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. Courses with bracketed titles will not be offered during the 2024–2025 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 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. Please visit our website at https://resources.environment.yale.edu/courses for an updated list. See also Yale Course Search at https://courses.yale.edu for many other environmental courses in other Yale departments.

ENV 511a, Ecological Foundations for Environmental Managers

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

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. 1¹/₂ Course cr

ENV 521a, Physical Science Foundations for Environmental Managers

This required foundational course provides students with the physical science basics that they need to understand and manage environmental problems. The course draws on 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, Human Science Foundations for Environmental Managers Amity Doolittle

The environmental fields of inquiry that focus on human behavior, culture, governance, and history have matured and proliferated in the twenty-first century. New scholarship has advanced the academic state of knowledge and sharpened our collective ability to understand human-environmental relations. Yet despite better science, we struggle to make material change in the collective rate of human consumption of Earth's natural resources. Not only is the planet harmed by our failures, but millions of people are also harmed. Embedded in all scientific endeavors is a theory of change. But rarely are theories of change made explicit for environmental stewardship. In this course, we investigate new bodies of scholarship that explore relational values, varying concepts of stewardship, a range of theories of change, and, finally, capabilities or human rightsbased measure of the life well lived. We explore the following questions: What does it mean to be an environmental steward in a world filled with social, political, and economic inequalities? How can we weave together multiple knowledge systems or ways of knowing through environmental stewardship? How can we balance the need for social and environmental change in a way that is both place-based and responsive to global concerns? Can theories of change help us act when the scientific data is both clear and uncertain? How can we incorporate non-economic measures of human well-being into our decision making? 11/2 Course cr

ENV 550a, Natural Science Research: From Idea to Proposal

The course guides students through the process of developing an individualized research project in close partnership with their faculty adviser. We focus on writing a research proposal, which prepares students to apply for competitive research funding and is required of all M.E.Sc./M.F.S. students. In doing so, we cover critical reading of the literature, narrowing a broad topic of interest to a feasible research project, proposal writing, and a high-level introduction to the philosophy of science. Students engage in peer review throughout the course and present their completed proposals to the class at the end of the semester. 3 Course cr

ENV 551a, Qualitative Inquiry and Research Design

Qualitative research and analysis are critical for exploring complex questions of the human condition. As an approach to understanding the human-environmental nexus, qualitative research prioritizes understanding varied "ways of knowing." The tools we learn, through the exploration of academic literature include (1) oral methods (interviews, life histories, focus groups), (2) text-based methods (archival research and document or textual analysis), and (3) participatory methods, based in observation and knowledge co-production. Students learn how to interpret and analyze qualitative data, as well as evaluate the claims made by qualitative researchers. The course is intended for doctoral students who are in the beginning stages of their dissertation research,

as well as for MESc students developing research proposals for their thesis projects. Advanced undergraduate students are welcome. The final project for this course is a research proposal. While we discuss the value of mixed methods, this course does not cover quantitative approaches such as survey research, econometrics, Q methodology, spatial analysis, or social network analysis. 3 Course cr

ENV 552b, Master Student Research Conf. Peter Raymond

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 YSE faculty and student body or by presenting a research poster in a session open to the YSE community. Students receive a score of satisfactory completion for this effort. o Course cr

ENV 553a, Perspectives: Environmental Leadership

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 568a, Geoengineering in the Context of Climate Overshoot

Despite dire warnings from the IPCC and earnest pledges of various governments and other institutions including Yale, our planet is likely to surpass the 1.5°C temperature anomaly threshold in this decade, placing us in the dangerous realm of temperature "overshoot." The course starts by examining our likely climate trajectory before critically examining the level of optimism that surrounds many proposed mitigation solutions. We then delve into the toolkit of climate responses that would become relevant in an overshoot scenario – not merely further mitigation and adaptation but also negative emissions technologies and strategies to reflect incoming sunlight. We examine not only the technological, economic, and political feasibility of these potential interventions but also their governance requirements and ethical implications. As I have found little literature illustrating what life in an overshoot world might entail, we create some. Our final project is to host a "cli-fi" short-story contest wherein students are asked to envision what they might see with their own eyes should the Earth transit 2°C in mid-century. 1½ Course cr

ENV 573a, Urban Ecology for Local and Regional Decision-Making

Urban ecology is the interdisciplinary study of urban and urbanizing systems from local to global scales. While urban ecology shares many features with the biological science of ecology, it emphasizes linkages with social, economic, and physical sciences and the humanities. Geographically, the subject includes central and edge cities, suburbs of various ages and densities, and exurban settlements in which urban lifestyles and economic commitments are dominant. In application, urban ecology can be useful as a social-ecological science for making cities more sustainable, resilient, and equitable. Emerging "grand challenges" in urban ecology include the development of robust approaches to and understanding of (1) integrated social-ecological systems in urban and urbanizing environments; (2) the assembly and function of novel ecological

communities and ecosystems under novel environmental conditions; (3) drivers of human well-being in diverse urban areas; (4) pathways for developing healthy, sustainable, and disaster-resilient cities; and (5) co-production of actionable science for policy, planning, design, and management. 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

Carbon is one of the most abundant elements in the universe, the building block for all of biochemistry, and the energy exchange material for the Earth's metabolism. Over the past two hundred years, people have mined fossil carbon to power the global economy, leading to profound transformations in the cycling of carbon among land, oceans, and atmosphere and disrupting Earth's climate. This course explores in detail the cycling of labile carbon among the major biogeochemical reservoirs. We spend roughly four weeks each on land and oceans and spend the final four weeks exploring carbon-climate. 3 Course cr

ENV 603a, Environmental Data Visualization for Communication

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 effectively communicate with data is equally essential for researchers, policymakers, 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. The course primarily uses the programming language R. Students are required to demonstrate basic proficiency in this software before or during the course. Resources for learning R are provided. 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 semester, 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 605a, Environmental Risk Communication

Risk communication is a critical but often overlooked part of how organizations identify and manage risks. Effective risk communication can help people understand risks and determine appropriate responses to them. It should help people to take seriously risks they might otherwise ignore (e.g., to get vaccinated or evacuate from a coming hurricane), or to understand that certain activities do not pose significant risks. 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 610a, Managing Ecosystems for Climate Change Solutions

