application for the plan prior to September 15 for the full year or fall term, or by January 31 for the spring term only.

For a full description of the services and benefits provided by Yale Health, please refer to the *Yale Health Student Handbook,* available from the Member Services Department, 203.432.0246, 55 Lock Street, PO Box 208237, New Haven CT 06520-8237.

Required Immunizations

Please access the Incoming Student Vaccination Form for graduate and professional students at http://yalehealth.yale.edu. Connecticut state law requires that this form be completed and signed, for each student, by a physician, nurse practitioner, or physician's assistant. The deadline date for submission may be found on the form. The form must be completed, independent of any and all health insurance elections or coverage chosen.

Measles, mumps, rubella, and varicella All students who were born after January 1, 1957, are required to provide proof of immunization against measles (rubeola), mumps, German measles (rubella), and varicella. Connecticut state law requires two doses of measles vaccine, two doses of mumps vaccine, two doses of rubella vaccine, and two doses of varicella vaccine. The first dose must have been given on or after January 1, 1980, *and* after the student's first birthday; the second dose must have been given at least thirty (30) days after the first dose. If dates of vaccination are not available, titer results (blood test) demonstrating immunity may be substituted for proof of vaccination. The cost for all vaccinations and/or titers rests with the student, as these vaccinations are considered to be a pre-entrance requirement by the Connecticut State Department of Public Health. Students who are not compliant with this state law will not be permitted to register for classes or move into the dormitories for the fall term, 2017.

Quadrivalent meningitis All students living in on-campus dormitory facilities must be vaccinated against meningitis. The only vaccines that will be accepted in satisfaction of the meningitis vaccination requirement are ACWY Vax, Menveo, Nimenrix, Menactra, Mencevax, and Menomune. The vaccine must have been received after January 1, 2013. Students who are not compliant with this state law will not be permitted to register for classes or move into the dormitories for the fall term, 2017. The cost for all vaccinations and/or titers rests with the student, as these vaccinations are considered to be a pre-entrance requirement by the Connecticut State Department of Public Health. Please note that the State of Connecticut does not require this vaccine for students who intend to reside off campus.

TB screening The University strongly recommends tuberculosis screening for all incoming students who have lived or traveled outside of the United States.

RESOURCE OFFICE ON DISABILITIES

The Resource Office on Disabilities facilitates accommodations for undergraduate and graduate and professional school students with disabilities who register with and have appropriate documentation on file in the Resource Office. Early planning is critical. Documentation may be submitted to the Resource Office even though a specific accommodation request is not anticipated at the time of registration. It is recommended that matriculating students in need of disability-related course accommodations at Yale University contact the Resource Office by June 15. Special requests for University housing need to be made in the housing application. Returning students must contact the Resource Office at the beginning of each term to arrange for course and exam accommodations.

The Resource Office also provides assistance to students with temporary disabilities. General informational inquiries are welcome from students and members of the Yale community and from the public. The mailing address is Resource Office on Disabilities, Yale University, PO Box 208305, New Haven CT 06520-8305. The Resource Office is located at 35 Broadway (rear entrance), Room 222. Office hours are Monday through Friday, 8:30 a.m. to 4:30 p.m. Voice callers may reach staff at 203.432.2324; fax at 203.432.8250. The Resource Office may also be reached by e-mail (ROD@yale.edu) or through its website (http://rod.yale.edu).

RESOURCES ON SEXUAL MISCONDUCT

Yale University is committed to maintaining and strengthening an educational, employment, and living environment founded on civility and mutual respect. Sexual misconduct is antithetical to the standards and ideals of our community, and it is a violation of Yale policy and the disciplinary regulations of Yale College and the graduate and professional schools.

Sexual misconduct incorporates a range of behaviors including sexual assault, sexual harassment, intimate partner violence, stalking, voyeurism, and any other conduct of a sexual nature that is nonconsensual, or has the purpose or effect of threatening, intimidating, or coercing a person. Violations of Yale's Policy on Teacher-Student Consensual Relations also constitute sexual misconduct. Sexual activity requires consent, which is defined as positive, unambiguous, and voluntary agreement to engage in specific sexual activity throughout a sexual encounter.

Yale aims to eradicate sexual misconduct through education, training, clear policies, and serious consequences for violations of these policies. In addition to being subject to University disciplinary action, many forms of sexual misconduct are prohibited by Connecticut and federal law and may lead to civil liability or criminal prosecution. Yale provides a range of services, resources, and mechanisms for victims of sexual misconduct. The options for undergraduate, graduate, and professional school students are described at http://smr.yale.edu.

SHARE: Information, Advocacy, and Support

55 Lock Street, Lower Level
Office hours: 9 a.m.–5 p.m., M–F
24/7 hotline: 203.432.2000
http://sharecenter.yale.edu

SHARE, the Sexual Harassment and Assault Response and Education Center, has trained counselors available 24/7, including holidays. SHARE is available to members of the Yale community who wish to discuss any experience of sexual misconduct involving themselves or someone they care about. SHARE services are confidential and can be anonymous if desired. SHARE can provide professional help with medical and health issues (including accompanying students to the hospital), as well as advice and assistance with contacting police and/or initiating a formal or informal complaint, and it offers ongoing counseling and support. SHARE works closely with the University-Wide Committee on Sexual Misconduct, the Title IX coordinators, the Yale Police Department, and other campus resources.

If you wish to make use of SHARE's services, you can call the SHARE number (203.432.2000) at any time for a phone consultation or to set up an in-person appointment. You may also drop in on weekdays during regular business hours. Some legal and medical options are time-sensitive, so if you have been assaulted, we encourage you to call SHARE and/or the Yale Police as soon as possible. Counselors can talk with you over the telephone or meet you in person at Acute Care in the Yale Health Center or at the Yale New Haven Emergency Room. If it is not an acute situation and you would like to contact the SHARE staff during regular business hours, you can contact Carole Goldberg, the director of SHARE (203.432.0310, carole.goldberg@yale.edu), Jennifer Czincz, assistant director (203.432.2610, jennifer.czincz@yale.edu), Sherine Powerful (203.436.8217, sherine.powerful@yale.edu), or John Criscuolo (203.494.6247, john.criscuolo@yale.edu).

Title IX Coordinators

203.432.4446
Office hours: 9 a.m.–5 p.m., M–F
http://provost.yale.edu/title-ix

Title IX of the Education Amendments of 1972 protects people from sex discrimination in educational programs and activities at institutions that receive federal financial assistance. Sex discrimination includes sexual harassment, sexual assault, and other forms of misconduct. The University is committed to providing an environment free from discrimination on the basis of sex.

Yale College, the Graduate School of Arts and Sciences, and the professional schools have each designated a senior administrator or faculty member to serve as a deputy Title IX coordinator, reporting to Stephanie Spangler, Deputy Provost for Health Affairs and Academic Integrity and the University Title IX Coordinator. Coordinators respond to and address specific complaints, provide information on and coordinate with the available resources, track and monitor incidents to identify patterns or systemic issues, deliver prevention and educational programming, and address issues relating to gender-based discrimination and sexual misconduct within their respective schools. Coordinators are knowledgeable about, and will provide information on, all options for complaint resolution, and can initiate institutional action when necessary. Discussions with a Title IX coordinator are confidential; at times, the coordinator may need to consult with other administrators or take action in the interest of safety. The coordinators also work closely with the SHARE Center, the University-Wide Committee on Sexual Misconduct, and the Yale Police Department.

University-Wide Committee on Sexual Misconduct

203.432.4449
Office hours: 9 a.m.–5 p.m., M–F
http://provost.yale.edu/uwc

The University-Wide Committee on Sexual Misconduct (UWC) is an internal disciplinary board for complaints of sexual misconduct available to students, faculty, and staff across the University, as described in the committee's procedures. The UWC provides

an accessible, representative, and trained body to fairly and expeditiously address formal complaints of sexual misconduct. UWC members can answer inquiries about procedures and the University definition of sexual misconduct. The UWC is comprised of faculty, administrative, and student representatives from across the University. In UWC cases, investigations are conducted by professional, independent fact finders.

