

SUSTAINABLE DEVELOPMENT

Departmental Office: The Earth Institute, Office of Academic and Research Programs, Hogan, B-Level; <http://sdev.ei.columbia.edu>

Co-Directors of Undergraduate Studies:

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Sustainable development is founded on the premise that human well-being should advance without irreparable harm to ecosystems and the vital services they provide, without depleting essential resources, and without posing risks to future generations. The term "sustainable" refers to managing the world's economy in a manner consistent with the continued healthy functioning of Earth's ecosystems, oceans, atmosphere and climate. In this context, "development" refers to continued social, political, and economic progress aimed at improving the well-being of the global community, especially for the poorest people.

Academic Programs

The Earth Institute—in collaboration with Columbia College, the School of General Studies, the School of International and Public Affairs, and the Departments of Earth and Environmental Science; Ecology, Evolution, and Environmental Biology; and Earth and Environmental Engineering—offers a major and a special concentration in sustainable development.

These programs are designed to: engage students in this emergent interdisciplinary discussion, provide knowledge of the theory and practice of sustainable development, stimulate a critical examination of historical and conceptual antecedents, provide experience in the complex challenges of sustainable development through direct engagement, and help them imagine alternative futures for our rapidly changing world. With help from the Earth Institute faculty, courses are specifically created to address the very real and complex issues of development as they relate to the interactions of the natural and social systems.

The major focuses heavily on the sciences and provides students with a working knowledge of issues on a range of interacting subject areas. After declaring the major, students are assigned an academic adviser from within the Earth Institute, who advises on class selection and career development. Students benefit from a support system of faculty, advisers, and program managers, and have access to the multitude of resources for internships, study abroad programs, and career development.

The special concentration is intentionally more flexible, but its structure allows students to benefit from the cross-disciplinary courses and to build the expertise to allow them to address the fundamental issue of how to move towards a trajectory of sustainability.

The sustainable development program is structured to ensure that students graduate with the skills and knowledge to enable them to advance professionally in the public, private, governmental, and nonprofit sectors, and to pursue advanced degrees. Those interested in sustainable development are encouraged to participate in lectures, conferences, and other programs sponsored by the Earth Institute.

Grading

A letter grade of C- or better is needed in all program-related courses in order to satisfy the program requirements.

Sustainable Development Faculty

Susana Adamo (Center for International Earth Information Network)

Satyajit Bose (School of International and Public Affairs)

Steve Cohen (The Earth Institute; School of International and Public Affairs)

Lisa Dale (The Earth Institute; Ecology, Evolution, and Environmental Biology)

Ruth DeFries (Ecology, Evolution, and Environmental Biology) (Co-Director)

Paul Galloway (Ecology, Evolution and Environmental Biology)

Michael Gerrard (Center for Climate Change Law and Columbia Law School)

Adela Gondek (Ecology, Evolution and Environmental Biology)

Radley Horton (Center for Climate Systems Research)

Joyce Klein-Rosenthal (The Earth Institute)

Jacqueline Klopp (The Earth Institute)

Upmanu Lall (Columbia Water Center; International Research Institute for Climate and Society)

Kytt McManus (Center for International Earth Science Information Network)

Dara Mendeloff (Center for International Earth Science Information Network)

Rachel Moresky (Population and Family Health)

John Mutter (Earth and Environmental Sciences; School of International and Public Affairs)

Linda Pistolesi (Center for International Earth Science Information Network)

Robert Pollack (Biological Sciences)

Elliott Sclar (The Earth Institute; Architecture, Planning, and Preservation; School of International and Public Affairs)

Jason Smerdon (Lamont-Doherty Earth Observatory) (Co-Director)

Marni Sommer (Mailman School of Public Health)

Martin Stute (Lamont-Doherty Earth Observatory)

Phil Weinberg (Ecology, Evolution and Environmental Biology)

Major in Sustainable Development

The sustainable development foundation courses should be taken first and students should then work with the program adviser on further course selection and sequencing.

The major in sustainable development requires a minimum of 15 courses and a practicum as follows:

Sustainable Development Foundation

SDEV UN1900	Introduction to Sustainable Development Seminar
SDEV UN2300	Challenges of Sustainable Development
EESC UN2330	Science for Sustainable Development

Basic Disciplinary Foundation

Select one of the following science sequences. NOTE--Associated labs are also required:

CHEM UN1403 - CHEM UN1404	General Chemistry I (Lecture) and General Chemistry II (Lecture)
EEEB UN2001 - EEEB UN2002	Environmental Biology I: Elements to Organisms and Environmental Biology II: Organisms to the Biosphere
EESC UN1600 - EESC UN2100	Earth Resources and Sustainable Development and Earth's Environmental Systems: The Climate System
EESC UN1600 - EESC UN2200	Earth Resources and Sustainable Development and Earth's Environmental Systems: The Solid Earth System
EESC UN1600 - EESC UN2300	Earth Resources and Sustainable Development and Earth's Environmental Systems: The Life System
EESC UN2100 - EESC UN2200	Earth's Environmental Systems: The Climate System and Earth's Environmental Systems: The Solid Earth System
EESC UN2100 - EESC UN2300	Earth's Environmental Systems: The Climate System and Earth's Environmental Systems: The Life System
EESC UN2200 - EESC UN2300	Earth's Environmental Systems: The Solid Earth System and Earth's Environmental Systems: The Life System
PHYS UN1201 - PHYS UN1202	General Physics I and General Physics II
PHYS UN1291	General Physics Laboratory
PHYS UN1202	General Physics II
PHYS UN1292	General Physics Laboratory II

