SUBJECTS OF INSTRUCTION

Courses offered by the School of the Environment 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. Courses with bracketed titles will not be offered during the 2021–2022 academic year.

In addition to offering courses in the traditional classroom setting, the School of the Environment 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 YSE 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.

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 the Environment, subject to limitations on class size and requirements for prerequisites.

COURSE DESCRIPTIONS

At YSE, new courses are often added after this bulletin is printed; and spring 2022 courses have not yet been scheduled. Our website at https://environment.yale.edu/courses will have an updated list, as well as a list of environmental courses available in other departments at Yale. See also Yale Course Search at https://courses.yale.edu.

ENV 511a, Ecological Foundations for Environmental Managers  Kealoha Freidenburg
This course gives students a fundamental mechanistic understanding about the way abiotic (e.g., climate) and biotic (e.g., resources, competitors, predators) factors determine pattern in the distribution and abundance of species. Students learn how individuals within a species cope with changing environmental conditions by altering their behavior, making physiological adjustments, and changing the allocation of resources among survival, growth, and reproduction. Students learn how populations of species coexist within communities and how species interactions within communities can drive ecosystem functioning. Students also learn how ecologists use scientific insight to deal with emerging environmental problems such as protecting biodiversity, understanding the consequences of habitat loss on species diversity, and forecasting the effects of global climate change on species population viability and geographic distribution. 1½ Course cr

ENV 512a, Microeconomic Foundations for Environmental Managers  Stephanie Weber
This six-week course provides an introduction to microeconomic analysis and its application to environmental policy. Students study how markets work to allocate scarce resources. This includes consideration of how individuals and firms make decisions, and how policy analysts seek to quantify the benefits and costs of consumption and production. We consider the conditions under which markets are beneficial to society and when they fail. We see that market failure arises frequently in the context of environmental and natural resource management. The last part of the course focuses on the design of environmental and natural resource policies to address such market failures. The course is designed to cover basic knowledge of economics analysis and prepare students for ENV 834 and other more advanced offerings. 1½ Course cr

ENV 521a, Physical Science Foundations for Environmental Managers  Shimon Anisfeld
This required foundational course provides students with the physical science basics that they need in order to understand and manage environmental problems. The course draws on the following disciplines: 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. 1½ Course cr

ENV 522a, Social Science Foundations for Environmental Managers  Amity Doolittle
The environmental social sciences shed light on how humans define, perceive, understand, manage, and otherwise influence the environment. Insights into the cultural, institutional, political-economic, and historic drivers of human actions are needed to describe and understand human-environment interactions as well as to move toward long-lasting and flexible responses to socio-environmental change. This basic knowledge course is designed to introduce students to a range of social science disciplines that are engaged in understanding the relationships between nature and society. Explicit focus is on how to mobilize the insights gained from environmental social sciences for natural resource management. 1½ Course cr

ENV 550a, Natural Science Research Methods  William Lauennroth
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. 3 Course cr

ENV 551a, Qualitative Social Science Research Methods  Amity Doolittle
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 with a focus on understanding the nexus of human-environment issues. 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—all with a strong emphasis on the relationship between people and natural resources. The final product for this course is a research proposal. 3 Course cr

**ENV 553a, Perspectives: Environmental Leadership**  Peter Boyd
The course is intended to offer a common experience and exposure to the variety of perspectives represented by YSE faculty and guest experts on the challenges and opportunities of environmental management. This year’s theme is Environmental Leadership, and over the term we create and foster a leadership toolkit and systems-thinking appreciation that enable first-year M.E.M. students to map out and maximize an impactful path through Yale, their careers, and their lives. 3 Course cr

**ENV 592a, Documentary Film Workshop**  Charles Musser
This workshop in audiovisual scholarship explores ways to present research through the moving image. Students work within a Public Humanities framework to make a documentary that draws on their disciplinary fields of study. Designed to fulfill requirements for the M.A. with a concentration in Public Humanities. 3 Course cr

**ENV 594a, Global Carbon Cycle**  A.Scott Denning
People are currently mining millions of years’ worth of stored photosynthetic carbon from the solid Earth and transferring it to the atmosphere, where it is profoundly changing the chemistry, physics, and biology of the atmosphere, land, and oceans. Exchanges with the oceans and land surface have been modified substantially, so that currently only about half of anthropogenic emissions remain in the atmosphere. These “carbon sinks” are poorly understood, contributing a great deal of uncertainty to future climate. We consider biogeochemical and transport processes in land ecosystems, the oceans, and atmosphere as well as anthropogenic emissions. We conclude with a study of changes in carbon cycling in the past and future, including predictions by coupled Earth System Models. 3 Course cr

**ENV 595a, Yale Environment Review**  Matthew Kotchen
The *Yale Environment Review* is a student-run publication that aims to increase access to the latest developments in environmental studies. We aim to shed light on cutting-edge environmental research through summaries, analysis, and interviews. During this 1-credit course, students produce one or two articles on subjects of their choosing for publication on the *YER* website. Please refer to our Canvas page for an overview of the different types of content that *YER* produces. Students receive coaching to improve their writing skills, and their work goes through a rigorous editing process. Participation in *Yale Environment Review* helps students sharpen their writing skills and familiarize themselves with science communication, and it provides a platform to showcase their expertise. Enrollment is limited to sixteen, and the class is selected through an application process. Application instructions can be found on our Canvas page. Please email environment.review@yale.edu with any questions. **Class meets five to six times throughout the term, dates to be announced. An information session will be held on a date to be determined.**

**ENV 602a, Ecosystems and Landscapes**  Mark Bradford
Concepts and their application in ecosystem and landscape ecology. Topics covered include biogeochemical cycling, food web interactions, biodiversity, and the abiotic and biotic controls that act on them. The course emphasizes how to integrate this knowledge to understand and manage ecosystem budgets. 3 Course cr