Yale Police Department

101 Ashmun Street
24/7 hotline: 203.432.4400
https://your.yale.edu/community/public-safety/police/sensitive-crimes-support

The Yale Police Department (YPD) operates 24/7 and is comprised of highly trained, professional officers. The YPD can provide information on available victims' assistance services and also has the capacity to perform full criminal investigations. If you wish to speak with Sergeant Marnie Robbins Hoffman, the Sensitive Crimes & Support coordinator, she can be reached at 203.432.9547 during business hours or via e-mail at marnie.robbins@yale.edu. Informational sessions are available with the Sensitive Crimes & Support coordinator to discuss safety planning, available options, etc. The YPD works closely with the New Haven State's Attorney, the SHARE Center, the University's Title IX coordinators, and various other departments within the University. Talking to the YPD does not commit you to submitting evidence or pressing charges; with few exceptions, all decisions about how to proceed are up to you.

OFFICE OF INTERNATIONAL STUDENTS AND SCHOLARS

The Office of International Students and Scholars (OISS) coordinates services and support for Yale's 5,200 international students, faculty, staff, and their dependents. OISS staff offers assistance with issues related to employment, immigration, and personal and cultural adjustment, as well as serves as a source of general information about living at Yale and in New Haven. As Yale University's representative for immigration concerns, OISS provides assistance to students, faculty, and staff on how to obtain and maintain legal nonimmigrant status in the United States. All international students and scholars must register with OISS as soon as they arrive at Yale; see http://oiss.yale.edu/coming.

OISS programs, like the Community Friends hosting program, daily English conversation groups, U.S. culture workshops and discussions, bus trips, and social events, provide an opportunity to meet members of Yale's international community and become acquainted with the many resources of Yale University and New Haven. Spouses and partners of Yale students and scholars will want to get involved with the International Spouses and Partners at Yale (ISPY), which organizes a variety of programs.

The OISS website (http://oiss.yale.edu) provides useful information to students and scholars prior to and upon arrival in New Haven, as well as throughout their stay at Yale. International students, scholars, and their families and partners can connect with OISS and the Yale international community virtually through Facebook.

OISS is housed in the International Center for Yale Students and Scholars, which serves as a welcoming venue for students and scholars who want to peruse resource

materials, check their e-mail, and meet up with a friend or colleague. Open until 9 p.m. on weekdays during the academic year, the center—located at 421 Temple Street, across the street from Helen Hadley Hall—also provides meeting space for student groups and a venue for events organized by both student groups and University departments. For more information about reserving space at the center, go to http://oiss.yale.edu/about/the-international-center/international-center-room-reservations. For information about the center, visit http://oiss.yale.edu/about/international-center.

RELIGIOUS RESOURCES

This year marks the ninetieth anniversary of the University Chaplaincy at Yale. The religious and spiritual resources of the University serve all students, faculty, and staff of all faiths. These resources are coordinated and/or supported through the Chaplaincy (located on the lower level of Bingham Hall on Old Campus); the University Church in Yale in Battell Chapel, an open and affirming ecumenical Christian congregation; and Yale Religious Ministries, the on-campus association of professionals representing numerous faith traditions. This association includes the Saint Thomas More Catholic Chapel and Center at Yale and the Joseph Slifka Center for Jewish Life at Yale, and it supports Buddhist, Hindu, and Muslim life professionals; several Protestant denominational and nondenominational ministries; and student religious groups such as the Baha'i Association, the Yale Hindu Student Council, the Muslim Student Association, and many others. Hours for the Chaplain's Office during the academic term are Monday through Thursday from 8:30 a.m. to 11 p.m., Friday from 8:30 a.m. to 5 p.m., and Sunday evenings from 5 to 11. Additional information is available at http://chaplain.yale.edu.

LIBRARIES

The Yale University Library comprises three central libraries—Sterling Memorial Library, Beinecke Rare Book and Manuscript Library, and the Anne T. and Robert M. Bass Library—and twelve school and department libraries as well as many special collections. Among the largest university libraries in the United States, it includes more than fifteen million volumes and information in all media, ranging from ancient papyri to early printed books to electronic databases. Students have access to the physical collections and study spaces of all the libraries at Yale, as well as to a full array of online and digital resources. For additional information, please visit http://web.library.yale.edu.

CULTURAL AND RECREATIONAL OPPORTUNITIES

Cultural Opportunities

There are many ways to keep up-to-date about campus news and events. These include the YaleNews website, which features stories, videos, and slide-shows about Yale people and programs (http://news.yale.edu); the interactive Yale Calendar of Events (http://events.yale.edu/opa); and the University's social media channels on Facebook, Twitter, Instagram, Tumblr, LinkedIn, and YouTube.

The Yale Peabody Museum of Natural History, founded in 1866, houses more than thirteen million specimens and objects in ten curatorial divisions: anthropology, botany,

entomology, historical scientific instruments, invertebrate paleontology, invertebrate zoology, mineralogy and meteoritics, paleobotany, vertebrate paleontology, and vertebrate zoology. The renowned collections provide crucial keys to the history of Earth and its life-forms, and in some cases are the only remaining traces of animals, plants, and cultures that have disappeared. About 5,000 objects are on public display, including the original "type" specimens—first of its kind—of *Brontosaurus, Stegosaurus,* and *Triceratops*.

The Yale University Art Gallery is the oldest college art museum in the United States, having been founded in 1832 when the patriot-artist John Trumbull gave more than one hundred of his paintings to Yale College. Since then its collections have grown to more than 200,000 objects ranging in date from ancient times to the present. In addition to its world-renowned collections of American paintings and decorative arts, the gallery is noted for outstanding collections of Greek and Roman art, including artifacts from the ancient Roman city of Dura-Europos; collections of early Italian paintings; the Société Anonyme Collection of twentieth-century European and American art; modern and contemporary art and design; Asian art; African art; art of the ancient Americas; and Indo-Pacific art. In December 2012 the gallery completed a comprehensive expansion and renovation project. The expanded museum unites all three buildings—the landmark Louis Kahn building (1953), the Old Yale Art Gallery (1928), and Street Hall (1866)—into a cohesive whole with a rooftop addition by Ennead Architects (2012). The gallery is both a collecting and an educational institution, and all activities are aimed at providing an invaluable resource and experience for Yale faculty, staff, and students, as well as for the general public. For more information, please visit http://artgallery.yale.edu.

The Yale Center for British Art houses the largest collection of British art outside the United Kingdom. Presented to the University by Paul Mellon (Yale College, Class of 1929), the collection reflects the development of British art and culture from the Elizabethan period onward. The center's collections include more than 2,000 paintings, 250 sculptures, 20,000 drawings and watercolors, 40,000 prints, and 35,000 rare books and manuscripts. More than 40,000 volumes supporting research in British art and related fields are available in the center's library. In May 2016 the center reopened to the public following the completion of a multiyear conservation project of its iconic Louis I. Kahn building. For more information, please visit http://britishart.yale.edu.

There are more than eighty endowed lecture series held at Yale each year on subjects ranging from anatomy to theology, and including virtually all disciplines.

More than five hundred musical events take place at the University during the academic year. In addition to recitals by graduate students and faculty artists, the School of Music presents the Yale Philharmonia, the Oneppo Chamber Music Series, the Ellington Jazz Series, the Horowitz Piano Series, New Music New Haven, Yale Opera, and concerts at the Yale Collection of Musical Instruments, as well as performances by the Yale Choral Artists. The Yale Summer School of Music/Norfolk Chamber Music Festival presents the New Music Workshop and the Chamber Choir and Choral Conducting Workshop, in addition to the six-week Chamber Music Session. Many of these concerts stream live on the School's website (http://music.yale.edu), the Norfolk website (http://norfolk.yale.edu), and the Collection of Musical Instruments website (http://collection.yale.edu). Additionally, the School presents the Iseman Broadcasts of the Metropolitan Opera Live

in HD free to members of the Yale community. Undergraduate organizations include the Yale Bands, the Yale Glee Club, the Yale Symphony Orchestra, and numerous other singing and instrumental groups. The Department of Music sponsors the Yale Collegium, Yale Baroque Opera Project, productions of new music and opera, and undergraduate recitals. The Institute of Sacred Music presents Great Organ Music at Yale, the Yale Camerata, the Yale Schola Cantorum, and many other special events.