Select two of the following social science courses:

ANTH UN1002	The Interpretation of Culture
ANTH UN2004	Introduction to Social and Cultural Theory
ECON UN1105	Principles of Economics
POLS UN1501	Introduction to Comparative Politics
POLS UN1601	Introduction to International Politics
SDEV UN2000	Introduction to Environmental Law
SDEV UN2050	Environmental Policy and Governance
SDEV UN3400	Human Populations and Sustainable Development
SOCI UN1000	The Social World

Select one of the following quantitative foundations courses:

EEEB UN3005	Introduction to Statistics for Ecology and Evolutionary Biology
EESC BC3017	Environmental Data Analysis

MATH UN2010	Linear Algebra
STAT UN1201	Calculus-Based Introduction to Statistics
STAT UN2103	Applied Linear Regression Analysis
STAT UN3105	Applied Statistical Methods
STAT UN3106	Applied Data Mining
STAT GU4203	PROBABILITY THEORY
STAT GU4204	Statistical Inference
STAT GU4205	Linear Regression Models
STAT GU4207	Elementary Stochastic Processes

Analysis and Solutions to Complex Problems

Select two of the following courses:

CIEE E3260	Engineering for developing communities
EAAE W4304	Closing the carbon cycle
ECIA W4100	Management and development of water systems
EESC BC3032	Agricultural and Urban Land Use: Human-Environment Interactions
EESC BC3045	Responding to Climate Change
EESC GU4600	Earth Resources and Sustainable Development
PLAN A4579	Introduction to Environmental Planning
PUBH UN3100	Fundamentals of Global Health
SDEV UN3330	Ecological and Social Systems for Sustainable Development
SDEV UN3355	Climate Change and Law
SDEV UN3360	Disasters and Development
SDEV UN3366	Energy Law
SDEV UN3410	Urbanization and Sustainable Development
SOCI BC3932	Climate Change, Global Migration, and Human Rights in the Anthropocene
URBS UN3565	Cities in Developing Countries: Problems and Prospects
SDEV GU4250	Climate Change: Resilience and Adaptation

The Summer Ecosystems Experience for Undergraduates (SEE-U) *

Skills/Actions

Select two of the following courses:

EAAE E4257	Environmental data analysis and modeling
EESC GU4050	Global Assessment and Monitoring Using Remote Sensing
EESC BC3050	Big Data with Python: Python for Environmental Analysis and Visualisation
SDEV UN2320	Economic and Financial Methods for Sustainable Development
SDEV UN3390	GIS for Sustainable Development
SDEV UN3450	Spatial Analysis and Modeling for Sustainable Development
SDEV GU4015	Complexity Science
SOCI UN3010	Methods for Social Research
SUMA PS4100	Sustainability Management
SDEV GU4101	Qualitative Research Methods for Sustainable Development

The Summer Ecosystems Experience for Undergraduates (SEE-U) *

Practicum

Select one of the following courses:

INAF U4420	Oil, Rights and Development
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SDEV UN3998	Sustainable Development Independent Study
SUMA PS4310	Practicum in Innovation Sustainability Leadership
SUMA PS4734	Earth Institute Practicum

Electives

Select two courses from the following areas. Courses can be combined across Areas 2-5 only. If you select Area 1, you must complete two thesis courses and these will fulfill the elective requirement:

Area 1: Senior Thesis Sequence (EESC BC3800/EESC BC3801 and EESC UN3901) **

Area 2: Upper level courses from the approved electives list (see link in footnotes to access list) ***

Area 3: Additional courses listed under Analysis and Solutions to Complex Problem

Area 4: Additional courses listed under Skills/Actions

Area 5

SDEV UN3310	Ethics of Sustainable Development
SDEV GU4050	Essential Connections: US Water & Energy Policy in a Resource-Constrained World
SDEV GU4350	Public Lands in the American West

Capstone Workshop

SDEV UN3280	Workshop in Sustainable Development
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* The Summer Ecosystem Experiences for Undergraduates (SEE-U): Please note that students in the major or the special concentration who take SEE-U as a 6-point course can use 3 points towards the Complex Problems requirement and 3 points towards the Skills/Action requirement. If SEE-U is taken for 3 points, it can only count as one Complex Problems class.

** If choosing the senior thesis option to fulfill the elective requirements, students must take both courses in the senior thesis sequence.

*** For a full list of previously approved electives, please visit the sustainable development program website: <http://sdev.ei.columbia.edu/curriculum/major/>.

Note: Please visit the Sustainable Development website for requirements: Majors: <http://sdev.ei.columbia.edu/curriculum/major/>

Special Concentration in Sustainable Development

In addition to the requirements of the special concentration, students must complete a major or a full concentration.

The sustainable development foundation courses should be taken first and students should then work with the program adviser on further course selection and sequencing.

