CLIMATE SYSTEM SCIENCE

The Department of Earth and Environmental Sciences:

Department website: https://eesc.columbia.edu/

Morningside Office Location: 556-7 Schermerhorn Hall Extension

Office Contact: 212-854-3614

Lamont-Doherty Earth Observatory Office Location: 106 Geoscience

Office Contact: 845-365-8550

Co-Directors of Undergraduate Studies:
Terry Plank and Joerg Schaefer
dees-dus@columbia.edu

Director of Academic Administration and Finance: Kaleigh Matthews, kaleighm@ldeo.columbia.edu
Undergraduate Program Manager: Julianna Russo, jr4432@columbia.edu

The Study of Earth and Environmental Sciences:

The undergraduate programs in the Department of Earth and Environmental Sciences provide an understanding of the natural functioning of our planet and considers the consequences of human interactions with it. Our program for majors aims to convey an understanding of how the complex Earth system works at a level that encourages students to think creatively about the Earth system processes and how to address multidisciplinary environmental problems. The breadth of material covered provides an excellent background for those planning to enter the professions of law, business, diplomacy, public policy, teaching, journalism, etc. At the same time, the program provides sufficient depth so that our graduates are prepared for graduate school in one of the Earth sciences. The program can be adjusted to accommodate students with particular career goals in mind.

All majors, minors, and concentrators, when planning their programs of study, should regularly consult the directors of undergraduate studies and make themselves aware of the requirements for their particular program.

Student Advising

Earth Science and Environmental Science Majors, Minors, and Concentrators:
DUS: Terry Plank, dees-dus@columbia.edu

Climate System Science and Climate and Sustainability Majors and Minors:
DUS: Joerg Schaefer, dees-dus@columbia.edu

All Programs:
Undergraduate Program Manager: Julianna Russo, jr4432@columbia.edu

Coursework Taken Outside of Columbia

Advanced Placement

To check if AP credits will fulfill program requirements, specifically the Supporting Courses requirement, please contact the DUS.
AP Environmental Science does not fulfill any DEES major, minor, or concentration requirements.

Barnard College Courses

Courses taken at Barnard College can count towards the Breadth requirement if they are science-based and 2000 level or above. Barnard courses with STEM prerequisites can count towards the Depth requirement. To check if Barnard College courses will fulfill program requirements, please contact the DUS with the course number, name, and syllabus.

Transfer Courses

Fulfillment of program requirements by earth, environmental, and/or climate-related transfer courses will be determined by the DUS. Please send your transcript and the course name and syllabi to dees-dus@columbia.edu for evaluation.

For DEES majors, at least 50% of upper-level courses must be taken at Columbia:
Climate System Science Majors: Students must take at least 3 Climate System Core courses, and at least 1 Climate Solutions, Justice, Policy, Communications course at Columbia, from their designated lists seen in the bulletin.
Earth Science and Environmental Science Majors: At least 3 Depth/Breadth courses must be taught by a DEES Instructor.
Trinity College Dublin Dual Degree: Please send your Trinity College transcripts to dees-dus@columbia.edu to check which courses will fulfill the Earth Science Major requirements. At least 3 Depth courses and 1 Breadth course, as well as the capstone sequence, must be taken at Columbia.

Study Abroad Courses

Courses taken abroad must be approved by the DUS ahead of time in order to count towards the major. If you are interested in studying abroad, please consult with the DUS to plan your major requirements accordingly. Typically, students can count supporting courses taken abroad, and any earth, environmental, and/or climate-related courses must be evaluated by the DUS. To check if Study Abroad courses will fulfill program requirements, please contact the DUS with the course syllabus.

Undergraduate Research and Senior Thesis

Senior Thesis Coursework and Requirements

All students majoring in DEES are required to complete the capstone requirement during their senior year. Depending on your major, you may have more than one option to fulfill this requirement - EESC UN3901 Senior Seminar, EESC U3904 Independent Research in Climate System Science, or an approved Field Course. Please refer to the Requirements page and the DEES website to learn more about the capstone options for each major. Only students who complete the senior thesis may be considered for departmental honors.