For theatergoers, Yale and New Haven offer a wide range of dramatic productions at the University Theatre, Yale Repertory Theatre, Yale School of Drama, Yale Cabaret, Long Wharf Theatre, and Shubert Performing Arts Center.

Recreational Opportunities

The Payne Whitney Gymnasium is one of the most elaborate and extensive indoor athletic facilities in the world. This complex includes the 3,100-seat John J. Lee Amphitheater, the site for many indoor varsity sports contests; the Robert J. H. Kiphuth Exhibition Pool; the Brady Squash Center, a world-class facility with fifteen international-style courts; the Adrian C. Israel Fitness Center, a state-of-the-art exercise and weight-training complex; the Brooks-Dwyer Varsity Strength and Conditioning Center; the Colonel William K. Lanman, Jr. Center, a 30,000-square-foot space for recreational/intramural play and varsity team practice; the Greenberg Brothers Track, an eighth-mile indoor jogging track; the David Paterson Golf Technology Center; and other rooms devoted to fencing, gymnastics, rowing, wrestling, martial arts, general exercise, and dance. Numerous physical education classes in dance (ballet, modern, and ballroom, among others), martial arts, zumba, yoga, pilates, aerobic exercise, and sport skills are offered throughout the year. Yale undergraduates and graduate and professional school students may use the gym at no charge throughout the year. Academic term and summer memberships at reasonable fees are available for faculty, employees, postdoctoral and visiting fellows, alumni, and student spouses. Additional information is available online at http://sportsandrecreation.yale.edu.

During the year various recreational opportunities are available at the David S. Ingalls Rink, the McNay Family Sailing Center in Branford, the Yale Outdoor Education Center in East Lyme, the Yale Tennis Complex, and the Golf Course at Yale. Students, faculty, employees, students' spouses, and guests of the University may participate at each of these venues for a modest fee. Up-to-date information on programs, hours, and specific costs is available online at http://sportsandrecreation.yale.edu.

Approximately fifty club sports come under the jurisdiction of the Office of Outdoor Education and Club Sports. Most of the teams are for undergraduates, but a few are available to graduate and professional school students. Yale undergraduates, graduate and professional school students, faculty, staff, and alumni/ae may use the Yale Outdoor Education Center (OEC), which consists of 1,500 acres surrounding a mile-long lake in East Lyme, Connecticut. The facility includes overnight cabins and campsites, a pavilion and dining hall available for group rental, and a waterfront area with supervised swimming, rowboats, canoes, stand-up paddleboards, and kayaks. Adjacent to the lake, a shaded picnic grove and gazebo are available to visitors. In a more remote area of the facility, hiking trails loop the north end of the property; trail maps and directions are

available on-site at the field office. The OEC runs seven days a week from the third week of June through Labor Day. For more information, including mid-September weekend availability, call 203.432.2492 or visit http://sportsandrecreation.yale.edu.

Throughout the year, Yale graduate and professional school students have the opportunity to participate in numerous intramural sports activities. These seasonal, team-oriented activities include volleyball, soccer, and softball in the fall; basketball and volleyball in the winter; softball, soccer, ultimate, and volleyball in the spring; and softball in the summer. With few exceptions, all academic-year graduate-professional student sports activities are scheduled on weekends, and most sports activities are open to competitive, recreational, and coeducational teams. More information is available from the Intramurals Office in Payne Whitney Gymnasium, 203.432.2487, or online at http://sportsandrecreation.yale.edu.

City and Countryside

Only a short bike ride away from the center of New Haven lies the countryside of a state that is over one-half forest land. Farms, parks, lakes, trails, beaches, and nature preserves all await students seeking to spend a few hours away from their studies.

The most spectacular local features are the region's traprock ridges, the largest being East Rock, West Rock, and the Sleeping Giant. All three of these have been preserved as parks. East Rock and West Rock actually extend into New Haven, and their rusty-orange cliffs form a dramatic backdrop for the city. Sleeping Giant lies a pleasant ninety-minute bicycle ride from town.

New Haven is also surrounded by water supply forests. For a small annual fee, the Water Authority's twenty thousand acres of woods, traprock ridges, lakes, and streams are open for hiking, cross-country skiing, and fishing.

Tucked away in pockets off the main corridors of development lie some of the country's most fertile farmland. The Central Valley of New England, in which New Haven is situated, was once famous for its tobacco, onions, potatoes, apples, and seed growers. The remaining acres are now mostly in dairy farms and pick-your-own orchards, providing the region with rural scenery and fresh produce.

Farther out from the city, the land gets progressively hillier and less inhabited. The most dramatic region of the state is the Northwest Highlands of Litchfield County, where the School maintains its Great Mountain Forest Camp. Just a two-hour drive from New Haven, the Northwest Highlands boast the Appalachian Trail, New England's largest caves, a portion of the Taconic Mountains, and the vibrant fall colors of the Litchfield Hills.

But there is no need to travel so far to experience nature's bounty. New Haven itself is fortunate to have five major parks, including Edgewood Park, designed by Frederick Law Olmsted, Jr. Seventeen percent of New Haven is parkland, a figure that few cities in the world can match.

With so much nature near at hand and foot, New Haven comes close to maintaining the elusive ideal balance of the convenience and culture of the city with the pleasures of the countryside.

Enrollment

MASTER'S DEGREES CONFERRED, 2017

Ethan Teichman Addicott (A.B. Harvard Univ.), Fla.
Dena Perri Adler (B.A. Brown Univ.), N.Y.
Shaadee Jasmine Ahmadnia (B.A. Univ. La Verne), Calif.
Maria Amodio (B.A. Emory Univ.) Indiana
Vinay Ananthachar (B.E. Bangalore Univ.; M.B.A. Fitchburg State Univ.; M.S. Univ. Massachusetts [Lowell]), Conn.
Logan Marie Ashcraft (B.A. Johns Hopkins Univ.), Ohio
Alhassan Ali O Badahdah (B.S. King Fahd Univ. Petrol and Minerals), Saudi Arabia
Jorge Guillermo Barbosa Garzón (B.S. SUNY Coll. Environmental Science & Forestry), Colombia
Adam Benjamin Bauer-Goulden (B.A. Tulane Univ.), Ill.
Martin Jose Becker Toro (B.S. Pontificia Univ. Católica Chile), Conn.
Ralien Catootje Bekkers (B.S. Univ. Amsterdam), Netherlands
Oscar Ellory Benjamin (B.A. Univ. Oxford), Conn.
André Bobek Lopes (B.E. Pontificia Univ. Católica Parana), Brazil
Lindsay Jane Brewer (A.B. Dartmouth Coll.), Md.
Laura Calderon Etter (B.A., M.A. Univ. Los Andes), Colombia
Stella Limin Cao (B.S. Yale Univ.), N.Y.
Megan Elizabeth Carr (B.S. Frostburg State Univ.), Conn.
Melissa Ivy Castera (B.E., M.S. Univ. Republic), Uruguay
Jay P. Chancellor (A.B. Princeton Univ.), Md.
Maria Veronica Chang Estrella (B.A. Univ. Agraria Ecuador), Conn.
Pooja Mukesh Choksi (B.A. H.R. Coll. Commerce and Economics), India
Alexander Co (B.S. Yale Univ.), Calif.
Benjamin Sklaroff Cohen (B.A. Williams Coll.), N.Y.
Amber Marie Collett (B.A. St. Olaf Coll.), Conn.
Erik Thomas Connelly (B.S. Univ. Illinois [Urbana-Champaign]), Ill.
Emily Starin Connor (B.A., B.S. Pennsylvania State Univ.), Pa.
Santiago Cortés Villota (B.S. Univ. Los Andes), Colombia
Deanna Jacqueline Cox (B.S. Colorado State Univ.), Pa.
Michael Maurice Cox II (B.S. Stanford Univ.), N.Y.
Elizabeth Cheryl Creech (B.S. Warren Wilson Coll.), N.C.
Jazmine da Costa (A.B. Princeton Univ.), Conn.
Milagros Marina De Camps German (M.A. Boston Univ. School Law; LL.B. Pontificia Univ. Católica Madre Maestra), Dominican Republic
Bartholomew Paul DiFiore (B.A. Middlebury Coll.), Mass.
Elizabeth Ayres Domenech (B.S. Wake Forest Univ.), Conn.
Danica Anne Doroski (B.A. Bates Coll.), Pa.
Erika Drazen (B.A. Univ. California [Los Angeles]), Calif.
Vaaruni Eashwar (M.A. Indian Inst. Technology [Madras]), India
Emily Reynolds Farr (B.S. Yale Univ.), Md.