The special concentration in sustainable development requires a minimum of 9 courses and a practicum as follows:

Sustainable Development Foundation

SDEV UN1900	Introduction to Sustainable Development Seminar
SDEV UN2300	Challenges of Sustainable Development
EESC UN2330	Science for Sustainable Development

Natural Science Systems

Select one of the following courses. NOTE--Associated Labs are also required:

CHEM UN1403	General Chemistry I (Lecture)
EEEB UN1001	Biodiversity
EEEB UN2002	Environmental Biology II: Organisms to the Biosphere
EESC UN1003	Climate and Society: Case Studies
EESC UN1011	Earth: Origin, Evolution, Processes, Future
EESC UN1201	Environmental Risks and Disasters
EESC UN1600	Earth Resources and Sustainable Development
EESC UN2100	Earth's Environmental Systems: The Climate System
EESC UN2200	Earth's Environmental Systems: The Solid Earth System
EESC UN2300	Earth's Environmental Systems: The Life System
PHYS UN1201	General Physics I
PHYS UN1291	General Physics Laboratory

Human Science Systems

Select one of the following courses:

ANTH UN1002	The Interpretation of Culture
ANTH UN2004	Introduction to Social and Cultural Theory
ECON UN1105	Principles of Economics
POLS UN1501	Introduction to Comparative Politics
POLS UN1601	Introduction to International Politics
SDEV UN2000	Introduction to Environmental Law
SDEV UN2050	Environmental Policy and Governance
SDEV UN3400	Human Populations and Sustainable Development
SOCI UN1000	The Social World

Analysis and Solutions to Complex Problems

Select two of the following courses:

CIEE E3260	Engineering for developing communities
EAEW W4304	Closing the carbon cycle
ECIA W4100	Management and development of water systems
EESC BC3032	Agricultural and Urban Land Use: Human-Environment Interactions
EESC BC3045	Responding to Climate Change
EESC GU4600	Earth Resources and Sustainable Development
PLAN A4579	Introduction to Environmental Planning
PUBH UN3100	Fundamentals of Global Health
SDEV UN3330	Ecological and Social Systems for Sustainable Development
SDEV UN3355	Climate Change and Law
SDEV UN3360	Disasters and Development
SDEV UN3366	Energy Law
SDEV UN3410	Urbanization and Sustainable Development
SOCI BC3932	Climate Change, Global Migration, and Human Rights in the Anthropocene
URBS UN3565	Cities in Developing Countries: Problems and Prospects

The Summer Ecosystem Experiences for Undergraduates (SEE-U) *

Skills/Actions

Select one of the following courses:

EAAE E4257	Environmental data analysis and modeling
EESC BC3050	Big Data with Python: Python for Environmental Analysis and Visualisation
EESC GU4050	Global Assessment and Monitoring Using Remote Sensing
SCNC W3010	Science, technology and society
SDEV UN2320	Economic and Financial Methods for Sustainable Development
SDEV UN3390	GIS for Sustainable Development
SDEV UN3450	Spatial Analysis and Modeling for Sustainable Development
SDEV GU4015	Complexity Science
SDEV GU4101	Qualitative Research Methods for Sustainable Development
SUMA PS4100	Sustainability Management
SOCI UN3010	Methods for Social Research

The Summer Ecosystem Experiences for Undergraduates (SEE-U) *

Practicum

Select one of the following courses:

INAF U4420	Oil, Rights and Development
SDEV UN3998	Sustainable Development Independent Study
SUMA PS4310	Practicum in Innovation Sustainability Leadership
SUMA PS4734	Earth Institute Practicum

Capstone Workshop

SDEV UN3280	Workshop in Sustainable Development
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* The Summer Ecosystem Experiences for Undergraduates (SEE-U): Please note that students in the major or the special concentration who take SEE-U as a 6-point course can use 3 points towards the Complex Problems requirement and 3 points towards the Skills/Action requirement. If SEE-U is taken for 3 points, it can only count as one Complex Problems class.

Note Sustainable Development Website for Special Concentrators: <http://sdev.ei.columbia.edu/curriculum/special-concentration/>

SDEV UN1900 Introduction to Sustainable Development Seminar. 1 Point.

Open to prospective sustainable development majors and concentrators only.

The course is designed to be a free flowing discussion of the principals of sustainable development and the scope of this emerging discipline. This course will also serve to introduce the students to the requirements of the undergraduate program in sustainable development and the content of the required courses in both the special concentration and the major. The focus will be on the breadth of subject matter, the multidisciplinary nature of the scholarship and familiarity with the other key courses in the program. Offered in the Fall and Spring.

Term	Section	Call Number	Instructor	Times/Location
Spring 2019	001	63844	Jason Smerdon	T 11:40am - 12:55pm 227 Seeley W. Mudd Building
Fall 2019	001	60935	Jason Smerdon	T 11:40am - 12:55pm 227 Seeley W. Mudd Building

SDEV UN2000 Introduction to Environmental Law. 3 Points.

The course provides an overview of environmental law for students without a legal background. It examines U.S. statutes and regulations regarding air, water, hazardous and toxic materials, land use, climate change, endangered species, and the like, as well as international environmental issues. After completing the course students should be equipped to understand how the environmental laws operate, the role of the courts, international treaties and government agencies in implementing environmental protection, and techniques used in addressing these issues.

Term	Section	Call Number	Instructor	Times/Location
Spring 2019	001	65707	Philip Weinberg	M W 10:10am - 11:25am 303 Hamilton Hall

SDEV UN2050 Environmental Policy and Governance. 3 Points.