This course explores how natural climate solutions (i.e., actions to protect, better manage and restore ecosystems) can mitigate climate change. It also assesses the challenges and barriers that must be overcome in order to make natural climate solutions more sustainable. During the course, students are exposed to concepts about how the conservation and management of natural and anthropogenic terrestrial ecosystems (e.g., conservation of natural ecosystems, forest and agriculture management, and restoration of degraded areas) have influenced the carbon and water cycles, two important climate services provided by terrestrial ecosystems. Students also address some of the potential socio-ecological consequences of nature-based solutions, with a focus in the tropics. Finally, the course covers some of the main challenges and opportunities for scaling up carbon natural climate solutions. 3 Course cr

ENV 613b, Writing for a Changing Environment Stephanie Hanes Wilson This course is an advanced nonfiction writing workshop with a focus in journalistic storytelling, designed to help environmental scholars and practitioners write for a broad, lay audience. In other words, this is not just a class for writers – although those with an interest in journalism will find it useful. This is a course for students who recognize the importance of reaching broad audiences in a time of rapidly transforming climate, technology, science, and culture. We learn and practice the tools of journalism – the ability to listen, communicate, research, capture hearts, spread ideas, and explain complexity – and study writings that exemplify these attributes. Our focus topic in this course is climate and other environmental changes, with an intentional look to the global south as well as the US and global north. Students write multiple pieces of their own, from short research "explainers" to reported profiles to first person reportage. By the end of the course, students have refined at least one of their pieces to a quality to submit for publication. 3 Course cr

ENV 617b, Real-World Environmental Data Science Elena Grewal and Sarah McGowan

To make sound decisions, we need good data, but the reality is that data is often messy, difficult to find, and incomplete. This is a practical, accessible course for those looking to learn Python and gain the foundational skills necessary to work with real-world environmental data. The first half of the class teaches best practices for sourcing and cleaning data (missing data, duplicates, merging, etc). We then teach data visualization, mapping, and statistical techniques. No programming experience is required. The focus is on implementation, not statistics. There are assignments and a midterm. In the second half of the class, students apply skills in a data project of their choosing. We host guest speakers doing innovative work in environmental data science and provide an overview of advanced topics in machine learning, data ethics, and Python programming. 3 Course cr

ENV 618a, Anthropology of Smallholder Agriculture in Developing Countries 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 620b, History of Environmental Thought and Activism Dorceta Taylor This course uses a race, class, and gender approach to examine the history of American environmental ideology and activism from the 1600s to the present. The course is divided into three units. The first unit examines environmental conditions in the city (health, sanitation, housing, overcrowding, occupational safety, and open space), the rise of urban American environmental consciousness, and activism related to urban issues. Unit II examines the rise of the conservation and preservation movements. It analyzes the relationship between hunting, wildlife extinction, and the rise of conservation ethics. This unit also examines the role of the countryside, frontier, and wilderness in environmental thought and activism. It examines conquest, conservation, primitivism, Transcendentalism, and Romanticism and the emergence of the preservation/conservation movement. Unit III focuses on contemporary environmental thought; it examines the birth of the modern environmental movement and the emergence of reform environmentalism. The course also examines the way in which a person's social class, race, gender, environmental, and labor market experiences influence their environmental perceptions and the kinds of environmental ideologies they develop. The course examines the rise of major environmental paradigms and the factors that make them influential. 3 Course cr

ENV 626b, Writing for Publication in the Natural Sciences Simon Queenborough This course is intended to give students insights into the process of writing natural science manuscripts. The course guides students through writing a paper and ends the term with a submitted manuscript. We also consider various strategies for writing, accountability, time management, and productivity. The course is aimed at students in the natural sciences with analyzed data that they want to write up for publication. 3 Course cr

ENV 630b, The Physical Science of Climate Change Peter Raymond and Xuhui Lee The course provides students with core knowledge on the processes controlling the earth's climate system. The first half of the class focuses on the four components of the earth climate system, providing a knowledge base on the atmospheric energy and water budgets and the roles of anthropogenic greenhouse gases, the oceans, land and cryosphere in altering these budgets. Students also learn how to run a climate GCM (general circulation model). The second half of the class focuses on impacts of climate change on a number of societal sectors including natural ecosystems, energy use, water resources, the food system and the built environment. 3 Course cr

ENV 633a, Critical Race Theory

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 634b, Ecology of Global Drylands William Lauenroth This course explores the controls on the geographic distribution and community and ecosystem structure and functioning of drylands globally. Lectures, writing, and student-led discussions. 3 Course cr

ENV 635b, Renewable Energy Project Finance Daniel Gross

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. 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. This course is primarily online but may include four to six in-person sessions, pending the instructor's availability to travel. While cross-listed at the School of Management, it follows the YSE academic calendar. Admission requires an application. 3 Course cr

ENV 641a, Market-Based Mechanisms for Water Management

This course provides students with both the theory and application of environmental water transactions (EWTs) to water management challenges, such as river restoration, drought-mitigation, and agricultural allocation. The geographic focus is primarily the western United States, as this region, out of necessity, has been very active in implementing EWTs in recent years. Other market-based mechanisms for water management also are explored, such as groundwater mitigation banks, urban stormwater markets, and water quality markets. The course also covers considerations such as environmental justice, tribal access to and use of water, and diversity/equity/ inclusion in water management. A final project gives students the opportunity to develop a simple hydrological and water rights model for a fictional watershed to use as the basis for designing a suite of water transactions and market-based water management solutions. This is an online course taught by experienced professionals who value a hands-on approach to learning. In addition, the course features discussion of current events in water, case studies, and guest lectures from practitioners actively using market-based mechanisms for water management. 3 Course cr