Anna Elizabeth Fiastro (B.A. Scripps Coll.), Ariz.
Katherine Marie Fiedler (B.A. Lewis & Clark Coll.), N.Y.
Taylor Renee Ganz (B.A. Lewis & Clark Coll.; B.S. Univ. Southern California), Calif.
Edwin Geovany Garcia Valdez (B.E. Univ. Cuenca; M.S. Polytechnic Univ.), Conn.
Samantha Garvin (B.A. Barnard Coll.), Wash.
Lynsey Reid Gaudioso (B.A. Vanderbilt Univ.), N.C.
Samuel Alexander Geldin (B.S. Univ. California [Los Angeles]), Calif.
Rebecca Paige Gildiner (B.A. Colgate Univ.), Conn.
Nathan David Hall (B.A. Berea Coll.), Ky.
Laura M. Hammett (B.A. Univ. Virginia), Conn.
Juliana Reed Burroughs Hanle (B.A. Yale Univ.), D.C.
Matthew Anton Hanna (B.S. Univ. Virginia), Ga.
Tess Hallowell Hart (B.A. Brown Univ.), Pa.
Mario Felipe Hervas Hervas (B.S. Univ. San Francisco [Quito]), Ecuador
Connor Donovan Hogan (B.A. Bates Coll.), Mass.
Annegret Laura Huober (B.A. Amherst Coll.), Conn.
Heidi M. Hurd (B.A. Queens Univ.; M.A. Dalhousie Univ.; J.D. Univ. Southern Calif.), Ill.
Abdul-Majeed Ibrahim (B.S. Univ. Cape Coast), Ghana
Shams-Il Arefin Islam (B.S. Ithaca Coll.; M.A. North South Univ.), Bangladesh
Pamela Jao (B.A. New York Univ.), Conn.
Olga Kachook (B.A. Univ. Washington), Wash.
Nathan Asher Kaufman (B.A. Wesleyan Univ.), Mass.
Erin Elizabeth Kelly (B.A. Univ. California [Berkeley]), Conn.
Siegfried Wilhelm King Valenzuela (B.S. Univ. Tecnica Federico [Santa Maria]), Chile
Allison Lindsay Khoe (B.A. Univ. California [San Diego]), Calif.
William Petersen Klein (B.S. Univ. California [Davis]), Va.
William Hagan Wonlim Koh (B.A. Yale Univ.), Conn.
Yanin Alexa Kramsky (B.S. Art Center Coll. Design), Conn.
Stefan Kuzmanovski (B.S. Jacobs Univ. Bremen), Macedonia
Nina Yuriko Hashimoto Lagpacan (B.A. Univ. California [Berkeley]), Calif.
Ana Elisa Lambert (B.S. Inst. Tecnológico y de Estudios Superiores de Occidente), Mexico
Grace Lange (B.A. Dickinson Coll.), Vt.
Kevin Terry Lee (B.A. Vassar Coll.), Calif.
Aaron Benjamin Lefland (B.S. Brandeis Univ.), Conn.
Melissa Anne Legge (A.B. Washington Univ.), Conn.
Jessica Leung (B.S. Univ. California [Davis]), Calif.
Zoe Cutting Lloyd (B.A. Haverford Coll.), Conn.
Rachel Sanford Lowenthal (B.A. Vassar Coll.), Md.
Allyza Rose Lustig (B.A. Barnard Coll.), N.Y.
Jared Andrew MacLane (B.A. San Francisco State Univ.), Conn.
Sanjna Aniruddha Malpani (B.S. St. Xavier's Coll. [India]), India
Ali Masoudi (B.S. Islamic Azad Univ.; M.S. Pohang Univ. Science and Technology), Republic of Korea

Kira Michelle McCall (B.S. Univ. California [Berkeley]), Calif.
Kathryn Ann McConnell (B.A. Wesleyan Univ.), Conn.
Logan Sean McCoy (B.S. Univ. California [Santa Barbara]), Calif.
Amir Chireh Mehr (B.A. Duke Univ.), New Zealand
Luke Lionel Menard (B.A. Amherst Coll.), Conn.
Michelle Mendlewicz (LL.B. Pontificia Univ. Católica [Rio de Janeiro]), Brazil
Oluwakemi Temitope Michael-Noah (B.S. Univ. Lagos), Nigeria
Katherine Allen Mixter (B.A. Vassar Coll.), N.Y.
Paul Molta (B.S., M.S. Univ. Rochester), Pa.
Irene Montes Londono (B.E. Univ. Los Andes), Conn.
Jordan Taylor Moore (B.A. Yale Univ.), Calif.
Joshua Wright Morse (B.A. Oberlin Coll.), Mass.
Caroline Muraida (B.A. Univ. New Mexico), N.Mex.
Lucyann Murray (B.A. Stanford Univ.), Conn.
Chandni Ahuja Navalkha (B.A. Cornell Univ.), N.J.
Erik Ndayishimiye (B.S. Rwandan National Univ.), Rwanda
Anja Nikolova (B.S. Pavia Univ.), Macedonia
Dickson Gathu Njunge (B.E.P.M. Kenyatta Univ.), Conn.
Lun Ou (B.S. Univ. Illinois [Urbana-Champaign]), China
Michele Victoria Palmer (B.S. Univ. Vermont), Calif.
Dana Marie Patterson (B.S. Fairleigh Dickinson Univ. [Madison]), N.J.
Leonora Genya Pepper (B.A. Smith Coll.), Mass.
Philip Burgess Picotte (B.A. Middlebury Coll.), Vt.
Maria Pozimski (B.S. Univ. Amsterdam), Germany
Julio Marcelo Prieto Mendez (LL.B. Univ. San Francisco [Quito]), Ecuador
Abhilasha Purwar (M.T. Inst. Technology Banaras Hindu Univ.), India
Kristin Nicolette Qui (B.S. St. John's Univ. [Queens]), Trinidad and Tobago
Ajit Rajiva (B.E. Manipal Inst. Technology; M.P.H. Sri Ramachandra Medical Coll.), India
Stephanie Mariko Ratte (B.A. Brown Univ.), Conn.
Brian Reed (B.E. Princeton Univ.), Conn.
Jessica Harvis Renny (B.A. Univ. Pennsylvania), N.J.
Britain L. Richardson (B.A. Univ. California [Santa Barbara]), Calif.
Ann Evans Robertson (B.A. Vassar Coll.), Ark.
Marisa A. Rodriguez-Mcgill (B.A. Colorado Coll.; MCRP Rutgers Univ.), N.J.
Catherine Alice Rothacker (B.A. Amherst Coll.), Wis.
Ariel Russ (B.A. Mount Holyoke Coll.), N.Y.
Adrien Militar Salazar (B.A. Univ. California [Berkeley]), Calif.
Sarah Lakshmi Sax (B.S. Univ. British Columbia), Conn.
Sara Elizabeth Schwartz (B.A. American Univ.), Conn.
Jessica P. Scott (B.S. Bucknell Univ.), Conn.
Ruth Cherono Sego (B.S. Kenyatta Univ.; M.A. Nairobi Univ.), Conn.
Benjamin Serrurier (B.A. Whitman Coll.), Wash.
Yi Shi (B.A., B.S. Univ. California [Berkeley]), Calif.
Rebecca Jeanne Shively (B.A. Univ. Oregon), Ore.