**ENV 603a, Environmental Data Visualization and Communication**  Simon Queenborough and Jennifer Marlon
Welcome to the Information Age! It is now much easier to generate and access more data than ever before. Yet, our ability to manage, analyze, understand, and communicate all this data is extremely limited. Visualization is a powerful means of enhancing our abilities to learn from data and to communicate results to others, especially when informed by insights into human behavior and social systems. Developing the quantitative skills necessary for analyzing data is important, but for addressing complex and often urgent environmental problems that involve diverse audiences, understanding how to communicate effectively with data is equally essential for researchers, policy makers, and the public alike. This course is for students who wish to gain an understanding of the principles, tools, and techniques needed to communicate effectively with data. Classes consist of short lectures about principles of design, data preparation, and visual communication; discussions about examples from the news and scientific literature; guest lectures; peer critiques; and hands-on individual and collaborative group activities. Throughout the term, we use Excel, PowerPoint, R, Tableau, and other tools to develop visualizations using diverse datasets. Students also work with a dataset of their own choice or from a partner organization to develop a final project consisting of a poster, infographic, report, dashboard, story map, or related product. Enrollment is limited and application is required. 3 Course cr

**ENV 604a, Social Entrepreneurship in Public Health**  Teresa Chahine
This is a case-based course about innovation and entrepreneurship for health equity, including racial equity and other drivers of health. COVID-19 has brought to light for many the complexities in drivers of health, and the role of entrepreneurship and cross-sectoral collaboration in eliminating health disparities. We examine cases of entrepreneurship for health equity in the United States and globally, using a research-based framework to analyze the role of innovation and design thinking, resource mobilization, financial viability, cross-disciplinary collaboration, and systems strengthening. 1½ Course cr

**ENV 605a, Environmental Risk Communication**  Andrew Schwarz
Risk communication is a critical but often overlooked part of how organizations identify and manage risks. Risk communication can help people take seriously risks that they might otherwise ignore (e.g., to wear a seatbelt or bicycle helmet, check for radon in their homes, evacuate from a coming hurricane). Risk communication can also provide reassurance when data indicate that a risk is not serious.
Effective risk communication enables environmental professionals to communicate information in a way that is understood and accepted by different stakeholders (e.g., the public, industry, government leaders, etc.) and allows the participation of these stakeholders in risk management decisions. This course provides an overview of the theory and practice of effective communication about environmental and health risks to diverse stakeholders. Students are expected to actively participate in class discussions, drawing upon assigned readings, lectures, and videos. 3 Course cr

ENV 606a, Methods in Climate Change and Health Research  Kai Chen
Climate change is recognized as one of the greatest public health challenges of the twenty-first century. This course takes multidisciplinary approaches to identify, assess, quantify, and project public health impacts of climate change and of measures to address climate change. It first introduces the fundamental principles of health impact assessment and gives a brief overview of the public health approaches to address climate change. Then it applies advanced data analysis methodologies in environmental epidemiology, including time-series analysis, spatial epidemiology, and vulnerability assessment, to characterize the present climate-health (exposure-response) relationships and to identify vulnerable populations. This course discusses key concepts of scenario-based climate projections and their applications in projecting future health impacts, evaluating health co-benefits of climate mitigation polices, and assessing climate change adaptation measures. Emphasis is placed on hands-on computer lab exercises with real-data examples and R scripts. 3 Course cr

ENV 617a, Real-World Environmental Data Science  Sarah McGowan and Elena Grewal
The goal of this course is to provide students with a foundational understanding of what it takes to perform environmental data work in a practical, professional setting. To make sound policy decisions, we need data, and the reality is that data is often messy, difficult to find, and incomplete. In order to effectively leverage the data, students need to be able to troubleshoot when there is a problem. We focus on understanding the mechanics and nuances of working with messy data in the professional setting, not teaching statistics. We provide a high-level explanation of methods, what they tell us, and how they are useful, and then focus on implementation. 3 Course cr

ENV 618a, Anthropology of Smallholder Agriculture in Developing Countries  Carol Carpenter
The premise of this course is that small-scale agriculture, its distinctive economic character, and its ecology shape each other in important ways. The course explores smallholder farming in the developing world through ethnographies. 3 Course cr

ENV 619a, Philosophical Environmental Ethics  Stephen Latham
This is a philosophical introduction to environmental ethics. The course introduces students to the basic contours of the field and to a small number of special philosophical problems within the field. No philosophical background is required or expected. Readings are posted on Canvas and consist almost entirely of contemporary essays by philosophers and environmentalists. The total reading load averages about three philosophy papers weekly—roughly sixty pages. Readings avoid environmental ethics topics that are treated in other Yale courses: e.g., religion and ecology, indigenous views of ecology, and all but a very little bit of environmental justice. 3 Course cr

ENV 633a, Critical Race Theory  Gerald Torres
This class studies critical race theory from its origins to its current expression. Understanding the deep interconnections between race and law, and how race and law are co-constitutive, is the project of critical race theory. One of the central claims of critical race theory is that racial subordination is not a deviation from the liberal legal ideal but is, unfortunately, part of its expression. We focus on the origins of the critique that is central to the development of the theory and contrast its analysis with conventional analytic frameworks on race and American law and society. Because it is a positive theory but also driven by a normative vision, we explore the possibility of transforming the relationship between law and racial power. The law is not the only site of critical race theory; it has had a significant impact on other disciplines in the social sciences. We examine those impacts as well. 3 Course cr

ENV 641a, Market-Based Mechanisms for Water Management  Sarah Kruse and David Pilz
This is an online course with remote, live instruction, designed to teach students the essential theoretical components and practical application of using voluntary water rights transactions to reallocate water to environmental purposes. The course primarily focuses on environmental water transactions (EWTs) in the context of water law in the western United States, though the riparian doctrine and other water management regimes are also discussed. Historically, water law and policy in the western United States prioritized irrigation and other economic uses that required diverting water from rivers, often leaving important ecosystems with zero or very little water to support in-situ values. EWTs are an increasingly utilized market-based mechanism for rebalancing water use, and they also provide a template for reallocating water supply to help society adapt to a rapidly changing climate. 3 Course cr