Sustainability is a powerful framework for thinking about business, economics, politics and environmental impacts. An overview course, Environmental Policy & Governance will focus specifically on the policy elements of sustainability. With an emphasis on the American political system, the course will begin by exploring the way the American bureaucracy addresses environmental challenges. We will then use the foundations established through our understanding of the US system to study sustainable governance at the international level. With both US and international perspectives in place, we will then address a range of specific sustainability issues including land use, climate change, food and agriculture, air quality, water quality, and energy. Over the course of the semester, we will study current events through the lens of sustainability policy to help illustrate course concepts and theories.

Term	Section	Call Number	Instructor	Times/Location
Fall 2019	001	60936	Lisa Dale	M W 11:40am - 12:55pm 233 Seeley W. Mudd Building

SDEV UN2300 Challenges of Sustainable Development. 3 Points.

This course provides an introduction to the field of sustainable development, drawing primarily from social science and policy studies. It offers a critical examination of the concept of sustainable development, showing how factors like economics, population, culture, politics and inequality complicate its goals. Students will learn how different social science disciplines (political science, demography, economics, geography, history, law, and sociology) approach challenges of sustainable development across a variety of topics (fisheries, climate change, air pollution, consumption, energy, conservation, and water management). The course provides students with some of the fundamental concepts, vocabulary, and analytical tools to pursue and think critically about sustainable development. Offered in the Spring.

Term	Section	Call Number	Instructor	Times/Location
Spring 2019	001	26450	Jason Chun Yu Wong, Lisa Dale	T Th 4:10pm - 5:25pm Room TBA

SDEV UN2320 Economic and Financial Methods for Sustainable Development. 3 Points.

Prerequisites: Principles of Economics and one semester of calculus. The objective of this course is to introduce students to the skills and methods necessary to understand and evaluate the economic and financial aspects of sustainable development. Throughout the course, students will compare competing objectives and policies through the prism of economic & financial reasoning. Environmental economics and finance are broad areas covering all the multi-faceted and complex interactions between the economic system and the natural environment. Financial markets are the primary source of signals used to direct economic activity in a capitalist global economy. Economic activity is the primary determinant of the quality and sustainability of the natural environment. Students interested in sustainable development who are unfamiliar with economics and who do not develop a facility with economic and financial concepts are severely handicapped in their efforts to increase the level of environmental responsibility embedded in economic activity. This course is intended to provide students with a flying introduction to key analytical concepts required to understand topics in environmental economics and finance and to introduce them to selected topics within the field. The first part of the course (the Analytical Toolbox) is designed to provide a set of portable skills for two sets of students: a) those who will work in fields specifically devoted to sustainable development who, as part of their work, will need to engage with sources of economic & financial information and with discourses where sustainable development is not a focus; and b) students who may end up following careers in organizations where sustainability is not the primary objective. The topics and readings in the second part of the course were chosen to facilitate a critical engagement with the broad intellectual framework underlying sustainable development from the perspective of economics and finance. The topics are intended to create a community of intellectual discourse on sustainable development that will spill over beyond the classroom to the conversations of students and alumni that will far outlive graduation. Offered in the Fall.

Term	Section	Call Number	Instructor	Times/Location
Fall 2019	001	60937	Satyajit Bose	M W 4:10pm - 5:25pm 424 Kent Hall

SDEV UN3280 Workshop in Sustainable Development. 4 Points.

Open to sustainable development seniors only.

The upper level undergraduate Sustainable Development Workshop will be modeled on client based graduate-level workshops, but with more time devoted to methods of applied policy analysis and issues in Sustainable Development. The heart of the course is the group project on an issue of sustainable development with a faculty advisor providing guidance and ultimately grading student performance. Students would receive instruction on methodology, group work, communication and the context of policy analysis. Much of the reading in the course would be project-specific and identified by the student research teams. Offered in Fall and Spring. For registration issues contact Cari Shimkus (cshimkus@ei.columbia.edu).

Term	Section	Call Number	Instructor	Times/Location
Spring 2019	001	62157	Cari Shimkus	M W 12:10pm - 2:00pm Room TBA
Spring 2019	002	71402	Radley Horton	T Th 12:10pm - 2:00pm 415 Schapiro Cepser
Fall 2019	001	60938	Joyce Klein Rosenthal	T Th 2:10pm - 4:00pm 717 Havemeyer Hall
Fall 2019	002	60939	Radley Horton	T Th 12:10pm - 2:00pm 402 Hamilton Hall

SDEV UN3310 Ethics of Sustainable Development. 3 Points.