Undergraduate Research Outside of Courses

The department's close affiliations with the Lamont-Doherty Earth Observatory, the American Museum of Natural History (AMNH), NASA's Goddard Institute for Space Studies (GISS), the Earth Institute at Columbia (EI), and several departments within the Fu Foundation School of Engineering and Applied Sciences afford opportunities for student participation in a wide variety of current research programs. Summer employment, research, and additional educational opportunities are available at Lamont and GISS. The department encourages majors to become involved in a research project by their junior year.

Department Honors and Prizes

The Department of Earth and Environmental Science awards departmental honors to the major or majors in DEES judged to have the best overall academic record. The award is accorded to no more than 10% of the graduating class, or one student in the case of a class smaller than 10. A grade point average of at least 3.6 in the major and a senior thesis or equivalent research of high quality are required. All students meeting these requirements are automatically considered for departmental honors.

Professors

Ryan Abernathey
Nicholas Christie-Blick
Joel E. Cohen
Hugh Ducklow
Sonya Dyhrman
Peter Eisenberger
Göran Ekström
Pierre Gentine
Steven L. Goldstein
Arnold L. Gordon
Kevin L. Griffin (Chair)
Alex Halliday
Sidney R. Hemming (Director of Graduate Studies)
Bärbel Hönisch
Peter B. Kelemen
Folarin Kolawole
Galen McKinley
Jerry F. McManus (Associate Chair)
Faye McNeill
William H. Menke
John C. Mutter
Meredith Nettles
Paul E. Olsen
Terry A. Plank (Director of Undergraduate Studies)
Lorenzo M. Polvani
G. Michael Purdy
Maureen Raymo
Christopher H. Scholz
Adam H. Sobel
Marc Spiegelman
Martin Stute (Barnard)
Maya Tolstoy
Renata Wentzcovich

Associate Professors

Jacqueline Austermann
Roisin Commane
Jonathan Kingslake

Assistant Professors

Folarin Kolawole
Yves Moussallam

Adjunct Professors

Robert F. Anderson
W. Roger Buck IV
Denton Ebel
John J. Flynn
Arthur Lerner-Lam
Alberto Malinverno
Ronald L. Miller
Dorothy M. Peteet
Andrew Robertson
Joerg M. Schaefer
Christopher Small
Andreas Thurnherr
Felix Waldhauser
Spahr C. Webb
Gisela Winckler

Adjunct Associate Professors

Anne Bécel

Emeritus

Mark Cane
Hugh Ducklow
Arnold Gordon
James Hays
Paul Richards
Lynn Sykes
David Walker

Guidelines for all Earth Science, Environmental Science, Climate System Science, and Climate and Sustainability Majors, Minors, Concentrators, and Special Concentrators

Advising

All majors, minors, and concentrators, when planning their programs of study, should regularly consult the directors of undergraduate studies, who can be contacted through the department office on the fifth floor of Schermerhorn. The requirements are different for each major, minor, and concentration and must be met in conjunction with the general requirements for the bachelor's degree. Declaration of the major must be approved by the department and filed in the departmental office.

Substitutions and Exceptions

1. Higher-level courses may be used to satisfy supporting mathematics and science requirements for students with Advanced Placement preparation with the permission of the major adviser.
2. In addition to the courses listed for the depth, and breadth and related courses requirements, several graduate-level courses offered in the department as well as several advanced courses offered at Barnard may be substituted with the permission of the major adviser.
3. *1000*-level courses in the Earth and Environmental Sciences Department **cannot** be used toward meeting the requirements of the Earth Science major and Environmental Science major, concentrations, or special concentrations. **Please note**:*1000*-level courses can be used towards meeting the requirements of the Climate System Science major and Climate and Sustainability major, and some Earth and Environmental Science minors.
4. Double counting is not permitted for minors.
5. EESC UN2330 does not fulfill the Breadth requirement.
6. EESC GU4600 does not fulfill the Depth requirement, this course would only fulfill the Breadth requirement.