ENV 645a, Urbanization, Global Change, and Sustainability  Karen Seto
Urbanization and associated changes in human activities on the land (land use) and in the physical attributes of Earth’s surface (land cover) have profound environmental consequences. Aggregated globally, these effects constitute some of the most significant human impacts on the functioning of Earth as a system. This course examines the interactions and relationships between urbanization and global change at local, regional, and global scales with an emphasis on the biophysical aspects of urbanization. Topics include urbanization in the context of global land use change, habitat and biodiversity loss, modification of surface energy balance and the urban heat island, climate change and impacts on urban areas, urban biogeochemistry, and urbanization as a component of sustainability. Emphasis is on management of urban areas worldwide or at national scales for planetary sustainability. 3 Course cr

ENV 646a, Foundations of Agriculture and Environment  Stephen Wood
Agricultural systems have a profound impact on the environment, but also depend on environmental processes—such as climate and nutrient cycling—for continued productivity. Because of this two-way relationship, there has been a growing integration of environmental and agricultural sciences over the past several decades with growing recognition that designing and implementing agricultural systems that minimize environmental harm and benefit people is necessary to sustainable development. This course provides
foundational knowledge of how agricultural and environmental systems are linked. The goal is to provide theoretical understanding of the important environmental and human processes, as well as practical experience interpreting these processes and applying them to real-world scenarios. 3 Course cr

ENV 654a, Structure, Function, and Development of Trees  Graeme Berlyn
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. 3 Course cr

ENV 660a, Forest Dynamics  Marlyse Duguid
This course introduces the study of forest stand dynamics—how forest structures and compositions change over time with growth and disturbances. Understanding the dynamic nature of forest stands is important for creating and maintaining a variety of critical ecosystem services sustainably and synergistically, including sustainable supplies of wood products, biodiversity and wildlife habitats, water, fire protection, and others. Through readings, lectures, discussions, and field trips we explore forest development processes and pathways, concentrating on the driving mechanisms and emergent properties including natural and human disturbances. We make use of New England forests as living laboratories while discussing how similar forest patterns and processes are played out throughout the temperate, tropical, and boreal worlds. This course 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. 3 Course cr

ENV 671a, Temperate Woody Plant Taxonomy and Dendrology  Marlyse Duguid
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 more than 120 individual species of woody plants using common morphological and ecological traits used for field identification. Dendrology is by nature context-specific, so this course has a focus on North American forest species, primarily of eastern North America. In addition, we use phylogenetic systematics as the structure for understanding taxonomy and the evolutionary history and relationships between species. Enrollment limited to thirteen. 3 Course cr

ENV 679a, Plant Ecophysiology  Craig Brodersen
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 (ENV 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. Enrollment limited to twenty-four. 3 Course cr

ENV 679a, Plant Ecophysiology  Craig Brodersen
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 (ENV 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. Enrollment limited to twenty-four. 3 Course cr

ENV 692a, Science and Practice of Temperate Agroforestry  Joseph Orefice
This course explores the science and practices of temperate agroforestry, covering current knowledge of agroforestry science and shedding light on the myths and assumptions that have yet to be tested regarding the integration of trees in agricultural systems. The course begins with an overview of modern agriculture to help us better understand why agroforestry systems have potential to improve the sustainability of farming systems. We also cover the social science regarding agroforestry and why it has not been widely adopted. Silvopasture and forest farming systems are the primary focus, but windbreaks, alley cropping, and riparian forest buffers are also covered. The field of agroforestry has struggled with the promotion of hypothetical practices; this course introduces students to real-world production agroforestry systems and helps them better contribute to financially viable and environmentally sound agricultural operations. 3 Course cr

ENV 701a, Climate Change Policy and Economics  Robert Mendelsohn
The seminar reviews the economic and scientific framework and the facts that underlie efficient mitigation and adaption decisions concerning climate change. The course then focuses on the key uncertainties and value judgments that make managing climate change complicated and controversial. Prerequisites: econometrics and relevant courses in economics. 3 Course cr

ENV 704a, Workshop on Remote Sensing and Photogrammetry with Drones  Xuhui Lee
A workshop that explores the current state and future outlook of remote sensing 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, flood 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 super-high-resolution spectral data acquired by fixed-wing drones; (3) cross-validating drone products against Lidar data and satellite imagery. Students may also have the opportunity to participate in drone flight missions. Data analysis, presentation, literature critique, field trips. Prerequisite: ENV 726 or equivalent experience.

ENV 705a, Current Topics in Global Climate Change  A. Scott Denning
People are currently mining millions of years’ worth of stored photosynthetic carbon from the solid Earth and transferring it to the atmosphere, where it is profoundly changing the chemistry, physics, and biology of the atmosphere, land, and oceans. Exchanges with
the oceans and land surface have been modified substantially, so that currently only about half of anthropogenic emissions remain in
the atmosphere. These “carbon sinks” are poorly understood, contributing a great deal of uncertainty to future climate. We consider
biogeochemical and transport processes in land ecosystems, the oceans, and atmosphere as well as anthropogenic emissions. We conclude
with a study of changes in carbon cycling in the past and future, including predictions by coupled Earth System Models.  3 Course cr

ENV 707a, Introduction to Environmental Chemistry  Gaboury Benoit
Introduction to environmental chemistry and to the nature and behavior of environmental pollutants, including chemical, biological,
and physical processes. The fundamental classes of chemical reactions in the environment; critical analysis of chemical data; sampling
techniques; analytical methods; natural biogeochemical controls on environmental chemistry. Case studies examine contaminants of
special interest such as acid precipitation, nutrients, and sewage. Prerequisite: college-level general chemistry.  3 Course cr