ENV 642a, Environmental Justice/Climate Justice

This course focuses on the evolution and development of the environmental justice movement and environmental justice law in the United States. We begin with a legal and social-historical survey and trace that history to the current moment. We explore traditional environmental law's shortcomings and the legal and policy developments that have followed the environmental justice critique. Concepts of environmental and climate justice have driven the environmental legal movement since its inception, but only recently has environmental justice law been recognized as a legal field. This course introduces students to contemporary legal regimes, debates, and social movements in the U.S. territories, Indian Country, and Hawai'i to explore how many environmental justice communities have responded to (or resisted) mainstream modalities of environmental law. This course explores law as one of many levers in enacting environmental justice, and students consider how grassroots organizing, public awareness and education, and litigation fit together in environmental and climate justice movements. Our discussion of environmental litigation considers traditional environmental statutes, complex tort (i.e., toxic/climate tort) actions, and constitutional case law. The class considers how environmental conditions and climate change implicate peoples' rights, including climate migration, drinking water access, tribal sovereignty, food access, industrial agriculture, and human health and wellbeing. For the final, each student chooses a particular movement or lawsuit (or one expression of it) and writes a paper bringing to bear all the questions we raise this semester. (For example, how did opposition from environmental justice advocates lead to a reformed climate change initiative in California? Or what lessons can we learn from Rise St. James' legal challenge against disproportionate pollution in "Cancer Alley"?) The paper need not focus on a domestic response because the environmental/climate justice critique is now global. Note: This class will follow the Yale School of the Environment calendar. 3 Course cr

ENV 645a, Urbanization, Global Change, and Sustainability

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 646b, Regenerative Agriculture Systems

Agriculture systems both depend and have a profound impact on the natural and human environment. There is widespread recognition of the need for agriculture systems to be more regenerative: regenerative food producing systems are ones that contribute to the improvement of the environment and to human wellbeing, not just avoid damages. The aim of this course is to explore what makes food producing systems regenerative. While there is a lot of momentum around the framing of "regenerative agriculture," there is not a lot of detail about what actually makes a system regenerative. The goals of the course are to: provide technical understanding of the science of agricultural systems; develop practical experience applying this science to real world scenarios of strategy development in agriculture; and increase exposure to practitioners at the interface of agriculture and the environment. 3 Course cr

ENV 650b, Seminar in Wildland Fire of the Western United States

The goal of this seminar is to offer an introduction to the ecology and management, and the policy drivers, of wildland fire in western North America. We seek to build a base of knowledge and understanding regarding fire and its applications/management in modern forestry. We start by learning the basic history and ecology of forest fire, then look at landscape-level fire behavior, prescribed fire applications, and the drivers of catastrophic fire. The course concludes with an applied field-learning experience managing fire at Yale-Myers Forest. We meet once a week, with a guest Zoom lecturer from the field of fire ecology and management joining most weeks. Each week, there is a presentation followed by a discussion of the lecture content and reading material assigned by the guest lecturer. Students are expected to have read the papers and to come with questions and thoughts ready to discuss. There are several field trips, and if logistically feasible, a prescribed burn that students are expected to participate in. 3 Course cr

ENV 652b, Wood: Structure and Function

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. Enrollment limited to ten with permission of the instructor. Prerequisites: basic statistics and a background in tree physiology and anatomy are strongly recommended. 3 Course cr

ENV 653b, Maple: From Tree to Table

This course covers the cultural, industrial, and sustainable practices of nontimber forest products through the lens of maple sap and syrup. Maple sugar is a forest product unique to northeastern North America, and it has seen a resurgence in interest as global consumers seek nutritious, natural, and sustainably produced foods. This course covers the booming industry and culture around maple syrup, from backyard operations through modern 100,000-tap investment operations. Maple producers are on the front lines of climate change and forest health threats. The course provides students with the knowledge of how challenges related to forest health and climate change are directly impacting maple producers and how these producers are learning to adapt in ways that are environmentally friendly, ecologically sound, and financially competitive in a global market.

ENV 659b, The Practice of Silviculture: Principles in Applied Forest Ecology

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 the management of wildlife habitat, bioenergy and carbon sequestration, water resources, urban environments, timber and nontimber products, and landscape design. Four to six hours lecture. One-hour tutorial. Seven days of fieldwork. Recommended: some knowledge of soils, ecology, plant physiology, human behavior, and resource economics. 4 Course cr

ENV 660a, Forest Dynamics

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, and discussions we explore forest development processes

and pathways, concentrating on the driving mechanisms and emergent properties including natural and human disturbances. 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 668b, Field Trips in Forest Resource Management and Silviculture

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.

ENV 670b, Southern Forest and Forestry Field Trip

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.

ENV 671a, Temperate Woody Plant Taxonomy and Dendrology

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 woody plant families, with a focus on North American forest species. In addition, students 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. Class periods consist of practical field and laboratory skills used in plant taxonomy and field lecturing. Weather permitting, we are in the field for the majority of class periods. We use an ecosystem focused approach for plant identification. Besides learning how to identify species, we discuss principles of plant ecology, biogeography, and natural history in each of the ecosystems we visit. Limited to thirteen. 3 Course cr

ENV 679a, Plant Ecophysiology

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. Enrollment limited to twenty-four. 3 Course cr

ENV 685b, Engaging Landholders and Communities in Conserving and Restoring Tropical Forest Landscapes

The design and implementation of sustainable land management strategies in tropical forest landscapes must effectively involve the people and communities who manage and govern these regions. In many cases, however, practitioners design projects that focus on technical solutions only and ignore people altogether, or base their projects upon incorrect assumptions about the people at the heart of their interventions. These trends ultimately lead to project failure and can cause a host of adverse unintended consequences that further exacerbate the problems that practitioners were trying to resolve. This pattern is particularly prevalent with recent pledges by global organizations and national governments to plant trillions of trees around the globe in an effort to address the adverse effects of climate change (The Bonn Challenge and Trillion Trees). While these initiatives are well-intended, they largely ignore the sociocultural and political complexities of the landscapes where the trees would be planted, including whether landholders already plant or protect trees and if they want to increase this practice and how; which species they want to plant or protect and how; and the effects of tree planting on land tenure systems, traditional livelihood strategies, and gender dynamics. Little attention is also given to examining who removed the trees from the landscape and why and whether tree planting is an appropriate solution. 3 Course cr