Grading

A grade of C- or better must be obtained for a course to count toward the majors, concentrations, or special concentrations. The grade of P is not acceptable, but a course taken Pass/D/Fail may be counted if and only if the P is uncovered by the Registrar's deadline.

Major in Earth Science

Please read Guidelines for all Earth Science, Environmental Science, Climate System Science, and Climate and Sustainability Majors, Minors, Concentrators, and Special Concentrators above.

The major in Earth Science requires a minimum of 45.5 points, distributed as follows:

Foundation Courses

EESC UN2200	EARTH'S ENVIRONMENTAL SYSTEMS: THE SOLID EARTH
Select one of the following:	
EESC UN2100	EARTH'S ENVIRO SYST: CLIM SYST
EESC UN2300	EARTH'S ENVIRO SYST: LIFE SYST

Students who wish to take both EESC UN2100 EARTH'S ENVIRO SYST: CLIM SYST and EESC UN2300 EARTH'S ENVIRO SYST: LIFE SYST can include one of these under breadth and related fields below.

Supporting Mathematics and Science Courses

One semester of Calculus at the level of Calculus I or higher (3 credits)	
MATH UN1101	CALCULUS I
Select one of the following three-course sequences:	
CHEM UN1403 & CHEM UN1404 & PHYS UN1201	GENERAL CHEMISTRY I-LECTURES and GENERAL CHEMISTRY II-LECTURES and GENERAL PHYSICS I
CHEM UN1403 & PHYS UN1201 & PHYS UN1202	GENERAL CHEMISTRY I-LECTURES and GENERAL PHYSICS I and GENERAL PHYSICS II

Capstone Experience

Select one of the following:	
EESC BC3800 & EESC UN3901	ENVIR SCIENCE SENIOR SEMINAR and SENIOR SEMINAR
EESC BC3801 & EESC UN3901	ENVIR SCIENCE SENIOR SEM II and SENIOR SEMINAR
A six to eight week summer geology field course	

Breadth and Related Fields Requirement

A minimum of 6 points (two courses) chosen with the major adviser are required.

Breadth and related field courses are science courses relevant for an Earth science major that do not require an Earth science background. Several such courses are offered at the *2000-*, *3000-* and *4000*-level in the department and at Barnard. Examples inlcude:

EESC UN2100	EARTH'S ENVIRO SYST: CLIM SYST
EESC UN2300	EARTH'S ENVIRO SYST: LIFE SYST
EESC UN3010	FIELD GEOLOGY
EESC BC3017	ENVIRONMENTAL DATA ANALYSIS
EESC GU4050	GLOBAL ASSMT-REMOTE SENSING
EESC GU4600	EARTH RESOURCES # SUSTAIN DEV
EESC GU4917	THE EARTH/HUMAN INTERACTIONS
EAEE E2002	

Also included among breadth and related fields courses are science, mathematics, statistics, and engineering courses offered by other departments that count toward fulfilling degree requirements in those departments.

Please note that EESC UN2330 SCIENCE FOR SUSTAINABLE DEVPT does not fulfill the Breadth requirement.

Depth Requirement

A minimum of 12 points (four courses) chosen with the major adviser to provide depth in the field of Earth science.

These courses build on the foundation and supporting courses listed above and provide a coherent focus in some area of Earth science. Depth courses are *3000-* and *4000-* level courses that carry EESC or supporting science pre-requisites. Students must include at least one of the following in their course of study:

EESC UN3101	Geochemistry for a Habitable Planet
or EESC UN3201	SOLID EARTH DYNAMICS

Please note that EESC GU4600 EARTH RESOURCES # SUSTAIN DEV does not fulfill the Depth requirement, this course would only fulfill the Breadth requirement.

Areas of Focus

The following areas of focus include one of the courses listed above and three or more additional courses. Students are not required to specialize in a focus area, but examples are given below for those who choose to do so.