Sachi Singh (B.A. Claremont McKenna Coll.), India
Kyle Douglas Smith (B.S. George Washington Univ.), R.I.
Joya C. Sonnenfeldt (B.A. Williams Coll.), N.Y.
Preeth Srinivasaraghavan (B.A. New York Univ.), N.Y.
Katherine Rose Stege (B.E.D. Univ. Colorado [Boulder]), Colo.
Christina Kay Stone (B.S. Univ. Maryland [Univ. Coll.]), Conn.
Nadine Zamira Syarief (B.S. Univ. Indonesia; M.A. London School of Public Relations), Indonesia
Sara Rose Tannenbaum (B.S. Univ. California [Berkeley]), Calif.
Shu Tao (B.S. Nanjing Inst. Meteorology), China
Rebecca Suzanne Terry (B.S. Cornell Univ.), N.Y.
Trevor Andrew Chou Thompson (A.B. Harvard Univ.), N.Y.
Tudeng (B.A. Qinghai Normal Univ.; M.A. Silliman Univ.), China
Zachary Michael Turk (B.A. Boise State Univ.; M.S. Univ. California [Davis]), Conn.
Jayson Uppal (B.S. Tufts Univ.), Conn.
Lisa Marie Veliz (B.S. Univ. California [Berkeley]), Conn.
Vanessa Vytlacil (B.A. Shanghai International Studies Univ.; M.A. Univ. Connecticut), Conn.
Hannah Eliza Walchak (B.A., B.S. Rice Univ.), Calif.
Jiayu Wang (B.E., M.S. Tongji Univ.), China
Wenjun Wang (B.E. Tsinghua Univ.), China
Michael Eric Warady (B.A. Duke Univ.), Conn.
Maxwell W. Webster (B.A. Univ. Cincinnati), Ohio
Marissa Weiss (B.A. Franklin Marshall Coll.), N.Y.
Leana Michelle Weissberg (B.A. San Francisco State Univ.), Conn.
Lindsay Willard White (B.A. Duke Univ.), Conn.
Emily Alice Wier (B.S. Tufts Univ.), Calif.
Ewin Sofian Winata (B.E. Brawijaya Univ.), Indonesia
Alessandra Wingerter (B.A. St. Lawrence Univ.; J.D. Vermont Law School), N.Y.
Wei Xin (B.A. Smith Coll.), China
Runqin Xu (B.A. Wellesley Coll.), China
Jiani Yang (B.S. Beijing Forestry Univ.), China
Katherine Jane Young (B.S. Cornell Univ.), Wis.
Raja Muhammad Farrukh Zaman (B.A., M.S. Univ. Karachi), Pakistan

DOCTORAL DEGREES CONFERRED, DECEMBER 2016

Jesse Brodie Burkhardt (B.Mus. Portland State Univ.; M.E.M. Yale Univ.), Ore.
Marlyse C. Duguid (B.S. Univ. Connecticut [Storrs]; B.S. Univ. New Hampshire [Durham]; M.F. Yale Univ.), Conn.
Meredith Atwood Holgerson (B.S. Denison Univ.; M.S. SUNY [Syracuse]), Mass.
Ranran Wang (B.S. Nanjing Univ.; M.E.S. Yale Univ.), China
Qiubei Amy Zhang (B.A. Simon Fraser Univ.; M.A. McMaster Univ.), Canada

DOCTORAL DEGREES CONFERRED, MAY 2017

Martin Bouda (B.A. Univ. Pennsylvania; M.E.Sc. Yale Univ.), Czech Republic
Sarah Jasmine Hyman (B.A. Columbia Univ.; M.Sc. London School of Economics), Calif.
Alder Keleman Saxena (B.A. Scripps Coll.; M.E.S., M.A. Yale Univ.), Wash.

STUDENTS WORKING TOWARD MASTER'S DEGREES

Ellen Abramowitz (B.A. Brandeis Univ.), N.Y.
Caroline Acheatel (B.A. Univ. Pennsylvania), Calif.
Beryl Ajwang' (B.S. Nairobi Univ.), Kenya
Nikola Alexandre (B.A. Vassar College), N.C.
Judith Amsalem (B.S. Cornell Univ.), N.Y.
Joseph Ansu (B.A. Wesleyan Univ.), D.C.
Anne Arbuthnot (B.A. Mount Holyoke Coll.), D.C.
Margaret Barnes (B.S. Indiana Univ. [Bloomington]), Ind.
Esparza Barragan (B.A. Inst. Tecnológico Autónomo México), Mexico
Andrew Beck (B.A. Yale Univ.), Conn.
Anthony Bell (B.S. Utah Univ.), Utah
Asha Bertsch (B.S. Univ. Florida), Conn.
Coral Bielecki (B.S. Univ. Hawaii [Manoa]), Conn.
Nicholas Biemiller (B.S. Warren Wilson Coll.), N.Y.
Linus Blomqvist (B.A. Univ. Cambridge), United Kingdom
Diane Boston (B.A. Stanford Univ.; M.A. Univ. Pennsylvania), Conn.
Lauren Boucher (B.S. Univ. Oregon; M.Ed. George Mason Univ.), Conn.
Benjamin Bovarnick (B.A. Univ. Rochester), Calif.
Eve Boyce (B.A. Bates Coll.), Conn.
Jolisa Brooks (B.A. Michigan State Univ.), Mich.
Meredith Brown (B.S. Santa Clara Univ.), Ill.
Cendejas Calderon (B.S. Univ. Nacional Autónoma México), Mexico
Alejandra Gnecco Campo (B.A. Univ. Los Andes), Colombia
Bowen Chang (B.A. Univ. Pennsylvania), China
Caitlin Chiquelin (B.A. Brandeis Univ.), N.H.
Joanne Choly (B.S., M.A. Fairfield Univ.), Conn.
Yang Chu (B.A. Univ. Calif. [San Diego]; M.A. Massachusetts Inst. Technology), Calif.
Milberg Cillóniz (B.S. Univ. Nacional Agraria La Molina), Peru
Kathryne Cleary (B.A. Boston Univ.), Mass.
Maanya Condamoor (B.S. Univ. Calif. [Los Angeles]), Calif.
Gioia Connell (B.A. St. Andrews Univ.), United Kingdom
Joshua Constanti (B.S. Univ. Arizona), Conn.
Dakota Cooley (B.F.A. Univ. Texas [Austin]), Conn.
Corey Creedon (B.A. Bates College), Conn.
Pinillos Crespo (B.E. Univ. Valladolid; M.S. Univ. Santiago de Compostela), Spain
Emma Crow-Willard (B.A., B.S. Occidental Coll.), Colo.