ENV 688b, Forest Management and Operations

This course provides students with an opportunity to understand many aspects of forest management, especially as it relates to multiple-use forestry. Course content includes understanding and critique of forest inventory, and students are introduced to growth and yield concepts. Forest planning and optimization for objectives such as forest products and carbon are covered. Stewardship of forestland is discussed, as are legal aspects to land ownership and forest conservation. Included are sections focused on forest operations. Students gain experience in the diverse elements and aspects of forest harvesting. The course is taught from the perspective of what a forester should know about harvesting, which includes logging safety, timber harvesting operations and sale administration, legal dimensions of harvesting, planning and maintaining forest access systems, timber procurement and appraisal, logging costs and analysis, and environmental and social influences. Field experiences complement lecture material. 3 Course cr

ENV 692a, Science and Practice of Temperate Agroforestry

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 695a, Yale Forest Forum Series: The Future of Mature and Old-Growth Forests in the US

With the release of Executive Order (EO) 14072 on April 22, 2022, the Biden Administration placed the health and sustainability of the nation's forest at the center of its agenda. The EO calls particular attention to the importance of mature and oldgrowth (MOG) forests on federal lands, citing their integral role as a natural climate solution and diverse cultural and spiritual significance. Stemming from EO 14072, the Mature and Old Growth Initiative is an ongoing effort by the USDA Forest Service to define, inventory, assess, and conserve MOG across federal lands. In collaboration with the Society of American Foresters (SAF), this seminar focuses on the challenge of fostering healthy and resilience federal forests in a changing climate while continuing to ensure they provide the diverse set of services and values that the public depend upon. Beginning with introductory webinars from Agency leadership and staff, we hear from a series of speakers of different tribes, universities, and non-profits exploring core challenges to this effort, including: how to define MOG, identifying key threats to MOG, the leading science of climate-informed forestry, integrating western and indigenous knowledge, and strategies for meaningful public engagement.

ENV 704a, Workshop on Remote Sensing and Photogrammetry with Drones

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. 3 Course cr

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 707b, Introduction to Environmental Chemistry

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

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 problems; and infrastructural and institutional issues. 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; stormwater management; dams and other technologies for water management; human impacts on aquatic ecosystems; water and energy; water economics; water rights; water conflict and cooperation. 3 Course cr

ENV 716b, Renewable Energy Michael Oristaglio

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. 3 Course cr

ENV 723a, Wetlands Ecology, Conservation, and Management

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 726b, Observing Earth from Space Xuhui Lee

A practical introduction to satellite image analysis of Earth's surface. 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. 3 Course cr

ENV 730a, Environmental Data Science in R: Introduction to Data Integration and Machine Learning

In today's world, understanding environmental data and making informed decisions based on it is crucial for addressing complex environmental challenges. This course serves as an introductory exploration into the integration of environmental data using R programming language coupled with machine learning techniques. Participants gain hands-on experience in handling, analyzing, and interpreting environmental datasets, with a focus on leveraging the power of R for data integration and predictive modeling. 3 Course cr

ENV 731b, Tropical Field Botany

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. 3 Course cr

ENV 734b, Biological Oceanography Mary Beth Decker

Exploration of oceanic ecosystems and how these environments function as coupled physical/biological systems. Ocean currents and other physical processes determine where nutrients are available to support primary production and where organisms from plankton to top predators occur. Includes discussion of anthropogenic impacts, such as the effects of fishing and climate change on marine ecosystems. Recommended prerequisite: college-level biology or ecology course. 3 Course cr

ENV 742b, Fundamentals of Working with People

Environmental scientists and environmental managers are working to transform environmental outcomes by changing institutional and human behavior. Research indicates time and time again that teams are important for tackling these important challenges. From developing research projects to building a business or NGO, teams can lead to better, more efficient output because they incorporate various perspectives and benefit from a wider range of skill sets. But developing and deploying effective teams is an art and a science, full of its own challenges. It requires a deep understanding of self, including one's own strengths, blind spots, priorities, and needs. It also requires reflection, empathy, communication, and collaboration. This course aims to introduce students – particularly scientists and environmental managers – to the theory and practice of team management. Through a series of lectures, simulations, reflections, discussions, and exercises, students will increase their ability to: (1) Understand themselves and other individuals; (2) Form and lead diverse teams; (3) Influence the actions of the organizations within which they are working; (4) Collaborate with others affecting the resources about which they care. 3 Course cr

ENV 744b, Conservation Science and Landscape Planning

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: ENV 602 or equivalent course in population or community ecology, F&ES 755 or equivalent course in GIS, and ENV 728 or equivalent course in statistical analysis of biological data. A course in economics or applied math for environmental studies is strongly encouraged. 4 Course cr

ENV 745a, Global Human-Wildlife Interactions

Wildlife and humans have increasingly complex interactions, balancing a myriad of potentially positive and negative outcomes. In a highly interactive format, students evaluate the importance of human-wildlife interactions across diverse ecosystems, exacerbators that influence outcomes, and management interventions that promote coexistence. 3 Course cr

ENV 750a, Writing the World

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 751b, Sampling Methodology and Practice

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 and final project. 3 Course cr

ENV 752a, Ecology and Conservation of Tropical Forests

Tropical forests contain extraordinarily high biological diversity and provide critical ecosystem services with complex interactions with humans. This course focuses on the structure, function, and diversity of intact and degraded tropical forests, with an emphasis on ecological processes that shape plant and animal communities in 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, classroom activities, and student-led discussions. Students who successfully complete this course are given priority for ENV 717, Tropical Field Ecology (field trip course). 3 Course cr

ENV 753a, Regression Modeling of Ecological and Environmental Data

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 755b, Modeling Geographic Space

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 ENV 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. 3 Course cr

ENV 756a, Modeling Geographic Objects

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 or b, 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 758b, Multivariate Data Analysis in the Environmental Sciences

An introduction to the analysis of multivariate data. Topics include multivariate analysis of variance (MANOVA), principal components analysis, cluster analysis, canonical correlation, ordination methods including multidimensional scaling, discriminate analysis, factor analysis, and structural equations modeling. Emphasis is placed on practical application of multivariate techniques to a variety of examples in the natural and social 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, MINITAB, and STATA. Three hours lecture/discussion. Prerequisites: a prior course in introductory statistics and a good understanding of multiple linear regression. 3 Course cr