Geological Science	
EESC GU4090	INTRO TO GEOCHRONOLGY
EESC GU4113	Mineralogy and Mineral Resources
EESC GU4223	SEDIMENTARY GEOLOGY
EESC GU4230	CRUSTAL DEFORMATION
EESC GU4701	Introduction to Igneous Petrology
EESC GU4887	ISOTOPE GEOLOGY I
EESC GU4947	PLATE TECTONICS AND CLIMATE
It is strongly recommended that students focusing in geological science take the summer geology field course as their capstone experience.	
Geochemistry	
EESC UN3015	The Earth's Carbon Cycle
EESC BC3016	ENVIRONMENTAL MEASURMENTS
EESC BC3200	Ecotoxicology
EESC GU4090	INTRO TO GEOCHRONOLGY
EESC GU4113	Mineralogy and Mineral Resources
EESC GU4701	Introduction to Igneous Petrology
EESC GU4885	CHEMISTRY OF CONTINENTL WATERS
EESC GU4887	ISOTOPE GEOLOGY I
EESC GU4926	INTRO TO CHEMICAL OCEANOGRAPHY
It is recommended that students focusing in geochemistry take CHEM UN1403-CHEM UN1404 General Chemistry I and II, and PHYS UN1201 General Physics I as their supporting science sequence.	
Atmosphere and Ocean Science	
EESC GU4008	Introduction to Atmospheric Science
EESC GU4920	PALEOCEANOGRAPHY
EESC GU4924	INTRO TO ATMOSPHERIC CHEMISTRY
EESC GU4925	INTRO TO PHYSICAL OCEANOGRAPHY
EESC GU4926	INTRO TO CHEMICAL OCEANOGRAPHY
It is recommended that students focusing on atmosphere and ocean science also take a course in fluid dynamics and a course in differential equations.	
Solid Earth Geophysics	
EESC GU4230	CRUSTAL DEFORMATION
EESC GU4300	THE EARTH'S DEEP INTERIOR
EESC GU4937	CENOZOIC PALEOCEANOGRAPHY
EESC GU4947	PLATE TECTONICS AND CLIMATE
EESC GU4949	Introduction to Seismology
It is recommended that students focusing in solid Earth geophysics take PHYS UN1201-PHYS UN1202 General Physics I and II, and CHEM UN1403 General Chemistry I as their supporting science sequence and also take MATH UN1201 Calculus II.	
Climate	
EESC UN3015	The Earth's Carbon Cycle
EESC BC3025	HYDROLOGY
EESC GU4008	Introduction to Atmospheric Science
EESC GU4330	INTRO-TERRESTRIAL PALEOCLIMATE
EESC GU4835	Wetlands and Climate Change
EESC GU4920	PALEOCEANOGRAPHY
EESC GU4924	INTRO TO ATMOSPHERIC CHEMISTRY
EESC GU4925	INTRO TO PHYSICAL OCEANOGRAPHY
EESC GU4937	CENOZOIC PALEOCEANOGRAPHY
Paleontology	
EESC GU4223	SEDIMENTARY GEOLOGY
EESC GU4550	Plant Ecophysiology
EESC GU4920	PALEOCEANOGRAPHY
EESC GU4924	INTRO TO ATMOSPHERIC CHEMISTRY
EESC GU4937	CENOZOIC PALEOCEANOGRAPHY
It is recommended that students focusing in paleontology take EESC UN2300 Earth's Environmental Systems: The Life System, as one of their foundation courses.	

Major in Environmental Science

Please read Guidelines for all Earth Science, Environmental Science, Climate System Science, and Climate and Sustainability Majors, Minors, Concentrators, and Special Concentrators above.

The major in Environmental Science requires a minimum of 47 points, distributed as follows:

Foundation Courses

EESC UN2100	EARTH'S ENVIRO SYST: CLIM SYST
EESC UN2200	EARTH'S ENVIRONMENTAL SYSTEMS: THE SOLID EARTH
EESC UN2300	EARTH'S ENVIRO SYST: LIFE SYST