ENV 712a, Water Management  Shimon Anisfeld
An exploration of water 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 engineering, legal, economic, and behavioral solutions.
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; water justice; impacts of climate change and land use change; storm water
management; dams and other technologies for water management; human impacts on aquatic ecosystems; water and energy; water
economics; water rights; water conflict and cooperation.  4 Course cr

ENV 723a, Wetlands Ecology, Conservation, and Management  Kealoha Freidenburg
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 their impact on global climate. Additionally, wetlands are linchpin 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.  3 Course cr

ENV 724a, Watershed Cycles and Processes  James Saiers
Everyone lives in a watershed, an area of land that funnels rainfall and snowmelt to a stream, river, lake, or section of coastline. This
course examines watershed processes that affect, or are affected by, the stocks, flows, and quality of freshwater. It also surveys challenges
faced by watershed managers, while emphasizing the science that informs their choices. By drawing from the fields of hydrology,
ecology, and chemistry, the course begins by investigating cycles that govern the fates of water, nutrients, carbon, and pollutants within
watersheds. This basic knowledge underpins watershed management decisions that are, for example, intended to safeguard drinking-
water quality, ensure sustainable freshwater consumption, and preserve ecosystem services that depend on healthy riparian corridors.
In coordination with treatments of watershed functions, the course explores the impacts of anthropogenic stresses on freshwater flows,
water quality, and the ecology of sensitive watershed ecosystems. The course also covers measurements, models, and other tools used in
watershed assessment and case studies of science-based watershed planning and adaptive management.  3 Course cr

ENV 728a, Introduction to Statistics and Data Analysis in the Environmental Sciences  Jonathan Reuning-Scherer
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 YSE, and it presents statistical methods used in many Yale courses in both the natural and social sciences. Three hours
lecture.  3 Course cr

ENV 738a, Wildlife Movement Ecology  Nyeema Harris
On a crowded planet, wildlife must navigate myriad externalities coupled with intrinsic life history characteristics that influence their
movement patterns. Students evaluate this crucial animal behavior at different temporal and spatial scales using theoretical, empirical,
and experimental approaches as well as draw connections to human societies and landscape histories.  3 Course cr

ENV 747a, Global Communication Skills  William Vance
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.  3 Course cr

ENV 750a, Writing the World  Verlyn Klinkenborg
This is a practical writing course meant to develop the student's 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. 3 Course cr

**ENV 753a, Regression Modeling of Ecological and Environmental Data** Timothy Gregoire
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. Three hours lecture. Statistical computing with R, weekly problem exercises. Prerequisite: a course in introductory statistics. 3 Course cr

**ENV 756a, Modeling Geographic Objects** Charles Tomlin
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 ENV 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. 3 Course cr

**ENV 757a, Data Exploration and Analysis** Ethan Meyers
Survey of statistical methods: plots, transformations, regression, analysis of variance, clustering, principal components, contingency tables, and time series analysis. The R computing language and web data sources are used. 3 Course cr

**ENV 759a, Power, Knowledge, and the Environment: Social Science Theory and Method** Michael Dove
Course on the social scientific contributions to environmental and natural resource issues, emphasizing equity, politics, and knowledge. Section I, introduction to the course. Section II, disaster and environmental perturbation: the social science of emerging diseases; and the social origins of disaster. Section III, boundaries: cost and benefit in the Green Revolution; riverine restoration; and aspirational infrastructure. Section IV, methods: working within development projects, and rapid appraisal and consultancies. Section V, local communities, resources, and (under)development: representing the poor, development discourse, and indigenous peoples and knowledge. This is a core M.E.M. specialization course in YSE and a core course in the combined YSE/Anthropology doctoral degree program. Enrollment capped. 3 Course cr

**ENV 764a, Sociology of Sacred Values: Modernity, Ecology, and Policy** Justin Farrell
This course equips students to understand how moral culture shapes all environmental issues and management, driving even the most basic decisions that on the surface may appear to be entirely obvious, rational, or scientific. Modern people and modern institutions are propelled toward certain ends and possibilities that are inescapably rooted in questions of human culture about who we are, what we should do, and why it all matters. The first half of the course draws on theoretical readings from sociology, philosophy, and religious studies to understand the ubiquity of sacred codes and how they work, with an emphasis on late modernity, rationality, capitalism, and the sacred/profane. The second half of the course introduces recent case studies to see in practice how moral values are embedded in environmental work, including policy making, advocacy, the free market, scientific research, race and class, death and extinction, ecotourism, and more. Cultivating a lens to see culture and moral values in all things will improve students’ applied work in all sectors. 3 Course cr

**ENV 773a, Air Pollution Control** Drew Gentner
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. 3 Course cr

**ENV 775a, Federal Indian Law** Gerald Torres
This course covers the basics of federal Indian law. It does not address the substantive content of tribal law. Tribal law is a specialized study arising from the exercise of the legal authority that the tribes retain. This course is designed to lay the groundwork for a deep understanding of what kinds of sovereignty Indian nations may exercise within the framework of our legal system. Normally, courses of this type begin with a historical exploration of the foundations of the relations between Indian and non-Indian peoples. Instead, we begin with questions that are current and sketch out, roughly, where we are now. Typically, we start with cases pending before or recently decided by the Supreme Court. We use the Marshall Trilogy to build from the present back to the origins to see how the doctrines reflect the positive aspects of the legal expression of contact between Europe and the native nations of the Western hemisphere as well as the more malign aspects. We do not neglect the history – it proves critical for understanding the ways in which federal Indian law is sui generis in domestic jurisprudence – but we see how that history is always haunted by the specter of colonialism, extra-legality, and finally international legal norms. Self-scheduled examination or paper option. Students are required to attend the first day of class. 3 Course cr