Aiming to improve human conditions within many diverse environments, sustainable development seeks to create, increase and perpetuate benefit and to cease, rectify and reverse harm. Sustainable development is consequently inextricable from the fabric of ethics, woven with determinations of benefit and harm to the existence and well-being of both humans and nonhumans. Underlying such determinations are those of self- and other-regarding motivation and behavior; and underlying these are still others, of sensitivity and rationality in decision-making, whether individual, social or public. Sustainable development is interlaced with and contingent upon all these determinations, at once prescriptive and judgmental, which can be called the ethics of sustainable development. This course is divided into four main sections, of which two are intended to show the ethical fallacies of unsustainable development, and two, the ethical pathways of sustainable development. The first section focuses upon ethically problematic basic assumptions, including human (species) hegemony, happy (hedonic) materialism, and selective (data) denial. The second focuses upon ethically problematic ensuing rationalizations, including those pertaining to damages, victims, consequences and situations of climatic, chemical, biological and ecological harm. The third section responds to these rationalizations with ethically vital considerations of earth justice, environmental justice, culturally-based ethics, and sector-based ethics (water, food, place and climate ethics). Finally, the fourth section responds to the initial, longstanding problematic assumptions with a newly emergent ethical paradigm, comprising biotic wholeness, environmental integrity and the deliberative zero-goal. Tying all sections together is the central theme: to be sustainable, development must be ethical. Reflecting the collaborative quality of the field of sustainable development, the course extends to readings whose authors have all pursued their work at intersections of science and ethics, environment and ethics, policy and ethics, business and ethics, and sustainable development and ethics.

Term	Section	Call Number	Instructor	Times/Location
Spring 2019	001	63044	Adela Gondek	T Th 1:10pm - 2:25pm 825 Seeley W. Mudd Building

SDEV UN3330 Ecological and Social Systems for Sustainable Development. 3 Points.

Prerequisites: SDEV UN2300 Challenges of Sustainable Development and EESC UN2330 Science for Sustainable Development.

The course focuses on basic principles in understanding ecological and social relationships and then focuses on three current topics central to Sustainable Development for in-depth study. Examples of topics to be covered are: conservation of biodiversity, payments for ecosystem services, and the ecology of food production. The emphasis will be on the multiple perspectives— environmental, social and economic— required to understand and develop solutions to problems in sustainable development. These topics will undoubtedly vary from year to year, as the course keeps pace with current topics.

Term	Section	Call Number	Instructor	Times/Location
Fall 2019	001	60940	Ruth DeFries	M W 6:10pm - 7:25pm 316 Hamilton Hall

SDEV UN3355 Climate Change and Law. 3 Points.

Enrollment limited to 15.

The purpose of this course is to provide students with a broad introduction to the field of climate law in the United States and at the international level. The course begins with an overview of the causes and effects of global climate change and the methods available to control and adapt to it. We then examine the negotiation, implementation and current status of the United Nations Framework Convention on Climate Change, the Kyoto Protocol, and the Copenhagen Accord. The focus then turns to the past and proposed actions of the U.S. Congress, the executive branch and the courts, as well as regional, state and municipal efforts. The Clean Air Act, the National Environmental Policy Act and the Endangered Species Act will receive special attention. We evaluate the various legal tools that are available to address climate change, including cap-and-trade schemes; carbon taxation; command-and-control regulation; litigation; securities disclosures; and voluntary action. The roles of energy efficiency, renewable energy sources, carbon capture and sequestration, and forestry and agriculture each receive close attention. Implications for international human rights, international trade, environmental justice, and international and intergenerational equity are discussed. The course concludes with examination of the special challenges posed by China; proposals for adaptation and geoengineering; and business opportunities and the role of lawyers. Offered in the Spring.

Term	Section	Call Number	Instructor	Times/Location
Spring 2019	001	75706	Michael Gerrard	W 6:00pm - 7:00pm 1102 International Affairs Bldg
Spring 2019	001	75706	Michael Gerrard	T Th 9:10am - 10:30am 107 Green Hall Law Building

SDEV UN3360 Disasters and Development. 3 Points.

Prerequisites: *EESC 2330; SDEV W2300.*

Human welfare status is very unevenly distributed throughout the globe – some of us live very comfortable lives, others remain in desperate poverty showing little progress away from their condition. Between are countries that are rapidly developing and converging toward the welfare of the richest. At all levels of economic development human activities place significant pressure on the environment and threatens all of Earth's vital functions and support systems for human life. This challenge requires timely responses based on solid understanding of the human/environment interface, technological and economic approaches to mitigate adverse effects on the environment, and routes to understanding the complex dynamics of the coupled human/natural systems that can chart a pathway to improvement in the lives of the poorest and continued well-being for those who have achieved prosperity without forcing natural systems into decline or massive fluctuation. This course offers undergraduate students, for the first time, a comprehensive course on the link between natural disaster events and human development at all levels of welfare. It explores the role that natural disasters might have and have had in modulating development prospects. Any student seriously interested in sustainable development, especially in light of climate change, must study the nature of extreme events - their causes, global distribution and likelihood of future change. This course will cover not only the nature of extreme events, including earthquakes, hurricanes, floods and droughts but also their transformation into disaster through social processes. It will ultimately help students to understand the link between such extreme events, the economic/social shock they represent and development outcomes. The course will combine careful analysis of the natural and social systems dynamics that give rise to disasters and examine through group learning case studies from the many disasters that have occurred in the first decade of the 21st century. Offered in the Spring (odd years only).

SDEV UN3366 Energy Law. 3 Points.

This course concerns the regulation of energy, energy resources, and energy facilities. Among the topics will be the regulation of rates and services; the roles of the Federal Energy Regulatory Commission and the state public utility commissions; and the interaction with environmental law. Attention will be devoted to energy resources (such as oil, natural gas and coal) and to generating, transmission and distribution facilities. The current and future roles of renewable energy, energy efficiency, and nuclear energy will receive special attention, as will the regulation and deregulation of electricity.