ENV 759a, Power, Knowledge, and the Environment: Social Science Theory and Method

Introductory graduate course on the social science of contemporary environmental and natural resource challenges, paying special attention to issues involving power and knowledge. Section I, overview of the course. Section II, disasters and environmental perturbation: pandemics, and the social dimensions of disaster. Section III, power and politics: river restoration in Nepal; the conceptual boundaries of resource systems, and the political ecology of water in Mumbai Section IV, methods: the dynamics of working within development projects; and a multi-sited study of irrigation in Egypt. Section V, local communities: representing the poor, development discourse, and indigenous peoples and knowledge. The goal of the course is to develop analytic distance from current conservation and development debates and discourse. This is a core course for M.E.M. students in YSE, and a core course in the combined YSE/Anthropology degree program. Enrollment is capped. 3 Course cr

ENV 760b, Conservation in Practice: An International Perspective

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 North America. 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 communitybased conservation. During the term, students work in small teams to assess one of several current case studies - integrating biological, social, economic, and governance considerations - to propose an effective path forward for conservation. Participation and leadership are key, as the seminar is discussion-based and approximately 25 percent of the sessions are student-led. Evaluation is based on participation, presentations, and a final paper. 3 Course cr

ENV 761a, Negotiating International Agreements: The Case of Climate Change

This class is a practical introduction to the negotiation of international agreements, with a focus on climate change. Through the climate lens, students explore crosscutting features of international agreements, the process of international negotiations, the development of national positions, advocacy of national positions internationally, and the many ways in which differences among negotiating countries are resolved. The seminar also examines the history and substance of the climate change regime, including, inter alia, the 1992 UN Framework Convention on Climate Change, the 1997 Kyoto Protocol, the 2009 Copenhagen Accord, the 2015 Paris Agreement, the UAE Consensus, and other recent developments. There are two mock negotiations. 3 Course cr

ENV 762a, Applied Math for Environmental Studies

The language of mathematics is an important leg in the stool of interdisciplinary research and analysis, and many graduate courses at YSE 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. 3 Course cr

ENV 764a, Sociology of Sacred Values: Modernity, Ecology, and Policy

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 767b, Tools for Conservation Project Design and Management

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. 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 design focused on a single case study of their choice. The suite of decision-support tools covered includes situation (logic) models for project design, stakeholder assessments, threats and opportunities analysis, conservation target identification, and monitoring frameworks. Students gain experience in design of projects and their monitoring, as well as familiarity with budgeting. Evaluation is based on class participation, regular assignments, and a final project design paper. 3 Course cr

ENV 771b, Fundamentals of Green Engineering and Green Chemistry

There is a broad desire to ensure that consumer products, manufacturing processes, and material and energy systems are compatible with public health and environmental sustainability. This course provides fundamental knowledge of the frameworks, methods, tools, and techniques of designing for sustainability. Through an understanding of conceptual contracts and application to real-world case studies, students learn the impacts of design on health (including toxic and ecotoxic effects) and the ways to ensure that new products, processes, and systems can be constructed through the principles of green engineering and green chemistry. This course provides the foundation for more advanced investigations in sustainable design; there are no prerequisites. 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 775b, Federal Indian Law

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 an 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 also situate the doctrinal evolution of federal Indian law with the struggle over colonialism as expressed in the insular cases. 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. Every student must complete the discussion question requirements to sit for the examination or to submit a paper. 3 Course cr

ENV 781b, Applied Spatial Statistics

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. Prerequisite: introductory course in statistics is mandatory. An intermediate-level course in statistical modeling and handling spatial data is strongly preferred, but not required. 3 Course cr

ENV 789b, Energy and Development

This course delves into the relationship between energy use and economic development, at a household, national, and global scale. The course provides both a quantitative and qualitative understanding of poverty, energy demand, and the relationship between the two. Students grapple with different income and multidimensional poverty and standard of living indicators, and with GDP and its limitations as a human development measure. They learn about energy poverty in various parts of the world and about energy consumption patterns with rising income. Students study actual household survey and national statistics data on consumption and energy use, and are exposed to cutting-edge research on standard of living measures and their embodied energy needs. The course covers basic models for household energy transitions and appliance diffusion. This is a seminar course, wherein students are expected to present readings in class. The course involves one term project and presentation, which may be quantitative or qualitative. Prerequisites: basic math, Excel, and microeconomics. Those selecting technical projects should have basic R or other data manipulation skills. 3 Course cr

ENV 793b, 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 795b, Nature as Capital: Merging Ecological and Economic Models

Students learn concepts and develop skills in natural resource economics including 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 Excel and Rin dynamic optimization, which are useful for forward-looking decision-making. Application focus on natural resources and conservation questions. 3 Course cr

ENV 796b, Biopolitics of Human-Nonhuman Relations

Advanced graduate seminar on the "post-humanist" turn toward multi-species ethnography. Section I, introduction to the course. Section II, perspectivism: ontological theory and multi-species ethnography; human consciousness and the environment; and mimesis in human-prey relations. Section III, entanglements: translating indigenous knowledge; the history of natural history; and the politics of environmentalism. Section IV, metaphors: non-human imagery in political discourses; and geologic/volcanic imagery. Section V, student selections of readings; and student presentations of their seminar papers. Section VI, conclusion: plants as teachers; and a lecture by the course TF. Three hour lecture/seminar. Enrollment capped. 3 Course cr

ENV 800b, Energy Economics and Policy Analysis

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: ENV 512 (or equivalent background) and at least one course on energy. 3 Course cr

ENV 805a or b, Seminar on Environmental and Natural Resource Economics

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 807b, Corporate Sustainability: Strategy and Management

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 seeks to provide students with an introduction to the range of sustainability issues and challenges that companies face in today's fast-changing marketplace. It introduces key corporate sustainability terms, concepts, tools, strategies, and frameworks based on the overarching theory that the traditional profit-maximizing mission of business (often called *shareholder primacy*) is giving way to a new vision of stakeholder responsibility that still seeks to provide good returns to the enterprise's owners but also acknowledges obligations to employees, suppliers, customers, communities, and society more broadly. 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. It explores 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