**ENV 777a, Water Quality Control** Jaehong Kim
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. 3 Course cr
ENV 793a, Climate Change, Societal Collapse, and Resilience  Harvey Weiss
Collapse documented in the archaeological and early historical records of the Old and New Worlds, including Mesopotamia, Mesoamerica, the Andes, and Europe. Analysis of politico-economic vulnerabilities, resiliencies, and adaptations in the face of abrupt climate change, anthropogenic environmental degradation, resource depletion, “barbarian” incursions, or class conflict.  3 Course cr

ENV 803a, Green Markets: Voluntary and Information Approaches to Environmental Management  Matthew Kotchen
Two observations provide motivation for this seminar. First, voluntary- and information-based approaches to environmental management are becoming increasingly common. Environmental managers should thus be familiar with the approaches, along with their advantages and limitations. Second, students, advocates, and managers are often searching for ways outside of formal regulatory contexts to promote more pro-environmental behavior. There exists a sizable academic literature on the subject, but rarely is it covered in courses on environmental management. The seminar is based on critical readings of original research papers with an eye toward real-world application. We consider both theoretical and empirical studies. In addition to focusing on results, students learn about how different research methods are appropriate for answering different types of questions. Readings span economics, psychology, and political science. Classes are, for the most part, based on structured discussion, rotating responsibility for presentation and critique. A preliminary list of topics to be covered includes: Public Disclosure Strategies for Pollution Control; Behavioral Responses to Environmental and Resource Information; Conservation Behavior Part I: “Doing One’s Part”; Conservation Behavior Part II: “Doing More than One’s Part”; Eco-labeling; Voluntary Environmental Programs; Corporate Social Responsibility and the Environment; Insights of Behavioral Economics and Psychology. Students with prior experience in economics and/or statistics are given priority for enrollment.  1½ Course cr

ENV 804a, Economics of Natural Resources  Robert Mendelsohn
Linking of abstract economic concepts to concrete policy and management decisions. Application of theoretical tools of economics to global warming, pollution control, fisheries, water management, forestry, recreation, and mining.  3 Course cr

ENV 805a, Seminar on Environmental and Natural Resource Economics  Kenneth Gillingham and Matthew Kotchen
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.  1½ Course cr

ENV 807a, Business and Environment: Management and Strategy  Marian Chertow
This survey course focuses on the policy and business logic for making environmental issues and sustainability a core focus of corporate strategy and management. Students are asked to analyze when and how sustainability leadership can translate into competitive advantage by helping to cut costs, reduce risk, drive growth, and promote brand identity and intangible value. The course combines lectures, case studies, and class discussions on management theory and tools, the legal and regulatory frameworks that shape the business-environment interface, and the evolving role of business in society, including how to deal with a world of diverse stakeholders, increasing transparency, and rising expectations related to corporate environmental, social, and governance (ESG) performance. Self-scheduled examination.  3 Course cr

ENV 814a, Energy Systems Analysis  Narasimha Rao
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 participate effectively in policy debates. 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. Participation in extra-credit skill development exercises (presentations, fact-finding missions, etc.) is encouraged. Invited outside speakers complement topics covered in class.  3 Course cr

ENV 816a, Electric Utilities: An Industry in Transition  Lawrence Reilly
The U.S. electric utility industry is a $400 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.  3 Course cr

ENV 817a, Urban, Suburban, and Regional Planning Practice  David Kooris
Our cities, towns, and regions represent the cumulative impact of planning policies implemented at multiple scales over the past 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. It looks at both suburban and urban approaches. The recent deep recession, climate change, and a lack of social cohesion call for a new triple bottom-line approach to decision-making for our future. Existing policies and governance structures are not always well suited for the new challenges and opportunities that we face. Local, state, and the national government are, to varying degrees, crafting new solutions to the challenges of urban and suburban America. 1½ Course cr

**ENV 822a, Strategic Communication: Delivering Effective Presentations**  Taly Reich

The focus of this half-term course is to increase students’ competencies in oral communication and presentation. Developing and executing effective communication strategies is essential in a variety of business settings. Business leaders are often expected to present their message with confidence and clarity to employees, clients, partners, investors, and the public. This highly interactive, practical course helps students develop confidence in public speaking through weekly presentations and assignments, lectures and discussions, guest speakers, simulated activities, and filmed feedback. Students are given the opportunity to present both individually and as part of a team. We explore the essentials of communication strategy and persuasion: audience analysis, message construction, communicator credibility, and delivery. Students at all levels of mastery of public speaking will benefit from this course. Limited enrollment. YSE students must submit a statement of interest to the instructor. Students are required to attend the first class session in order to remain enrolled in or bid for the course. 1½ Course cr

**ENV 824a, Environmental Law and Policy**  Robert Klee

This course provides an introduction to the legal requirements and policy underpinnings of the basic U.S. environmental laws, including the Clean Air Act, Clean Water Act, and various statutes governing waste, food safety, and toxic substances. Students examine and evaluate current approaches to pollution control and resource management as well as the “next generation” of regulatory strategies, including economic incentives, voluntary emissions reductions, and information disclosure requirements. This course investigates mechanisms for addressing environmental issues at the local, regional, and global levels, and explores the intersection between environmental and energy law and policy. Students gain an understanding of overarching legal and policy concepts, such as federalism, administrative procedure, separation of powers, environmental justice, judicial review, and statutory interpretation. 3 Course cr

**ENV 826a, Foundations of Natural Resources Policy and Management**  Susan Clark

This is a research seminar focused on the foundations of natural resources policy and management and designed for students in any subfield of environmental studies or other disciplines. The seminar’s purpose is to help students improve their skills in thinking more effectively and acting more responsibly in complex management and policy cases. The seminar explores comprehensive and integrated (interdisciplinary) concepts and methods for thinking about problems in natural resources policy and management and proposing solutions to them. Once students gain familiarity with the core concepts and methods of standpoint clarification and problem orientation, they apply them to particular issues in natural resources policy and management. Each student, alone and in collaboration with a group, is responsible for researching a particular problem. Each student circulates a draft of their paper to other seminar participants and lectures on and leads discussion of it in a class session. It is hoped that papers of sufficient quality will be published. Each student is also required to engage in course exercises outside of class and in in-class dialogue on a weekly basis. The seminar is designed to lay the foundation for all future work and for all other policy courses. Enrollment limited to eighteen; application required. 3 Course cr