Kevin Dahms (A.B. Dartmouth Coll.), Conn.
Gyan de Silva (B.S. Univ. Edinburgh), United Kingdom
Alexandra Deprez (A.B. Princeton Univ.), Costa Rica
Mark DeSantis (B.A. American Univ.), Conn.
Alexandra Dobles (B.S. Swinburne Univ. Technology), Australia
Emily Dolhansky (B.S. Richard Stockton Coll.), N.J.
Ross Donihue (B.A. Macalester Coll.), Calif.
Cara Donovan (B.A. Connecticut Coll.), Conn.
Shannon Dulaney (B.A. Univ. Calif. [San Diego]), Conn.
Adam Eichenwald (B.A. Bowdoin Coll.), Conn.
Luke Elder (B.A. Middlebury Coll.), Mass.
Kelechi Eleanya (B.S., M.S., Ph.D. Ibadan Univ.), Nigeria
Nathan Empsall (A.B. Dartmouth Coll.), Idaho
Siwei Fan (B.E. Tsinghua Univ.), China
Mary Felker (B.S. Univ. Calif. [Berkeley]), Tenn.
Adam Fishman (B.A. Wesleyan Univ.), N.Y.
Parfait Gasana (B.A. Univ. Connecticut; M.S. Univ. Massachusetts [Boston]), Conn.
David Gibson (B.A. Middlebury Coll.), Tex.
Genora Givens (B.A. Willamette Univ.), Calif.
Andrew Greaves (B.A. Connecticut Coll.), Conn.
Laura Green (B.A. Vassar Coll.), Mass.
Emily Greenbaum (B.A. American Univ.), Ariz.
Victoria Grieves (B.A. Hamilton Coll.), N.Y.
Lauren Griffith (B.A. Siena Coll.), N.J.
Maria Guevara (B.A., B.S. Univ. San Francisco [Quito]), Ecuador
Rachel Gulbraa (B.A. Univ. Calif. [Berkeley]), Calif.
Annie Guo (B.S. Univ. Southern Calif.), Ore.
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Sara Harari (B.S. Tufts Univ.), Mass.
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Jonathan Held (B.A. Bowdoin Coll.), Mass.
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Jeremy Hunt (B.A. Univ. Mass [Dartmouth]), Conn.
Tasneem Islam (B.A. Brandeis Univ.), Calif.
Jingjing Jiang (B.E. Tsinghua Univ.), China
Lucas Johnson (B.A. Stanford Univ.), Conn.
Samuel Jordan (B.S. Univ. Tennessee [Knoxville]), Tenn.
Sidney Jules (B.A., M.E. Univ. Cambridge), United Kingdom
Lucy Kessler (B.A. Colorado Coll.), Conn.
Carli Kierstead (B.S. Univ. Calif. [San Diego]), Calif.
Yookyung Kim (B.A. Arizona State Univ.), Republic of Korea
Kelly Kneeland (B.A. Colby Coll.), Mass.

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Yishen Li (B.S. Univ. Miami), China
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Samantha Maher (B.A. Univ. Texas [Austin]), Tex.
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Tess McNamara (A.B. Princeton Univ.), N.Y.
Brenda Meany (B.S. Bucknell Univ.), Conn.
Lydia Mendoza (B.A. Vassar Coll.), Conn.
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Rohini Mukherjee (B.S. Presidency Coll. [Calcutta]; M.S. Indian Inst. Technology [Bombay]), India
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Rachel Renne (B.A. New Coll. [Florida]), Conn.
Elizabeth Reville (B.A. Colby Coll.), Conn.
Jacob Reznick (B.A. Carleton Coll.), N.Y.
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Byron Ruby (B.A., B.S. Univ. Calif. [Berkeley]), Calif.
Badini Sanchez (B.S. Univ. British Columbia), Canada
Caroline Scanlan (B.S. Brown Univ.), Calif.
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Abigail Smith (B.A. Univ. Notre Dame), Conn.
Aidan Smith (B.A. Vassar Coll.), Vt.
Abigail Snyder (B.A. Dickinson Coll.), Md.
Esther Sosa (B.A. Bowdoin Coll.), N.Y.
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Natalie Spiegel (B.S. Univ. Calif. [Berkeley]), Conn.
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Perk Han Eugene Tan (B.A. Colorado Coll.), Malaysia
Eli Terris (B.A. Brandeis Univ.), Mass.
Brittany Thomas (B.A. Johns Hopkins Univ.), Va.
Sharada Vadlamani (B.A. Christ Univ.), India
Alexandra Vecchio (B.A. Loyola Univ. [Chicago]), Conn.
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Adam Walker (B.A. Yale Univ.), Mass.
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Kyle Ward (B.S. Cornell Univ.), Conn.
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Ziyun Ye (B.E. Tsinghua Univ.), China
Leehi Yona (A.B. Dartmouth Coll.), Canada
Yani Zeng (B.E. Tsinghua Univ.), China
Yuhan Zhang (B.S., B.E. Peking Univ.), China
Weiyang Zhao (B.S. Colorado State Univ. [Ft. Collins]), China
Santiago Zindel Mundet Cruz (B.A. Middlebury Coll.), Conn.

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Doctor of Philosophy

Kelly Aho (A.B. Dartmouth Coll.; M.E.S. Yale Univ.), Alaska
Adam Andis (B.S. Northland Coll.; M.S. Univ. Montana), Indiana
Matthew Baird Archer (B.A. Univ. Mississippi; M.S. London School Economics), Miss.
Erica Bergen Barth (B.A. Johns Hopkins Univ.; M.E.M. Yale Univ.), N.Y.
Alexandra Mochary Bergstein (B.A. Wesleyan Univ.; J.D. Univ. Chicago Law School), Conn.
Peter Berrill (B.E. National Univ. Ireland [Galway]; M.S. Univ. Karl-Franz), Ireland
Samara Meade Brock (B.A. Univ. Victoria; M.A. Univ. British Columbia; M.E.M. Yale Univ.), Canada
Robert Walter Buchkowski (B.S. Lakehead Univ.; M.E.Sc. Yale Univ.), Canada
Mary Burak (B.A. Providence Coll.), Mass.
Paul Burow (B.A. Univ. California [Davis]; M.E.S. Yale Univ.), Calif.
Katherine Burrows (B.A, M.P.H. Columbia Univ.), N.Y.
Tirthankar Chakraborty (B.E. West Bengal Univ. Technology; M.E. Indian Inst. Technology), India
Deepti Chatti (B.E. Osmania Univ.; M.S. Stanford Univ.), India
Chen Chen (B.S. Fudan Univ.; M.P.H. Johns Hopkins Univ.), China
Luisa Cortesi (B.A. Univ. Torino [Italy]; M.A. Univ. London), Italy
Wade Davis (B.A. Williams Coll.), Maine
Hao Deng (B.E., M.E. Tsinghua Univ.; M.S. Pennsylvania State Univ.), China
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Chelsea Elizabeth Judy (B.A. Chapman Univ.; M.P.P. Univ. Melbourne), Calif.
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Noah Sokol (B.S. Univ. Guelph), Canada
Mario Soriano (B.S. Univ. Philippines; M.S. United Nations Univ. [Japan]), Philippines
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Eleanor Catherine Stokes (B.A. Dartmouth Coll.; M.S. Massachusetts Inst. Technology), Ala.
Michael William Stone (B.A., M.S. Michigan State Univ.), Mich.
Megan Sullivan (B.S. Ohio State Univ.; B.A. Cleveland Inst. Art), Ohio

Timothy Michael Terway (B.L.A. Pennsylvania State Univ.; M.C.P. Massachusetts Inst. Technology), Pa.
Peter Mbanda Umunay (B.S. Univ. Kisangani; M.F.S. Yale Univ.), Democratic Republic of the Congo
Harikrishnan Venugopalan Nair Radhamoni (B.S. Kerala Agricultural Univ.; M.E.S. Yale Univ.), India
Lisa Christina Weber (B.A. Columbia Univ.; M.E.S. Yale Univ.), Va.
Paige Elizabeth Weber (B.A. Univ. California [Berkeley]; M.E.Sc. Yale Univ.), Calif.
Stephanie Margalit Weber (B.S. Stanford Univ.), Ill.
Paul Wolfram (B.S. Technische Univ. Dresden; M.S. Technische Univ. Berlin), Germany
Zhemin Xuan (B.S. Tongji Univ.; M.S. Univ. Central Florida), China
Jonghyun Yoo (B.A. Seoul National Univ.; M.E.S. Yale Univ.), Republic of Korea
Byungman Yoon (B.A. Univ. Washington; M.E.S. Yale Univ.), Republic of Korea
Lily Zeng (B.S. Queen's Univ. [Canada]; M.E.S. Yale Univ.), Canada
Yong Zhao (B.S. Peking Univ.; M.E.S. Yale Univ.), China
Wen Zhou (B.A. Columbia Univ.; M.E.M. Univ. Oxford), NY
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Law School Est. 1824. Courses for college graduates. Juris Doctor (J.D.). For additional information, please visit http://law.yale.edu, e-mail admissions.law@yale.edu, or call the Admissions Office at 203.432.4995. Postal correspondence should be directed to Admissions Office, Yale Law School, PO Box 208215, New Haven CT 06520-8215.