This three-credit lecture course offers an overview of all aspects of energy systems and their interaction with society and the environment. The course provides students with a comprehensive theoretical and empirical knowledge base about energy systems in the world. This course describes and explains the basics of energy and the laws that govern it, the different components of an energy system (supply technologies, delivery systems, and demand), the institutions that govern the energy sectors, the role of energy in development, its impact on climate change, and an understanding of the key challenges of an energy transition towards a sustainable future. The course has a specific emphasis on electricity systems, how they are operated and governed, and how they have to be transformed to tackle climate change. Students receive a unique exposure to energy issues in the Global South. This course provides students with basic analytical tools and knowledge to formulate and solve energy-related decisions at an individual, national, and global scale and to understand and critique ongoing policy dialogues on energy and climate. <u>3</u> Course cr

ENV 816a, Electric Utilities: An Industry in Transition

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

The built environment in which we live, work, and recreate represents the cumulative impact of government policies and private sector investments implemented at multiple geographic scales over the past several centuries. This course explores the ways in which North American cities and towns have evolved and the dynamic trends facing their urban and suburban neighborhoods. We examine the ways in which past decisions prepare or hinder our communities addressing the big challenges they will face in the coming decades. We delve into the ways that city and regional planning practice is evolving to address current issues such as climate change, demographic shifts, gentrification, sclerotic government, and contested public hearings and realize opportunities such as community resilience, active transportation, eco districts, and participatory planning. 3 Course cr

ENV 821a, Environmental Policy Making: From Local to Global

This course focuses on policy making around environmental issues. We explore and analyze institutions at all levels of government, from community management of forests to global management of greenhouse gas emissions. We also explore a variety of environmental case studies. Students learn to examine issues and institutions through the lens of the actors involved, their incentives, and the information they have. The course includes a simulation taking place over multiple weeks at which students negotiate an international environmental agreement. 3 Course cr

ENV 824b, Environmental Law and Policy

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 834b, Environmental Economics and Policy

This is a course in 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 material is tailored specifically to master's students pursuing professional degrees in environmental management. The course therefore has a focus on environmental problem solving in the real world. Topics covered include, but are not limited to, evaluation of environmental policies (e.g., standards, taxes, cap-and-trade); costbenefit analysis and its critiques; nonmarket valuation (ecosystem services, revealed and stated preferences); discounting and macroeconomic perspectives on climate change; management of nonrenewable resources (oil, minerals, etc.); management of renewable resources (forests, fisheries, etc.); land and biodiversity conservation; the relationship between development, trade, and the environment; strategic incentives for international environmental agreements; and environmental behavioral economics. Prerequisite: ENV 512 or equivalent. 3 Course cr

ENV 835a and ENV 835Eb, Seminar on Land Use Planning

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. Some synchronized classes are held online to accommodate guest speakers around the country and outside of the U.S. 11/2 Course cr per term

ENV 835Eb, Seminar on Land Use Planning

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 / SOCY 617a, Agrarian Societies: Culture, Society, History, and Development Jonathan Wyrtzen and Elisabeth Wood

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 838b, Life-Cycle Assessment

The increasing concerns about environmental pollution and resource challenges drive the development of sustainable solutions that can meet societal needs without compromising the environment or depleting the resources for future generations. Given many technological, behavioral, and policy options, it is challenging to determine which option best serves humanity and the environment. Life-cycle assessment (LCA) offers a systems approach to support these decisions. This course is an overview of life-cycle thinking, the fundamental theory of LCA framework, and practical applications in supporting real-world decision-making. Students learn state-of-the-art LCA tools, industrial case studies, and advanced LCA methodologies. The course has an emphasis on systems thinking. It is appropriate for all M.E.M. specializations. 3 Course cr

ENV 839b, Power in Conservation

This course examines the anthropology of power, particularly power in conservation interventions in the global South. It is intended to give students a toolbox of ideas about power in order to improve the effectiveness of conservation. Conservation thought and practice are power-laden: conservation thought is powerfully shaped by the history of ideas of nature and its relation to people, and conservation interventions govern and affect peoples and ecologies. This course argues that being able to think deeply, particularly about power, improves conservation policy making and practice. Political ecology is by far the best known and published approach to thinking about power in conservation; this course emphasizes the relatively neglected but robust anthropology of conservation literature outside political ecology, especially literature rooted in Foucault. It is intended to make four of Foucault's concepts of power accessible, concepts that are the most used in the anthropology of conservation: the power of discourses, discipline and governmentality, subject formation, and neoliberal governmentality. The important ethnographic literature that these concepts have stimulated is also examined. Together, theory and ethnography can underpin our emerging understanding of a new, Anthropocene-shaped world. This course will be of interest to students and scholars of conservation, environmental anthropology, and political ecology, as well as conservation practitioners and policy makers. It is a required course for students in the combined YSE/Anthropology doctoral degree program. It

is highly recommended for M.E.Sc. students who need an in-depth course on social science theory. M.E.M. students interested in conservation practice and policy making are also encouraged to consider this course, which makes an effort to bridge the gap between the best academic literature and practice. Open to advanced undergraduates. No prerequisites. Three-hour discussion-centered seminar. 3 Course cr

ENV 840a / GLBL 7170, Climate Change Policy and Perspectives

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

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 852b, Food Systems and Environmental Law