**ENV 827a, Animal Law**  Staff

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. Follows Law School calendar. 2 Course cr

**ENV 835a, Seminar on Land Use Planning**  Jessica Bacher

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 equitable housing, energy, 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 and urban planning and their associated ecological implications. Numerous land use strategies are discussed, including identifying and defining climate change mitigation and adaptation strategies, including affordable housing, community revitalization, energy development and siting, equitable community engagement, transit-oriented development, building and neighborhood energy conservation, distressed building remediation, jobs and housing balance, coastal resiliency, and biological carbon sequestration. The course also explores how recent events impact these planning issues. The focus is on exposing students to the basics of land use and urban planning, especially in the United States but also internationally, and serving as an introduction for a YSE curricular concentration in land use. Guest speakers are professionals involved in sustainable development, land conservation, smart growth, renewable energy, and climate change management. 1½ Course cr
ENV 836a / ANTH 541a / HIST 965a / PLSC 779a, Agrarian Societies: Culture, Society, History, and Development  Kalyanakrishnan Sivaramakrishnan and Marcela Echeverri Munoz
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 transformations of rural society. Team-taught.  3 Course cr

ENV 840a, Climate Change Policy and Perspectives  Daniel Esty
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.  3 Course cr

ENV 850a, International Organizations and Conferences  Gordon Geballe
This course focuses on the historic, present, and future roles of international environmental conferences. Through guest speakers, assigned readings, and discussions, students explore conferences including IUCN's World Conservation Congress, the UN's Convention on Biological Diversity, UNFCCC's climate change conference, the UN Environment Programme (UNEP), and the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). Students, along with visiting alumni and guest speakers, discuss the roles and impacts of the various conferences in international environmental decision-making and the future of international conferences in a post-COVID world. The course also assesses the potential for improved equity, justice, and inclusion in international conferences, organizations, and their secretariats. Students attending fall conferences (in person or virtually) develop work plans to be completed during the conference under the guidance of their host delegations and the instructor.  3 Course cr

ENV 878a, Climate and Society: Past to Present  Michael Dove
Seminar on the major traditions of thought regarding climate, climate change, and society, drawing largely on the social sciences and humanities. Section I, introduction to the course. Section II, disaster: the social origins of disaster; and the attribution of societal “collapse” to extreme climatic events. Section III, causality: climatic perturbation as revelatory; the politics of weather/climate control; and nineteenth–twentieth-century theories of environmental determinism. Section IV, history and culture: explaining differences among people in terms of differences in climate; and western vs. non-western views of climate. Section V, knowledge: folk knowledge of climate; and local views of climatic perturbation and change. Section VI, politics: climatic change and perturbation in national politics; and contesting global views of climate change. The goal of the course is to clarify the historical, cultural, and political drivers of climate change debates and discourses. Enrollment capped.  3 Course cr

ENV 884a, Industrial Ecology  Yuan Yao
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 (White 1994). 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 and at multiple scales; 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.  3 Course cr

ENV 894a, Green Building: Issues and Perspectives  Peter Yost and Melissa Kops
Our built environment shapes the planet, our communities, and each of us. Green buildings seek to minimize environmental impacts, strengthen the fabric of our cities and towns, and make our work and our homes 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 the 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 takes a “joint-discovery” approach with substantial emphasis on research and group project work, some fieldwork, and online individual testing. There are too many topics within green building to cover in one term, so the course is broken down into two sections. The first six weeks focus on the following topics, led by the instructor and/or an expert guest lecturer: building science, materials, indoor environmental quality, rating programs and systems, resilience, systems integration. The second half of the course focuses on selected topics driven by students and their particular interest/academic focus. The class meets once a week, with the instructor available to students that same day. Enrollment limited to twenty-four.  3 Course cr

ENV 898a, Environment and Human Health  Michelle Bell
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 weather, air pollution, greenspace, environmental justice, and occupational health. Other topics include environmental ethics, exposure assessment, 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 on the environment and human health. The course incorporates lectures and discussion.  3 Course cr

ENV 900a, Doctoral Student Seminar and Responsible Conduct of Research  Oswald Schmitz
This course provides the foundation for doctoral study at the School of the Environment. Students learn what it means to do scholarly research as well as become adept with philosophy of science and research methodology and proposal writing, as a basis for exploring diverse approaches to formulating and addressing research questions. Students work with their advisers to put these concepts and principles into practice to develop the basis for their dissertation research (including building bibliography, identifying and crafting research questions, formulating research hypotheses, and drafting a research proposal). Students further learn about funding opportunities and procedures for submitting grants. The course also covers professional ethics and responsible conduct of research, including ethical approaches to inquiry and measurement, data acquisition and management, authorship and publication, peer review, conflicts of interest, mentoring, collaborative research, and animal and human subjects research. Finally, the course explores ethical ways to advocate for the application of scholarly knowledge in the interest of environmental problem solving. Weekly assigned readings support concepts and issues addressed in class. Students present their embryonic research ideas in class and use feedback from the group to further develop their ideas.  3 Course cr

ENV 902a, Environmental Anthropology Research Lab  Michael Dove
A biweekly seminar for Dove doctoral advisees and students in the combined YSE/Anthropology doctoral program. Presentation and discussion of grant proposals, dissertation prospectuses, and dissertation chapters; trial runs of conference presentations and job talks; discussion of comprehensive exams, grantsmanship, fieldwork, data analysis, writing and publishing, and the job search; and collaborative writing and publishing projects.  3 Course cr