Supporting Mathematics and Science Courses

One semester of Calculus at the level of Calculus I or higher (3 credits)	
MATH UN1101	CALCULUS I
Select one of the following three-course sequences:	
CHEM UN1403 & CHEM UN1404 & PHYS UN1201	GENERAL CHEMISTRY I-LECTURES and GENERAL CHEMISTRY II-LECTURES and GENERAL PHYSICS I
CHEM UN1403 & PHYS UN1201 & PHYS UN1202	GENERAL CHEMISTRY I-LECTURES and GENERAL PHYSICS I and GENERAL PHYSICS II
CHEM UN1403 & EEEB UN2001 & PHYS UN1201	GENERAL CHEMISTRY I-LECTURES and ENVIRONMENTAL BIOLOGY I and GENERAL PHYSICS I

Capstone Experience

EESC BC3800	ENVIR SCIENCE SENIOR SEMINAR
or EESC BC3801	ENVIR SCIENCE SENIOR SEM II
EESC UN3901	SENIOR SEMINAR

Breadth and Related Fields Requirement

A minimum of 6 points (two courses) chosen with the major adviser are required.

Breadth and related field courses are science courses relevant for an environmental science major that do not require an environmental science background. Several such courses are offered at the *2000-*, *3000-* and *4000*-level in the department and at Barnard. Examples include:

EESC BC3017	ENVIRONMENTAL DATA ANALYSIS
EESC GU4050	GLOBAL ASSMT-REMOTE SENSING
EESC GU4600	EARTH RESOURCES # SUSTAIN DEV

EESC GU4917	THE EARTH/HUMAN INTERACTIONS
EESC UN3010	FIELD GEOLOGY

Also included among breadth and related fields courses are science, mathematics, statistics, and engineering courses offered by other departments that count toward fulfilling degree requirements in those departments.

Please note that EESC UN2330 SCIENCE FOR SUSTAINABLE DEVPT does not fulfill the Breadth requirement.

Depth Requirement

A minimum of 9 points (three courses) chosen with the major adviser to provide depth in the field of environmental science.

These courses build on the foundation and supporting courses listed above and provide a coherent focus in some area of environmental science. Depth courses are *3000-* and *4000-* level courses that carry EESC or supporting science pre-requisites. Students must include at least one of the following in their course of study:

EESC UN3101	Geochemistry for a Habitable Planet
or EESC UN3201	SOLID EARTH DYNAMICS

Please note that EESC GU4600 EARTH RESOURCES # SUSTAIN DEV does not fulfill the Depth Requirement, this course would only fulfill the Breadth requirement.

Areas of focus

The following areas of focus include one of the courses listed above and two or more additional courses. Students are not required to specialize in a focus area, but examples are given below for those who choose to do so.

Environmental Geology	
EESC GU4076	Geologic Mapping
EESC GU4480	Paleobiology and Earth System History
EAEE E3221	
It is recommended that students focusing in environmental geology also take EESC W4050 Remote Sensing.	
Environmental Geochemistry	
EESC UN3015	The Earth's Carbon Cycle
EESC GU4885	CHEMISTRY OF CONTINENTL WATERS
EESC GU4887	ISOTOPE GEOLOGY I
EESC GU4924	INTRO TO ATMOSPHERIC CHEMISTRY
EESC GU4888	Stable Isotope Geochemistry
EESC GU4926	INTRO TO CHEMICAL OCEANOGRAPHY
Hydrology	
EESC GU4076	Geologic Mapping
EESC GU4835	Wetlands and Climate Change
EESC GU4885	CHEMISTRY OF CONTINENTL WATERS
EESC BC3025	HYDROLOGY
EAEE E3221	
Climate Change	
EESC UN3015	The Earth's Carbon Cycle
EESC GU4008	Introduction to Atmospheric Science
EESC GU4330	INTRO-TERRESTRIAL PALEOCLIMATE
EESC GU4480	Paleobiology and Earth System History
EESC GU4835	Wetlands and Climate Change
EESC GU4920	PALEOCEANOGRAPHY
It is recommended that students focusing in environmental geology also take EESC GU4050 Remote Sensing.	
Energy and Resources	
EESC GU4076	Geologic Mapping
EESC GU4701	Introduction to Igneous Petrology
EAEE E2002	

Major in Climate System Science

Please read Guidelines for all Earth Science, Environmental Science, Climate System Science, and Climate and Sustainability Majors, Minors, Concentrators, and Special Concentrators above.