We eat food every day. The food system, from agricultural production to processing and distribution to consumption and waste, shapes our lives. Less well known, but of equal or greater impact, are the effects the food system has on our environment, climate, and public health. This course takes the food one eats in a day and uses it to demonstrate the environmental impact of modern agriculture and the U.S. laws that attempt to reduce those harms. Today's industrial food system bears little relation to the bucolic family farms we imagine – and that were in Congress's mind when it passed most modern environmental laws. Since the 1970's when most environmental laws were enacted, U.S. agriculture has grown increasingly concentrated and industrial. In terms of output of cheap food, the system is a success: we now produce about 60% more food than we need, food is about one-third less expensive today than in 1980; and less than 2% of U.S. employment is in agriculture. In addition, agriculture now also produces about 10% of the nation's vehicle fuel. On the other hand, the increased industrialization, without the environmental safeguards applicable to other industries, has led to agriculture being a major source of environmental and health harm. Agriculture occupies approximately 60% of the country's contiguous land and thus is the main driver of loss of native habitats. Almost 800 million acres of U.S. land are used for pasture or range for livestock, which often destroy habitat, imperil native species, and pollute waters. Most row crops are monocultures dependent on high doses of fertilizers and pesticides that pollute waters and endanger workers, surrounding communities, and downstream consumers. The vast majority of our meat is produced in industrial-scale "concentrated animal feeding operations" that house thousands or even millions of animals producing more waste than many cities, yet without sewage treatment systems, and thus cause significant water and air pollution. Agriculture is responsible for about 20% of the country's greenhouse gas emissions and the food system as a whole contributes over a third of total greenhouse gas emissions. At the end of the system, approximately 35% of food is wasted, and most of that ends up in landfills where it releases methane. U.S. environmental law directly and indirectly seeks to reduce these harms, although often in partial, ineffective, or unenforceable ways. While there are alternative production systems that have been demonstrated to produce sufficient food with much less environmental impact, the law rarely encourages, and often discourages, such approaches. This course studies existing U.S. environmental law and its strengths and weaknesses and explores alternative approaches to environmental and public health protections. We start and end with climate change-its impact on agriculture and agriculture's impact on climateand address other impacts and statutes between. Several short papers and in-class presentations, as well as a final paper are required for all students. Students who write a longer paper for Substantial Paper credit may earn a third unit. Paper required. Enrollment limited to eighteen. Application required. 2 Course cr

ENV 857b, Financing Climate Change Adaptation in Developing Countries

This course is intended for students who are interested in applied work in development organizations or public institutions focused on nature, climate, energy and waste that are involved in catalyzing finance for climate change adaptation, particularly in the global south. The course has no specific prerequisites but students will find that courses in development economics, natural resources management, finance and law are helpful. The class entails in-class discussions where students are expected to critically analyze course content, discuss and debate, as well as present material. Enrollment is limited to fifteen. 3 Course cr

ENV 860a, Developing Environmental Policies and Winning Campaigns

This course is about what makes an environmental policy idea successful – one that can go from concept to law, get implemented well, and achieve its intended goals. In addition, this class covers how to develop and run effective campaigns to win environmental policies. Good policy does not just happen. It takes creative thinking, learning from experience and history, and an ability to "look around corners" to help ensure that your idea can actually be well implemented, won't have unintended consequences, and will actually solve the problem you set out to alleviate. And, once you have a honed policy idea, there is no magic wand that will turn it into the law of the land. Whether in city hall, the state legislature, the U.S. Congress, or a corporate boardroom, many stakeholders will have a hand in determining whether an idea turns into a law. 3 Course cr

ENV 878a, Climate and Society: Past to Present Michael Dove

Seminar on the major traditions of thought and debate regarding climate, climate change, and society, drawing largely on the social sciences and humanities. Section I, overview of the course. Section II, disaster: the social origins of disastrous events; and the attribution of societal "collapse" to extreme climatic events. Section III, causality: the revelatory character of climatic perturbation; politics and the history of efforts to control weather/climate; and nineteenth-twentieth-century theories of environmental determinism. Section IV, history and culture: the ancient tradition of explaining differences among people in terms of differences in climate; and cross-cultural differences in views of climate. Section V, knowledge: the study of folk knowledge of climate; and local views of climatic perturbation and change. Section VI, politics: knowledge, humor, and symbolism in North-South climate debates. The goal of the course is to examine the embedded historical, cultural, and political drivers of current climate change debates and discourses. This course can be applied towards Yale College distributional requirements in Social Science and Writing. The course is open to both graduate and undergraduate students. Enrollment capped. 3 Course cr

ENV 884a, Industrial Ecology

The principal objective of industrial ecology is to reorganise the industrial system so that it evolves towards a mode of operation that is compatible with the biosphere and is sustainable over the long term" (Erkman 2017). To achieve this ambitious objective, the field of Industrial Ecology takes a systems perspective and draws analogies between industrial systems and ecology. Industrial Ecologists study (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). This course will introduce the foundations and applications of key tools of the field: Material Flow Analysis (MFA), Life Cycle Assessment (LCA), Environmentally-Extended Input-Output Analysis (EEIO), and Industrial Symbiosis (IS). Strategic applications of these tools can provide insight for a wide range of decisionmakers with sustainability aims. The overall 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 gain an understanding of the tools, applications, and implications of Industrial Ecology 3 Course cr

ENV 892a, Introduction to Planning

This course offers an exploration of contemporary planning practice in the United States through the introduction of foundational planning principles and the different planning subfields that the profession now encompasses. Through academic research, readings that reveal the practical challenges and political realities each subfield faces, and discussion, the course seeks to clarify and explain the general structure and process inherent in practicing the planning profession. Additionally, the individual planning subfields – transportation and infrastructure planning, housing and the built environment, economic development, community planning and advocacy, sustainability and the environment, and general practice – are explored to further understand these specialized skill sets and how collaborations among them lead to the creation and implementation of more robust planning decisions. The course consists of lecture classes alternating with case study discussion groups. 3 Course cr

ENV 894a, Green Building: Issues and Perspectives

Buildings have an outsized impact on human and environmental health. The building sector is the largest contributor to greenhouse gas emissions globally, responsible for almost 40 percent of total emissions. Construction and demolition activities generated 600 million tons of waste in 2018 in the United States, more than twice what was generated in municipal solid waste. Buildings represent an enormous opportunity to reduce environmental impact, and the movement that represents this approach is commonly called green building. But green building is broad and deep-involving process, products, and policy – and crisscrosses many disciplines. This course examines green building from a variety of perspectives, placing it in a technical, social, financial, and historical context. The task of reducing the environmental impact of our buildings requires cross-disciplinary integration and touches nearly every aspect of our lives as occupants and managers of interior spaces. Individual topics in green building-such as building science, indoor environmental quality, innovative finance, and public- and private-sector programs - are covered through research, class discussion, guest lectures, field trips, and group projects. Great emphasis is placed on the practical challenges and opportunities that green building presents to building and non-building professionals working together to design, specify, construct, operate, renovate, and finance our nation's buildings. Enrollment limited to fifteen. 3 Course cr

ENV 898a, Environment and Human Health

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

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 Colloquy

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 905a, Doctoral Seminar in Environmental and Energy Economics

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 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. 3 Course cr

ENV 910b, Survival Skills for Finishing Doctoral Students

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 webpages. Finally, the course exposes students to resources and opportunities for continuing to apply and polish their skills. Pass/Fail.