ENV 907a, Justice, Equity, Diversity, and Sustainable Laboratory Seminar  Dorceta Taylor
This course is only open to students who are working in the Justice, Equity, Diversity, and Sustainability Initiative (JEDSI) Lab. The course examines food insecurity; inequities in access to fresh, healthy, and affordable foods; and disparate impacts arising from exposure to environmental hazards. Students also examine issues such as energy and health justice, as well as the distribution of and access to environmental amenities such as parks and open space.  3 Course cr

ENV 953a, Sustainable Business Capstone Consulting Clinic  Peter Boyd
This course provides students with a capstone experience, consulting to established organizations confronting real-life challenges at the intersection of business and environmental sustainability. Students apply tools and insights gained in this and other courses, including ENV 553, to a defined project, creating deliverables that will be useful to the partner organizations. The course is designed to help prepare anyone who wishes to become a consultant after graduation, though it is also intended to be useful for those who plan to engage with consultants in their career post-Yale. Client briefs are topical and relevant to challenges and opportunities faced by their organizations, and intersect business and environmental opportunity. They are also likely to surface potential trade-offs and require addressing cross-cutting critical issues of justice, equity, diversity, and inclusion—all complicated by living through, and emerging from, the pandemic. Clients are on hand to provide insight and guidance at points throughout the term. Through a combination of individual and group work and lively discussion, students establish an understanding of the client’s wider purpose and priorities; then help co-define and connect the potential success of the project with the organization’s broader goals. Students work together in small consulting teams, holding each other accountable to perform and creating defined deliverables for the client.  3 Course cr

ENV 954a, Management Plans for Protected Areas  P Mark Ashton
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. Ten days fieldwork. Enrollment limited to twenty. Must also register for ENV 957, Field Skills in Land Stewardship. Prerequisite: ENV 659 or permission of the instructor.  3 Course cr

ENV 955a, Seminar in Research Analysis and Communication in Forest Ecology  P Mark Ashton
A seminar for students in their second year working on research projects. Students start by working through the peer-review publication process. They identify the scope and scale of the appropriate journal for their work. They then work on their projects, which comprise data and projects in applied forest ecology. Discussions involve rationale and hypothesis testing for a project, data analysis techniques, and 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. Extensive training in writing and presenting work is provided. Enrollment limited to twelve. Prerequisite: ENV 659 or permission of the instructor.  3 Course cr

ENV 957a, Field Skills in Land Stewardship  P Mark Ashton
An intensive technical and field ecology seminar that is taught in combination with ENV 954. In this course students learn field skills that contribute to the base set of information used in assessment, planning, prescription writing, and management of forest and open space. Students learn to identify plants; interpret surficial geology, soils, and hydrology; and read the land for use history. Assessments learned in a series of field exercises comprise forest health and invasive surveys, wildlife habitat evaluations, and soil surveys and wetland delineation. This culminates in understanding and developing a site classification. Lastly, students learn field inventory and sampling techniques in data collection for soils, geology, plants, and wildlife habitat.  3 Course cr
ENV 959a, Clinic in Climate Justice, Law, and Public Health  Laura Bozzi
This course is an innovative collaboration between Yale School of Public Health and Vermont Law School and includes faculty and students from both Yale and Vermont Law School. In the course, interdisciplinary student teams carry out applied projects at the intersection of climate justice, law and public policy, and public health. Each team works with a partner organization (e.g., state agency, community organization, other nongovernmental organization) to study, design, and implement a project, typically through community-based participatory research practices. The course affords the opportunity to have a real-world impact by applying concepts and competencies learned in the classroom. Class sessions and team meetings are conducted using a hybrid approach that combines in-person, all-virtual, and virtually connected classroom arrangements. This course should be of interest to graduate and professional students across the University and is open to Yale College juniors and seniors. In addition, this course is one of the options available to students to fulfill the practice requirement for the M.P.H. degree at YSPH and the capstone requirement for the M.E.M. degree at YSE. Students who plan to enroll must complete an application, which will be used to match each student with a clinic project. Check the course’s Canvas site or contact the Yale instructor at laura.bozzi@yale.edu for more information. Prerequisite: EHS 547 or permission of the instructor.  3 Course cr

ENV 960a, Climate Solutions Capstone: Nature-Based Solutions Clinic  Brad Gentry
The course pairs teams of students with state and local governments and nonprofit organizations to help advance the nature-based solutions/investments they are pursuing. The focus of the course is on how policy and financing efforts might help advance nature-based solutions from either a mitigation perspective (e.g., storing carbon) or in adaptation and resilience efforts (e.g., managing flooding, reducing temperatures, improving health). Our hope is to attract students from different specializations and backgrounds to form multidisciplinary teams. Projects being offered through the course can be seen on the YSE course site. The course sessions start with an overview of climate and nature-based solutions, followed by practice-based sessions on developing teamwork and consulting skills. The focus on nature-based solutions covers many aspects of the implementation needs of such approaches, such as policy analysis, financing structures, target research, and beyond. Once teams are formed and project scopes refined, most class sessions are more focused on allowing students to work on their projects, as well as providing opportunities for feedback and guidance. At the end of the term, the students present their findings and recommendations to their project sponsors and each other. This course is being coordinated with ENV 979, the spring climate solutions capstone on subnational actors (taught with more of an energy focus) so that active and ongoing relationships can be maintained with clients over time.  3 Course cr