Term	Section	Call Number	Instructor	Times/Location
Fall 2019	001	60941	Michael Gerrard	T 4:20pm - 6:10pm 102b Jerome L Greene Hall
Fall 2019	001	60941	Michael Gerrard	Th 6:00pm - 7:00pm 114 Knox Hall
Fall 2019	001	60941	Michael Gerrard	W 7:30pm - 8:30pm Room TBA

SDEV UN3390 GIS for Sustainable Development. 3 Points.

Priority given to sustainable development senior and juniors.

This course is designed to provide students with a comprehensive overview of theoretical concepts underlying GIS systems and to give students a strong set of practical skills to use GIS for sustainable development research. Geographic Information Systems (GIS) are a system of computer software, data and analysis methods used to create, store, manage, digital information that allow us to create maps and dynamic models to analyze the physical and social processes of the world. Through a mixture of lectures, readings, focused discussions, and hands-on exercises, students will acquire an understanding of the variety and structure of spatial data and databases, gain knowledge of the principles behind raster and vector based spatial analysis, and learn basic cartographic principles for producing maps that effectively communicate a message. Student will also learn to use newly emerging web based mapping tools such as Google Earth, Google Maps and similar tools to develop on-line interactive maps and graphics. The use of other geospatial technologies such as the Global Positioning System will also be explored in this class. Case studies examined in class will draw examples from a wide ranges of GIS applications developed to assist in the development, implementation and evaluation of sustainable development projects and programs. On completion of the course, students will: 1. use a variety of GIS software programs to create maps and reports; 2. develop a sound knowledge of methods to search, obtain, and evaluate a wide variety of spatial data resources; 3. develop skills needed to determine best practices for managing spatial data resources; 4. use GIS to analyze the economic, social and environmental processes underlying the concept of building a sustainable world; 5. Gain an understanding of the limits of these technologies and make assessments of uncertainty associated with spatial data and spatial analysis models. Offered in the fall and spring.

Term	Section	Call Number	Instructor	Times/Location
Spring 2019	001	21731	Linda Pistolessi, Kytt MacManus	M 1:10pm - 2:25pm 252 Engineering Terrace
Spring 2019	001	21731	Linda Pistolessi, Kytt MacManus	W 1:10pm - 3:25pm 252 Engineering Terrace
Fall 2019	001	60942	Kytt MacManus	M 10:10am - 11:25am 252 Engineering Terrace
Fall 2019	001	60942	Kytt MacManus	W 10:10am - 12:25pm 252 Engineering Terrace

SDEV UN3400 Human Populations and Sustainable Development. 3 Points.

Population processes and their outcomes in terms of population size and distribution have a fundamental role in sustainable development and also broad policy implications. This course will introduce students to the scientific study of human populations as a contribution toward understanding social structure, relations, and dynamics, as well as society-nature interactions. The aim is to offer a basic introduction to the main theories, concepts, measures, and uses of demography. The course will cover the issues of population size, distribution and composition, and consumption, at different scales from global to regional to local, as well as the implications for population-environment relationships. It will also address the fundamental demographic processes of mortality, fertility and migration, including their trends and transitions. We will consider these topics in the context of economic development, sustainability and cultural change. The course will also include an overview of basic demographic techniques and tools used for identifying, managing, analyzing and interpreting population data, and an introduction to population projections. Lab sessions will supplement readings and lectures by enabling students to explore data sources, calculate rates, and graphically represent demographic data. Offered in the Fall (even years).

SDEV UN3410 Urbanization and Sustainable Development. 3 Points.

The first decade of the 21st century marked the first time in human history when more of world's population lived in urban as distinct from rural places. It is impossible to achieve sustainable development in a physical, social or economic manner absent an understanding of the powerful and interdependent relationship between these concepts of sustainability and urbanization. This course explores this vital nexus. Students will gain a more detailed understanding of the ways in which urban life provides opportunities and challenges for addressing climate change, access to water and energy efficiency, among other topics. The intention is to provide students majoring in Sustainable Development with an historic and contemporary understanding of the connections between the process of urbanization that now dominates the world and the range of ways in which that process, directly and indirectly, shapes the challenge of sustainable development. Offered in the Fall (even years).

Term	Section	Call Number	Instructor	Times/Location
Spring 2019	001	21194	Elliott Sclar, Siobhan Watson	M 2:10pm - 4:00pm 613 Hamilton Hall

SDEV UN3450 Spatial Analysis and Modeling for Sustainable Development. 3 Points.

Priority given to sustainable development senior and juniors.

This is an intermediate course in spatial modeling developed specifically for students in the undergraduate Sustainable Development program. This course will provide a foundation for understanding a variety of issues related to spatial analysis and modeling. Students will explore the concepts, tools, and techniques of GIS modeling and review and critique modeling applications used for environmental planning and policy development. The course will also offer students the opportunity to design, build and evaluate their own spatial analysis models. The course will cover both vector and raster based methods of analysis with a strong focus on raster-based modeling. Participants will also learn how to develop and publish online maps, spatial applications, metadata, and mobile Apps in a geodatabase environment to support fieldwork research and geospatial data gathering and analysis. Course registration includes online mapping user license and credits to store, analyze, and serve geospatial data and apps. We will draw examples from a wide range of applications in such areas as modeling Land Use and Land Cover for biodiversity and conservation, hydrological modeling, and site suitability modeling. The course will consist of lectures, reading assignments, lab assignments, and a final project. **Students must register for required lab: SDEV W3452.**

SDEV UN3998 Sustainable Development Independent Study. 1-3 Points.