ENV 951b, Strategic Environmental Communication

Strategic communication is a powerful means of achieving an organization's mission, especially when informed by insights into human behavior and social systems. By the end of this course, students are able to develop communication strategies and apply insights from the social and behavioral sciences to improve the effectiveness of their communication campaigns. Enrollment limited to twelve. 3 Course cr

ENV 953b, Sustainable Business Capstone Consulting Clinic

The intended outcome of this course is to provide you with a 'capstone' experience; consulting to an organization in its early formative years, confronting real-life challenges at the intersections of starting-up, business strategy, and environmental sustainability; all with regular contact with the Founder/Founding team of an entrepreneurial venture started by recent alumni or current student Founders. The course is designed for you to apply tools and insights gained in this and other courses to a defined project; creating deliverables that will be useful to the entrepreneurs leading their organization. It is designed to help prepare anyone who wishes to become a consultant after graduation; though it is also intended to be useful for those that intend to engage with consultants in their careers post-Yale and may be considering becoming an entrepreneur themselves. In short, there is hopefully something in it for many of you! Enrollment by Application. 3 Course cr

ENV 954a, Management Plans for Protected Areas

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 or b, Seminar in Research Analysis and Communication in Forest Ecology

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 subjectarea conferences and meetings. Extensive training in writing and presenting work is provided. 1 credit option is available for incoming students only. Must be taken for 3 credits to count as a capstone course. Limited to twelve.

Prerequisite: ENV 659 or permission of the instructor. 3 Course cr

ENV 956b, Strategies for Land Conservation

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/ organization 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. 3 Course cr

ENV 957a, Field Skills in Land Stewardship

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 and Public Health

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. 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 instructor for more information. Prerequisite: EHS 547 or permission of the instructor. Not open to auditors. 3 Course cr

ENV 966a, Sustainability Implementation: Change Management in Institutional Settings Sara Smiley Smith and Lindsay Crum

Yale's formal sustainability efforts are nearing the two-decade mark, with the Office of Sustainability established in 2005, but the work to make the campus more sustainable has been going on far longer. From sending food scraps to pig farmers in the 1800s, to responding to energy crises and crashes with infrastructure changes, to establishing early recycling programs in the 1980s, the University's work has deep roots, if not always the comprehensive impact some would desire. This YSE Capstone course provides students with the opportunity to learn about this long history of effort to improve the University's sustainability and engage in the real act of change management in current efforts on campus. Exploring change management theory and learning from many on campus experts, students work in groups, bringing a diversity of experiences and knowledge to the table to tackle real and wicked problems in our midst. In taking on these timely projects, students have the opportunity to tangibly impact Yale's ongoing efforts to fully embrace sustainable operations while experiencing the friction, joy, disappointment, learning, and challenge that are all part of working to make real change happen. 3 Course cr

ENV 971b, Land Use Clinic

The Land Use Clinic gives students the opportunity to explore a variety of specific land use topics that are of current concern and relevance to the field, to the curriculum, and to society, including renewable energy, natural resources, rural-based land uses, watershed management, agriculture, and sustainable urban planning. In our rapidly changing political environment, strategies that focus on the local level are increasingly more important to achieving our global sustainability goals. Students work with the clinic professor and practitioners in the field to develop papers, research memoranda, and publications on a selected topic. The clinic professor and guest speakers conduct skill-based workshops focused on the tools and techniques needed to pursue a career in community land use planning. Some synchronized classes are held online to accommodate guest speakers around the country and outside of the U.S. The clinic includes a field trip over spring break and is available by application only. Applications are available at the beginning of the fall semester, and selections are made no later than November 1. 3 Course cr

ENV 975b, Western Lands and Communities Field Clinic: Research to Practice

This project-based course is for students engaged in social research, humanities study, natural science, and/or conservation management and policy in Western U.S. landscapes. The Spring 2024 version of the course focuses heavily on helping students excel in the writing and publishing process. The course counts toward the MEM capstone if desired. There is a mandatory spring field trip (expenses generously covered by YSE) for experiential learning, research, and writing in the Rocky Mountain West during the second week of spring break. Western lands and communities face growing ecological, economic, and social equity problems that require integrated solutions. Students complete a self-driven writing project throughout the term. At the end of the term, they submit it for publication to an outlet fit to their field of study and career goals (i.e., scholarly journal, book press, reputable news media, audio/video script-writing, etc.). The course is capped and requires an application. No preference is given to a particular field of study. Strong preference is given to students with ongoing writing projects or new ideas that are refined. 3 Course cr

ENV 982b, Green Engineering and Sustainable Design

Study of green engineering, focusing on key approaches to advancing sustainability through engineering design. Topics include current design, manufacturing, and disposal processes; toxicity and benign alternatives; policy implications; pollution prevention and source reduction; separations and disassembly; material and energy efficiencies and flows; systems analysis; biomimicry; and life cycle design, management, and analysis. 3 Course cr

Modules

ENV 001a, Self to System

Students work to gain the tools needed to thoughtfully design and maximize an impactful path through YSE, Yale University, and to their careers and lives beyond Yale. Students work through their own personal motivations and variety of lived experience. This MOD is designed to help students appreciate themselves and those around them and prepare them to maximize their time at YSE. o Course cr

ENV 002a, Science to Solutions

Students work to understand different strategies for knowing how to collect primary data; how to evaluate evidence; how to generate, visualize, and communicate alternative solutions; and how to iterate, monitor, and adaptively manage solutions. Students then opt into one of two pathways: A New Haven experience or Yale-Myers Forest experience. o Course cr