The major in Climate System Science requires a minimum of 43.5 points, distributed as follows:

Foundational Courses

7.5 points minimum (2 courses):

Required:	
EESC UN2100	EARTH'S ENVIRO SYST: CLIM SYST
And any one of:	
EESC UN1009	GLOBAL WARMING FOR GLOBAL LEADERS
EESC UN1030	OCEANOGRAPHY
EESC UN1201	Environmental Risks and Disasters
EESC UN1600	EARTH RESOURCES # SUSTAIN DEV
or EESC GU4600	EARTH RESOURCES # SUSTAIN DEV
EESC UN2200	EARTH'S ENVIRONMENTAL SYSTEMS: THE SOLID EARTH
EESC UN2300	EARTH'S ENVIRO SYST: LIFE SYST
EESC UN2330	SCIENCE FOR SUSTAINABLE DEVPT

Supporting Courses

12 points minimum (4 courses):

One semester of Calculus at the level of Calculus I or higher:	
MATH UN1101	CALCULUS I
And any three courses:	
PHYS UN1201	GENERAL PHYSICS I
PHYS UN1202	GENERAL PHYSICS II
CHEM UN1403	GENERAL CHEMISTRY I-LECTURES
CHEM UN1404	GENERAL CHEMISTRY II-LECTURES
EEEB UN2001	ENVIRONMENTAL BIOLOGY I
EESC UN2300	EARTH'S ENVIRO SYST: LIFE SYST

Climate System Core

15 points minimum (five courses):

Required: at least one Paleoclimate Course	
EESC GU4235	SEA LEVEL CHANGE
EESC GU4330	INTRO-TERRESTRIAL PALEOCLIMATE
EESC GU4480	Paleobiology and Earth System History
EESC GU4920	PALEOCEANOGRAPHY
EESC GU4937	CENOZOIC PALEOCEANOGRAPHY
Required: at least one Modern Climate Course	
EESC UN3031	CHEMISTRY OF CLIMATE
EESC UN3109	CLIMATE PHYSICS

EESC GU4008	Introduction to Atmospheric Science
EESC GU4020	HUMANS # THE CARBON CYCLE
EESC GU4040	CLIM THERMODYN/ENERGY TRANSFER
EESC GU4835	Wetlands and Climate Change
EESC GU4923	Biological Oceanography
EESC GU4925	INTRO TO PHYSICAL OCEANOGRAPHY
EESC GU4926	INTRO TO CHEMICAL OCEANOGRAPHY
EESC GU4930	EARTH'S OCEANS # ATMOSPHERE
Could include: Other Climate System Course	
EESC BC3109 Hydrology	
EESC UN3101	Geochemistry for a Habitable Planet
EESC UN3201	SOLID EARTH DYNAMICS
EESC GU4220	GLACIOLOGY
EESC GU4835	Wetlands and Climate Change
EESC GU4885	CHEMISTRY OF CONTINENTL WATERS
EESC GU4923	Biological Oceanography
EESC GU4924	INTRO TO ATMOSPHERIC CHEMISTRY
EESC GU4926	INTRO TO CHEMICAL OCEANOGRAPHY
Could include one: Supporting EESC Course	
EESC UN3400	COMPUTATIONAL EARTH SCIENCE
EESC GU4210	GEOPHYSICAL FLUID DYNAMICS
EESC GU4223	SEDIMENTARY GEOLOGY
EESC GU4230	CRUSTAL DEFORMATION
EESC GU4887	ISOTOPE GEOLOGY I
EESC GU4888	Stable Isotope Geochemistry

Climate Solutions, Justice, Policy and Communication

6 points minimum (any two courses below):