Sustainable development majors and special concentrators must register for this independent study to use internship hours for the practicum credit. Students must consult with their program adviser and department before registering. Offered fall, spring and summer.

Term	Section	Call Number	Instructor	Times/Location
Spring 2019	001	26573	Ruth DeFries, Cari Shimkus	
Fall 2019	001	60943	Ruth DeFries	

SDEV GU4015 Complexity Science. 3 Points.

The Complexity Course is a survey of techniques, applications, and implications of complexity science and complex systems. This course aims to be both an introduction for students from other fields, and a forum for continued discussion within the complexity community. Topics include systems dynamics, chaos, scaling, fatterailed distributions, fractals, information theory, emergence, criticality, agentbased models, graph theory, and social networks.

SDEV GU4050 Essential Connections: US Water & Energy Policy in a Resource-Constrained World . 3 Points.

Course Summary:

Water, one of humankind's first power sources, remains critically important to the task of maintaining a sustainable energy supply, in the United States and elsewhere. Conversely, the need to provide safe drinking water and keep America's rivers clean cannot be met without access to reliable energy supplies. As the impact of climate disruption and other resource constraints begins to mount, the water/energy nexus is growing increasingly complex and conflict-prone.

Essential Connections begins by examining the development of America's water and energy policies over the past century and how such policies helped to shape present-day environmental law and regulation. Our focus then turns to the current state of US water and energy resources and policy, covering issues such as oil and gas exploration, nuclear energy, hydroelectric power and renewables. We also examine questions of inclusion and equity in connection with the ways in which communities allocate their water and energy resources and burdens along racial, ethnic and socioeconomic lines. The third and final section of the course addresses the prospects for establishing water and energy policies that can withstand climate disruption, scarcity and, perhaps most importantly, America's seemingly endless appetite for political dysfunction.

By semester's end, students will better understand the state of America's energy and water supply systems and current efforts to cope with depletion, climate change and related threats affecting these critical, highly-interdependent systems. As a final project, students will utilize the knowledge gained during the semester to create specific proposals for preserving and enhancing the sustainability of US water and energy resources.

Term	Section	Call Number	Instructor	Times/Location
Spring 2019	001	15099	Paul Gally	M 6:10pm - 8:00pm 401 Hamilton Hall

SDEV GU4101 Qualitative Research Methods for Sustainable Development. 3 Points.

Students of sustainable development are faced with an array of global challenges that warrant scholarly inquiry. Social science questions are particularly well suited for qualitative research. This course will provide an overview of social science research methods, with a focus on building a toolkit for undergraduate students. We begin with an overview of the science of knowing. How do we generate scientific hypotheses in the social sciences, and then how can we find out whether those hypotheses are accurate? An exploration of a range of qualitative research methods will occupy the majority of our class time, including interviewing, case studies, questionnaires, surveys, coding, and participant observation. Toward the end of the course we consider how mixed methods allow for the integration of quantitative tools in the social sciences. Throughout, students will both study and practice these research methods, experimenting to better understand the strengths and challenges associated with each approach. The course will end with poster presentations in which students share their own research and justify the methods they have employed.

Term	Section	Call Number	Instructor	Times/Location
Fall 2019	001	60944	Lisa Dale	T 4:10pm - 6:00pm 201a Philosophy Hall

SDEV GU4250 Climate Change: Resilience and Adaptation. 3 Points.

For much of recent history, climate change policy has focused on mitigation. Reducing emissions and shifting our energy sources away from fossil fuels, for example, are actions that could slow the pace of climate change. But since human populations are vulnerable to baseline climate, and the climate is already changing, policy-makers have also begun to address adaptation. This course will explore dimensions of climate adaptation across sectors and scales. With a thematic focus on pervasive global inequities, students will also consider challenges associated with international development and disaster risk management. An inter-disciplinary framework will enrich the course, and students will learn about perspectives from the natural sciences, law, architecture, anthropology, humanitarian aid, and public policy.

Term	Section	Call Number	Instructor	Times/Location
Spring 2019	001	27780	Lisa Dale	W 4:10pm - 6:00pm 401 Hamilton Hall

SDEV GU4350 Public Lands in the American West. 3 Points.

Course Description:

Environmental issues in the American West are dramatically different from the rest of the country due in large part to the prevalence of public lands. Most western states have a land base that is at least 35% public, and competing interests vie for limited resources and navigate a complex bureaucracy. This course will focus on the federal agencies authorized to make management decisions across those lands: the U.S. Forest Service, U.S. Bureau of Land Management, U.S. Park Service, and others. We will explore the legal and regulatory framework that guides land use decisions, and study enduring resource access conflicts. Pulling from both academic scholarship and the gray literature in political science, environmental sciences, law, and organizational behavior, this course provides an interdisciplinary overview of governance challenges in the American West.