Graduate Programs: Master of Laws (LL.M.), Doctor of the Science of Law (J.S.D.), Master of Studies in Law (M.S.L.). Doctor of Philosophy (Ph.D.) awarded by the Graduate School of Arts and Sciences. For additional information, please visit http://law.yale.edu, e-mail gradpro.law@yale.edu, or call the Graduate Programs Office at

203.432.1696. Postal correspondence should be directed to Graduate Programs, Yale Law School, PO Box 208215, New Haven CT 06520-8215.

School of Engineering & Applied Science Est. 1852. Courses for college graduates. Master of Science (M.S.) and Doctor of Philosophy (Ph.D.) awarded by the Graduate School of Arts and Sciences.

For additional information, please visit http://seas.yale.edu, e-mail grad.engineering@yale.edu, or call 203.432.4252. Postal correspondence should be directed to Office of Graduate Studies, Yale School of Engineering & Applied Science, PO Box 208267, New Haven CT 06520-8267.

School of Art Est. 1869. Professional courses for college and art school graduates. Master of Fine Arts (M.F.A.).

For additional information, please visit http://art.yale.edu, e-mail artschool.info@yale.edu, or call the Office of Academic Affairs at 203.432.2600. Postal correspondence should be directed to Office of Academic Affairs, Yale School of Art, PO Box 208339, New Haven CT 06520-8339.

School of Music Est. 1894. Graduate professional studies in performance, composition, and conducting. Certificate in Performance, Master of Music (M.M.), Master of Musical Arts (M.M.A.), Artist Diploma (A.D.), Doctor of Musical Arts (D.M.A.).

For additional information, please visit http://music.yale.edu, e-mail gradmusic.admissions@yale.edu, or call the Office of Admissions at 203.432.4155. Postal correspondence should be directed to Yale School of Music, PO Box 208246, New Haven CT 06520-8246.

School of Forestry & Environmental Studies Est. 1900. Courses for college graduates. Master of Forestry (M.F.), Master of Forest Science (M.F.S.), Master of Environmental Science (M.E.Sc.), Master of Environmental Management (M.E.M.). Doctor of Philosophy (Ph.D.) awarded by the Graduate School of Arts and Sciences.

For additional information, please visit http://environment.yale.edu, e-mail fesinfo@yale.edu, or call the Office of Admissions at 800.825.0330. Postal correspondence should be directed to Office of Admissions, Yale School of Forestry & Environmental Studies, 195 Prospect Street, New Haven CT 06511.

School of Public Health Est. 1915. Courses for college graduates. Master of Public Health (M.P.H.). Master of Science (M.S.) and Doctor of Philosophy (Ph.D.) awarded by the Graduate School of Arts and Sciences.

For additional information, please visit http://publichealth.yale.edu, e-mail ysph.admissions@yale.edu, or call the Admissions Office at 203.785.2844.

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For additional information, please visit http://architecture.yale.edu, e-mail gradarch.admissions@yale.edu, or call 203.432.2296. Postal correspondence should be directed to the Yale School of Architecture, PO Box 208242, New Haven CT 06520-8242.

School of Nursing Est. 1923. Courses for college graduates. Master of Science in Nursing (M.S.N.), Post Master's Certificate, Doctor of Nursing Practice (D.N.P.). Doctor of Philosophy (Ph.D.) awarded by the Graduate School of Arts and Sciences.

For additional information, please visit http://nursing.yale.edu or call 203.785.2389. Postal correspondence should be directed to Yale School of Nursing, Yale University West Campus, PO Box 27399, West Haven CT 06516-0974.

School of Drama Est. 1925. Courses for college graduates and certificate students. Master of Fine Arts (M.F.A.), Certificate in Drama, One-year Technical Internship (Certificate), Doctor of Fine Arts (D.F.A.).

For additional information, please visit http://drama.yale.edu, e-mail ysd.admissions @yale.edu, or call the Registrar/Admissions Office at 203.432.1507. Postal correspondence should be directed to Yale School of Drama, PO Box 208325, New Haven CT 06520-8325.

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For additional information, please visit http://som.yale.edu. Postal correspondence should be directed to Yale School of Management, PO Box 208200, New Haven CT 06520-8200.

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Anastas, Paul	2008
Anisfeld, Shimon	2010
Ashton, Mark	2020
Bacher, Jessica	2030
Bell, Michelle	2035
Benoit, Gaboury	2040
Berlyn, Graeme	2050
Borak, Jonathan	2053
Bradford, Mark	2054
Brodersen, Craig	2072
Burke, Maureen	2075
Burroughs, Richard	2080
Caccone, Adalgisa	2090
Carpenter, Carol	2110
Cashore, Benjamin	2120
Chertow, Marian	2130
Clark, Susan	2140
Comita, Liza	2143
DeCew, Stuart	2153
Doolittle, Amity	2158
Dove, Michael	2160
Esty, Daniel	2180
Farrell, Justin	2185
Fenichel, Eli	2195
Galperin, Joshua	2202
Geballe, Gordon	2200
Gentry, Bradford	2210
Gillingham, Kenneth	2215
Graedel, Thomas	2230
Gregoire, Timothy	2240
Grim, John	2242
Hertwich, Edgar	2246
Kotchen, Matthew	2257
Kysar Douglas	2259
Lee, Xuhui	2260
Leiserowitz, Anthony	2263
Lifset, Reid	2270
Lussier, Paul	2278
Lyons, James	2280
Mendelsohn, Robert	2320
Mendez, Michael	2321
Oliver, Chadwick	2340

F&ES M.E.Sc./M.F.S. Thesis Research Numbers

Faculty	F&ES Thesis Research Number
Anisfeld, Shimon	3010
Ashton, Mark	3020
Bell, Michelle	3035
Benoit, Gaboury	3040
Berlyn, Graeme	3050
Bradford, Mark	3054
Brodersen, Craig	3072
Carpenter, Carol	3110
Cashore, Benjamin	3120
Chertow, Marian	3130
Clark, Susan	3140
Comita, Liza	3143
Doolittle, Amity	3158
Dove, Michael	3160
Esty, Daniel	3180
Farrell, Justin	3185
Fenichel, Eli	3195
Gillingham, Kenneth	3215
Gregoire, Timothy	3240
Hertwich, Edgar	3246
Kotchen, Matthew	3257
Lee, Xuhui	3260
Mendelsohn, Robert	3320
Oliver, Chadwick	3340
Raymond, Peter	3364
Saiers, James	3390
Schmitz, Oswald	3400
Seto, Karen	3408
Skelly, David	3420
Wargo, John	3470
Zimmerman, Julie	3500