ENV 970a, Environmental Protection Clinic: Policy and Advocacy  Doug Kysar, Rebecca Loomis, Jennifer Skene, Conor Dwyer Reynolds, David Hawkins, and Lisa Suatoni
The clinic’s mission is to train students in environmental advocacy through skills-based seminars, interdisciplinary project work, and collaboration with the Natural Resources Defense Council and other significant environmental organizations. Students are assigned to teams of two-to-four members drawn from both the Law School and the School of the Environment. Teams work on a project developed in collaboration with client organizations, with most projects having both legal and policy components. In addition to covering substantive areas of environmental law, clinic seminars help students master the tools of effective environmental advocacy, including the abilities to research law and science, write and cite persuasively, navigate environmental organizations, and manage projects cooperatively. Enrollment limited. For all questions, please email Alison Gocke at alison.gocke@yale.edu. Note: Attendance at the first class meeting is mandatory for admitted students and for those on the waiting list who wish to remain in consideration for admission if a place becomes available. Admitted students must confirm their participation in advance of the first class by a date designated by the instructors. A no-drop policy applies.  3 Course cr

ENV 972a, Advanced Environmental Protection Clinic  Doug Kysar, Rebecca Loomis, Jennifer Skene, Conor Dwyer Reynolds, David Hawkins, and Lisa Suatoni
Open only to students who have successfully completed the Environmental Protection Clinic (ENV 970). No statement of interest required. Attendance at clinic seminar is optional. For all questions, please email Alison Gocke (alison.gocke@yale.edu). Permission of the instructor required.

ENV 977a, Nature-Based Carbon Solutions in the Urban Realm: The Yale Campus as a Case Study  Oswald Schmitz
This integrative capstone course broadly explores how urban areas can be designed to enlist their natural biophysical features (soils, vegetation, and biodiversity) to enhance natural carbon storage. Students work collaboratively to develop the final product of the course: a nature-based carbon storage plan for the Yale campus and natural lands. Students learn fundamental scientific principles of the carbon cycle and learn to apply these principles to leverage urban natural biophysical features to facilitate carbon capture and storage. Students further learn to conduct economic analysis and financial accounting of carbon storage as investments to offset urban emissions. Finally, students meet with Yale campus planners and land managers to learn about the kinds of information needed to formulate actionable policy to maximize carbon storage on the Yale campus and natural lands as an offset to Yale’s carbon emissions.  3 Course cr

ENV 980a, Social Justice in the Global Food System Capstone  Kristin Reynolds
This course explores social justice dimensions of today’s globalized food system, considering justice in terms of sociopolitical and environmental dynamics. We connect theory and practice through work with community-based organizations working at the nexus of food, agriculture, and social justice. The capstone project work is grounded in food and social justice concepts examined through course materials and seminar discussions. We examine how governmental environmental strategies affect social equity in the food system at multiple scales. We discuss how land grabbing or food insecurity is connected to relative power on the global stage. We consider how phenomena such as structural violence and neoliberalization surface within the food system, and what this means for sustainability and justice—in urban and rural settings. We examine and debate concepts and practices including food sovereignty, agroecology, black
agrarianism, and the right to food used to advance positive change. Through the capstone project, students have the opportunity to deepen learning and contribute to the work of community groups forging pathways for equity and justice in the food system, particularly among communities historically marginalized from mainstream economies and policy making. Project work includes meetings with organizational leaders to understand context and co-develop appropriate project approaches. Students work in groups to conduct in-depth research and analysis, and engage in additional professional and educational activities connected to the project. Student groups prepare a final presentation and report to be shared with the partner organizations. The course provides opportunities to develop competencies in analyzing global food system phenomena through social justice frameworks, and working within diverse settings on food and social justice issues, as practice for management, policy making, and other professional roles. 3 Course cr

**ENV 999a, Directed Research-Doctoral  Staff**

**Modules**

**ENV 001a, Urban Ecosystem Analysis** Colleen Murphy-Dunning, Joseph Orefice, Marlyse Duguid, Stuart DeCew, Mark Bradford, Amity Doolittle, and Gaboury Benoit
The goal of this module is to acquaint students with field skills for characterizing and understanding urban ecosystems. It is designed to complement the Yale Myers module, which uses an ecosystem framework and examines comparatively 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. Throughout this module, students also gain a better understanding of the New Haven community, including its resources, history, and challenges. At the same time this module is an opportunity to explore themes and techniques that are especially well suited for human-dominated environments. An emphasis is also placed on qualitative methods and social science research, to complement quantitative methods highlighted at Yale Myers. 0 Course cr

**ENV 002a, People and Pathways** Colleen Murphy-Dunning
In this module, students explore the breadth and dimensions of our diverse perspectives and backgrounds, the flows of energy and food in our economy, and how personal and societal forces shape the development of our communities. Students begin by exploring how we value, produce, and consume energy and food. We examine our own perspectives and environmental footprints, explore the theory and physical realities in energy and food systems, and begin identifying key questions on how to reimagine and adapt these systems toward a sustainable future. We explore the dimensions of these issues through interactive workshops at Yale, lectures from faculty and state leaders, and site visits to better understand the communities, infrastructure, and systems upon which we all depend. 0 Course cr

**ENV 003a, Ecosystem Science** Colleen Murphy-Dunning
In their book on the fundamentals of ecosystem science, Weathers et al. (2013) start by introducing the idea that humans have devised many intellectual systems to understand and manage the complicated world in which we live, from physics to philosophy to economics. One such intellectual system is ecosystem science. It is a science that tries to make sense of the complex natural world and help us to better manage it. Ecosystems can be highly varied in size and character, from a little pool of water in a tree cavity, to a redwood forest, to a neighborhood in a city, to a frigid river, to the entire globe. Nevertheless, a common set of tools and ideas can be used to analyze and understand these varied and complicated systems. The results of these analyses are both intellectually satisfying and useful in managing our planet for the benefit of humankind and nature. Indeed, because of the growing demands placed on living and nonliving resources by humans, it could be argued that ecosystem science is one of the essential core disciplines needed to understand and manage the modern planet Earth. The overarching objective of this module is to explore the ecosystem framework for sustainable resource science, assessment, and management. 0 Course cr

**ENV 005a, Apprentice Forester Program** P Mark Ashton, Joseph Orefice, and Marlyse Duguid
Apprentice Forester Program for SAF requirements. 0 Course cr