Organized into four parts, the course will unfold as follows. Part I reviews the theory and origins of our public lands system. We will explore political and ecological history, as well as contributions from psychology and anthropology that help flesh out the layered values associated with the collective choice to remove so much land from the private estate. Part II brings us to the nuts and bolts of the system, and we will learn about the agencies responsible for managing public lands with a focus on the National Park Service, the U.S. Forest Service, and the Bureau of Land Management. Laws and regulations that guide these agencies will also be covered in this section of the course. Part III will focus on stakeholders, including environmental groups, industry groups, local communities, and, indeed, American taxpayers. With so many competing interests, these groups have been active participants in management, and we will consider the various tactics these groups use to advance their goals. Part IV brings everything together in a more detailed study of key controversies on public lands, including energy development, recreation access, Wilderness designation, wildfire management, and endangered species management

Term	Section	Call Number	Instructor	Times/Location
Spring 2019	001	66425	Lisa Dale	M W 11:40am - 12:55pm 407 Mathematics Building

Of Related Interest

Analysis of Climate and Earth Systems

EESC BC3017	Environmental Data Analysis
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EESC GU4008	Introduction to Atmospheric Science	JWST G4610	Environment and Sustainability in Israel â€” Between the Local and the Regional
EESC GU4917	Earth/Human Interactions	SCNC W3010	Science, technology and society
EESC GR6901	Research Computing for the Earth Sciences	SDEV UN3310	Ethics of Sustainable Development
Disasters and Health		SDEV GU4350	Public Lands in the American West
ANTH V3924	Anthropology and Disaster	SOCI UN3020	Social Statistics
ANTH V3971	Culture and Environmental Behavior	SOCI UN3235	Social Movements
INAF U6760	Managing Risk in Natural and Other Disasters	SOCI UN3324	Global Urbanism
Economics		SOCI UN3960	Law, Science, and Society
ECON UN2257	Global Economy	POLS V3212	Environmental Politics
ECON BC3029	Empirical Development Economics	REGN U6639	Gender and Development in Southeast Asia
ECON UN3211	Intermediate Microeconomics	POLS UN3604	War, Peace, and International Interventions in Africa
ECON UN3213	Intermediate Macroeconomics	POLS UN3690	International Law
ECON GU4301	Economic Growth and Development	CGTH UN3402	Topics in Global Thought: Global 20-Youth in an Interconnected World
ECON GU4370	Political Economy	Urban Studies/Urbanization	
ECON GU4500	International Trade	URBS V3200	Spatial Analysis: GIS Methods and Urban Case Studies
ECON G4527	Economic Organization and Development of China	URBS UN3565	Cities in Developing Countries: Problems and Prospects
ECON W4625	Economics of the Environment	PLAN A4579	Introduction to Environmental Planning
SUMA PS4190	Economics of Sustainability Management	SUMA PS4130	Sustainable Cities
Energy and Engineering		SUMA PS4330	Disaster Risk Management and Sustainable Urban Resilience
ANTH V3872	From Physics Labs to Oil Futures: Social Studies of Energy	SUMA PS4490	Women in Cities: Integrating Needs, Rights, Access and Opportunity into Sustainable Urban Design, Planning and Management
INAF U6242	Energy Policy	Waste Management and Pollution	
INAF U8778	Distributed Energy Economics, Technology, and Policy	EAAE E4009	Geographic information systems (GIS) for resource, environmental and infrastructure management
EAAE E3103	Energy, minerals and materials systems	EAAE E4150	Air pollution prevention and control
CIEE E4252	Foundations of Environmental Engineering	EAAE E4160	Solid and hazardous waste management
EAAE E4001	Industrial ecology of earth resources	EAAE E4257	Environmental data analysis and modeling
EAAE E3900	Undergraduate research in Earth and environmental engineering	EESC BC3033	Waste Management
Food, Health and Ecology		CIEE E3255	Environmental control and pollution reduction systems
EEEE UN3087	Conservation Biology	Water	
EEEE W4122	Fundamentals of Ecology and Evolution	EAAE E4350	Planning and management of urban hydrologic systems
EEEE GU4260	Food, Ecology, and Globalization	EEEE W4110	Coastal and Estuarine Ecology
HSPB W3950	Social History of American Public Health	EEEE GU4195	Marine Conservation Ecology
PUBH GU4200	Environment, Health, and Justice: Concepts and Practice	ECIA W4100	Management and development of water systems
SOCI V2230	Food and the Social Order	CIEE E3250	Hydrosystems engineering
SUMA PS4235	The Science of Urban Ecology	CIEE E4163	Sustainable Water Treatment and Reuse
SUMA PS 5030	Hungry City Workshop	SDEV GU4050	Essential Connections: US Water & Energy Policy in a Resource-Constrained World
Law, Policy and Human Rights		SUMA PS4145	Science of Sustainable Water
EEEE GU4321	Human Nature: DNA, Race & Identity		
EEEE GU4700	Race: The Tangled History of a Biological Concept		
ENVP U6236	Origins of Environmental Law: Regulation & Evolution		
HIST W4400	Americans and the Natural World, 1800 to the Present		
HRTS UN3001	Introduction to Human Rights		
HRTS BC3850	Human Rights and Public Health		
POLS BC3805	*Colloquium on International Organization		
INAF U4545	Contemporary Diplomacy		
INAF U6243	International Environmental Policy		