F&ES Independent Study Courses

Faculty	F&ES Independent Study Course Number
Anastas, Paul	1008
Anisfeld, Shimon	1010
Ashton, Mark	1020
Bacher, Jessica	1030
Bell, Michelle	1035
Benoit, Gaboury	1040
Berlyn, Graeme	1050
Bradford, Mark	1054
Brodersen, Craig	1072
Burke, Maureen	1075
Burroughs, Richard	1080
Caccone, Adalgisa	1090
Carpenter, Carol	1110
Cashore, Benjamin	1120
Chertow, Marian	1130
Clark, Susan	1140
Comita, Liza	1143
Cort, Todd	1147
Dale, Lisa	1151
Daly, Douglas	1152
DeCew, Stuart	1153
Decker, Mary Beth	1155
Doolittle, Amity	1158
Dove, Michael	1160
Esty, Daniel	1180
Farrell, Justin	1185
Fenichel, Eli	1195
Ferrucci, Michael	1193
Galperin, Joshua	1202
Geballe, Gordon	1200
Gentry, Bradford	1210
Gillingham, Kenneth	1215
Graedel, Thomas	1230
Gregoire, Timothy	1240
Grim, John	1242
Hertwich, Edgar	1246
Klinkenborg, Verlyn	1256
Kotchen, Matthew	1257
Kysar, Douglas	1259
Lee, Roy	1262
Lee, Xuhui	1260
Leiserowitz, Anthony	1263

Lifset, Reid	1270
Lussier, Paul	1278
Lyons, James	1280
MacBroom, James	1290
Mendelsohn, Robert	1320
Mendez, Michael	1321
Michelangeli, Fabian	1325
Nordhaus, William	1337
Oliver, Chadwick	1340
Raymond, Peter	1364
Reuning-Scherer, Jonathan	1380
Reynolds, Kristin	1368
Robinson, Nicholas	1385
Saiers, James	1390
Saxena, Alark	1398
Schmitz, Oswald	1400
Seto, Karen	1408
Skelly, David	1420
Smith, Ronald	1430
Spalding, Deborah	1440
Strebeigh, Fred	1450
Toensmeier, Eric	1457
Tomlin, Dana	1460
Tucker, Mary Evelyn	1463
Tyrrell, Mary	1465
Vandebroek, Ina	1467
Vaughn, Sarah	1468
Vedder, Amy	1469
Wargo, John	1470
Weber, Albert William	1473
Yost, Peter	1490
Zimmerman, Julie	1500

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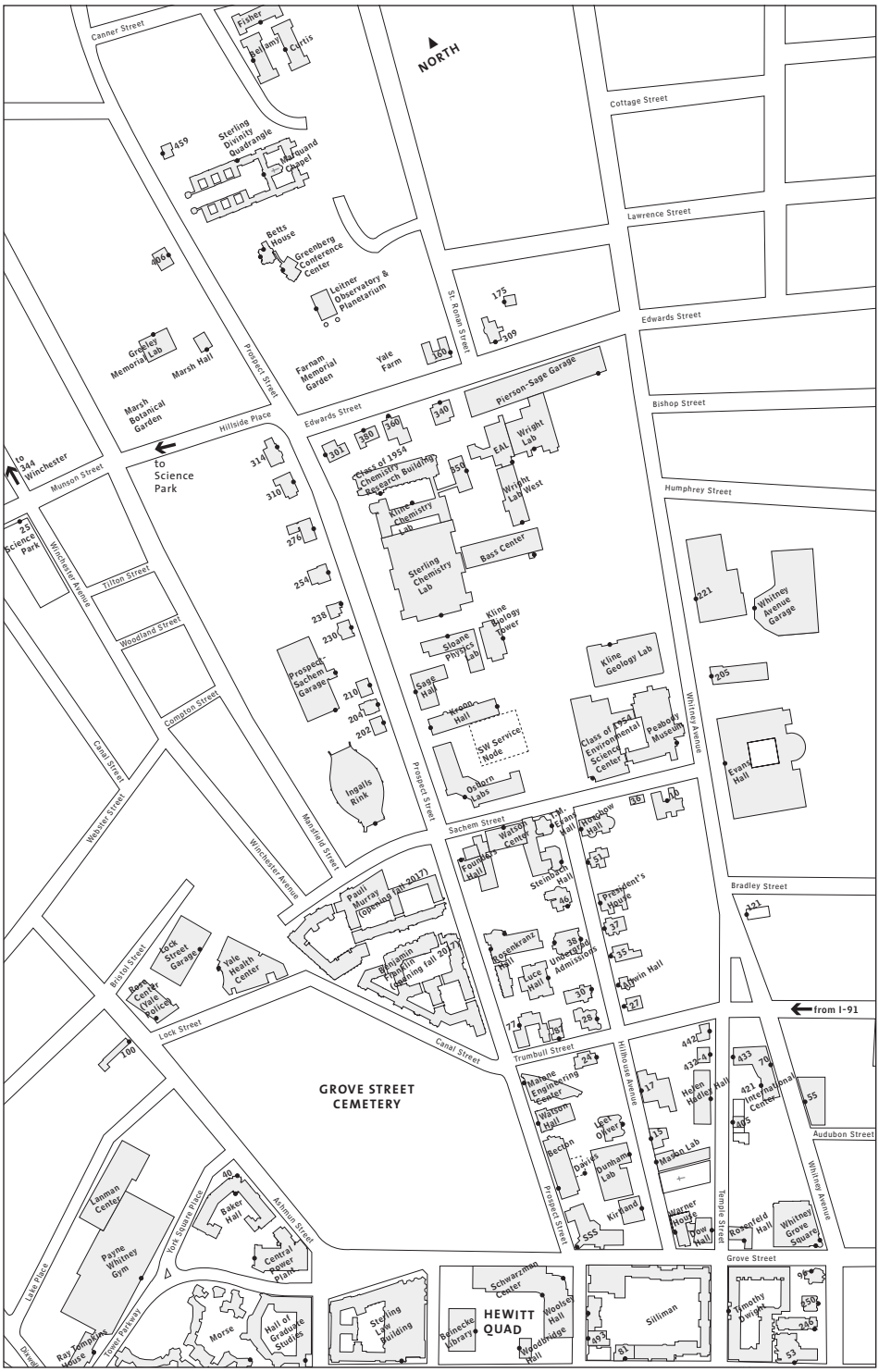

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University policy is committed to affirmative action under law in employment of women, minority group members, individuals with disabilities, and protected veterans.

Inquiries concerning these policies may be referred to Valarie Stanley, Director of the Office for Equal Opportunity Programs, 221 Whitney Avenue, 3rd Floor, 203.432.0849. For additional information, see www.yale.edu/equalopportunity.

Title IX of the Education Amendments of 1972 protects people from sex discrimination in educational programs and activities at institutions that receive federal financial assistance. Questions regarding Title IX may be referred to the University's Title IX Coordinator, Stephanie Spangler, at 203.432.4446 or at titleix@yale.edu, or to the U.S. Department of Education, Office for Civil Rights, 8th Floor, 5 Post Office Square, Boston MA 02109-3921; tel. 617.289.0111, fax 617.289.0150, TDD 800.877.8339, or ocr.boston@ed.gov.

In accordance with federal and state law, the University maintains information on security policies and procedures and prepares an annual campus security and fire safety report containing three years' worth of campus crime statistics and security policy statements, fire safety information, and a description of where students, faculty, and staff should go to report crimes. The fire safety section of the annual report contains information on current fire safety practices and any fires that occurred within on-campus student housing facilities. Upon request to the Office of the Deputy Vice President for Human Resources and Administration, PO Box 208322, 2 Whitney Avenue, Suite 810, New Haven CT 06520-8322, 203.432.8049, the University will provide this information to any applicant for admission, or prospective students and employees may visit http://publicsafety.yale.edu.

In accordance with federal law, the University prepares an annual report on participation rates, financial support, and other information regarding men's and women's intercollegiate athletic programs. Upon request to the Director of Athletics, PO Box 208216, New Haven CT 06520-8216, 203.432.1414, the University will provide its annual report to any student or prospective student. The Equity in Athletics Disclosure Act (EADA) report is also available online at http://ope.ed.gov/athletics.

For all other matters related to admission to the School of Forestry & Environmental Studies, please telephone the Admissions Office, 800.825.0330 or 203.432.5138, or e-mail fesinfo@yale.edu.

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