Solutions Courses	
EESC BC3045 RESPONDING TO CLIMATE CHANGE (Barnard College)	
ARCH UN3120	CITY,LANDSCAPE, # ECOLOGY
EAEE E2002	
EAEE E2100	A BETTER PLANET BY DESIGN
EAEE E4001	INDUST ECOLOGY-EARTH RESOURCES
EAEE E4002	ALTERNATIVE ENERGY RESOURCES
EAEE E4006	Field methods for environmental engineering
EAEE E4300	INTRO TO CARBON MANAGEMENT
EAEE E4302	CARBON CAPTURE
EAEE E4301	CARBON STORAGE
EAEE E4305	CO2 UTILIZATION AND CONVERSION
CIEE E3250	
MECE E4211	ENERGY SOURCES AND CONVERSION
SDEV GU4250	CLIMATE CHANGE: RESILIENCE # ADAPTATION
Climate Justice, Policy, Economics	
ANTH BC3932 CLIMATE CH./GLOB. MIGRATION/HUMAN RIGHTS (Barnard College)	
ANTH V3861	
ARCH UN3400	ENVIRONMENTAL VISUALIZATIONS OF NYC
ECON BC3039 ENVIRONMENTAL & NAT. RES. ECONOMICS (Barnard College)	
ECON BC3040 ENVIRONMENTAL LAW (Barnard College)	
ECON UN2257	THE GLOBAL ECONOMY
ECON GU4750	GLOBALIZATION # ITS RISKS
POLS UN3648	GOVERNING THE GLOBAL ECONOMY
POLS GU4814	GLOBAL ENERGY: SECURITY/GEOPOL
POLS GU4863	INTERNATIONAL POLITICAL ECONOMY OF DEVELOPING COUNTRIES
SDEV UN3355	CLIMATE CHANGE AND LAW
SDEV UN3360	DISASTERS AND DEVELOPMENT
SDEV UN2050	ENVIRONMENTAL POLICY AND GOVERNANCE

Climate System Capstone

3 points minimum (one course):

EESC UN3904	INDEPENDENT RESEARCH IN CLIMATE SYSTEM SCIENCE
EESC UN3901	SENIOR SEMINAR (taken twice, in fall and spring)
or EESC BC3800 followed by EESC UN3901	
Approved Field Course focused on the Climate System	
~6 weeks, must be proposed and then approved by DUS	

Major in Climate and Sustainability

Please read Guidelines for all Earth Science, Environmental Science, Climate System Science, and Climate and Sustainability Majors, Minors, Concentrators, and Special Concentrators above.

The major in Climate and Sustainability is a joint major between the Undergraduate Program in Sustainable Development and DEES, and requires a minimum of 46.5 points, distributed as follows:

Climate and Sustainability Foundations

Two courses:

SDEV UN2300	CHALLENGES OF SUSTAINABLE DEV
EESC UN2330	SCIENCE FOR SUSTAINABLE DEVPT

Basic Disciplinary Foundations

Five courses:

A. Natural Science Courses (2):

Required:	
EESC UN2100	EARTH'S ENVIRO SYST: CLIM SYST
One of the following:	
EESC UN1201	Environmental Risks and Disasters
EESC UN1600	EARTH RESOURCES # SUSTAIN DEV
EESC UN2200	EARTH'S ENVIRONMENTAL SYSTEMS: THE SOLID EARTH
EESC UN2300	EARTH'S ENVIRO SYST: LIFE SYST

B. Social Science Courses (2):

Required:	
SDEV UN2100	Introduction to Climate Justice
One of the following:	
ECON UN1105	PRINCIPLES OF ECONOMICS
POLS UN1601	INTERNATIONAL POLITICS
SDEV UN2000	INTRO TO ENVIRONMENTAL LAW
SDEV UN2050	ENVIRONMENTAL POLICY AND GOVERNANCE

ANTH BC2427	ANTHROPOLOGY OF CLIMATE CHANGE
SDEV UN3400	HUMAN POPULATIONS # SDEV

C. Quantitative Foundations Course (1)

One of the following:

STAT UN1201	CALC-BASED INTRO TO STATISTICS
MATH UN2010	LINEAR ALGEBRA
EEEB UN3005	INTRO-STAT-ECOLOGY # EVOL BIOL
EESC BC3017	ENVIRONMENTAL DATA ANALYSIS

Note: Taking Introduction to Statistics and Calculus separately will not fulfill the quantitative requirement.

Climate and Sustainability: Complexities and Analyses

Four courses:

Two courses from the following:

TBD#### Climate Change: Mitigation	
SDEV GU4250	CLIMATE CHANGE: RESILIENCE # ADAPTATION
ANTH BC3932	CLIM CHNG/GLOBAL MIGR/HUM RGT
SDEV UN3355	CLIMATE CHANGE AND LAW
SDEV UN3366	ENERGY LAW
EESC GU4235	SEA LEVEL CHANGE
EAEE E4304	CLOSING THE CARBON CYCLE

One of the following Natural Science courses:

EESC GU4220	GLACIOLOGY
EESC GU4926	INTRO TO CHEMICAL OCEANOGRAPHY
EESC GU4923	Biological Oceanography
EESC GU4925	INTRO TO PHYSICAL OCEANOGRAPHY
EESC GU4835	Wetlands and Climate Change
EESC GU4330	INTRO-TERRESTRIAL PALEOCLIMATE
EESC GU4920	PALEOCEANOGRAPHY
EESC GU4937	CENOZOIC PALEOCEANOGRAPHY
EESC GU4235	SEA LEVEL CHANGE
EAEE E4304	CLOSING THE CARBON CYCLE

One of the following Social Science courses:

ANTH 3861 Anthropology of the Anthropocene	
POLS 4811 Global Energy: Security/Geopolitics	
SDEV 4240 Science Communications	
ANTH BC3932	CLIM CHNG/GLOBAL MIGR/HUM RGT
SDEV UN3355	CLIMATE CHANGE AND LAW
SDEV UN3366	ENERGY LAW
SDEV GU4050	US WATER # ENERGY POLICY
ECON BC3039	Environmental and Natural Resource Economics

Electives

Select two courses from the following areas. If you select Area 1, you must complete two thesis courses, and these will fulfill the elective requirement:

Area 1:

EESC UN3901	SENIOR SEMINAR

Area 2:

Additional courses listed under the *Climate and Sustainability: Complexities and Analysis* requirement

Area 3:

Additional quantitative or qualitative methods or skills courses:

STAT UN2103	APPLIED LINEAR REG ANALYSIS
STAT UN3105	APPLIED STATISTICAL METHODS
STAT UN3106	APPLIED MACHINE LEARNING
STAT GU4203	PROBABILITY THEORY
STAT GU4204	STATISTICAL INFERENCE
STAT GU4207	ELEMENTARY STOCHASTIC PROCESS
STAT GU4205	LINEAR REGRESSION MODELS
EAEE E4257	ENVIR DATA ANALYSIS # MODELING
EESC BC3050	BIG DATA WITH PYTHON
SDEV UN3390	GIS FOR SUSTAINABLE DEVELOPMNT
SDEV UN3450	SPATIAL ANALYSIS FOR SDEV
SDEV GU4101	QUAL RESEARCH METHODS SDEV

Practicum

One course:

One of the following:

SDEV UN3998	SUPERVISED INDIVIDUAL RESEARCH
SDEV GU4500	SUSTAINABILITY AND THE MEANING OF PLACE ON CUTTYHUNK ISLAND
SDEV GU4550	The New York City Watershed: From Community Displacement to Collaboration and Climate Adaptation
SUMA PS4734	Earth Institute Practicum

Capstone Workshop

One course:

One of the following:

SDEV UN3280	WORKSHOP IN SUSTAINABLE DEVPT
SDEV UN3550	BANGLADSH:LIFE-TECT ACTV DELTA
SDEV GU4400	Sustainable Development in Rwanda

Minor in Earth and Environmental Science

Please read Guidelines for all Earth Science, Environmental Science, Climate System Science, and Climate and Sustainability Majors, Minors, Concentrators, and Special Concentrators above.

The minor in Earth and Environmental Science requires a minimum of 18 points, distributed as follows:

Foundational Courses

9 points (two courses):

Select two of the following:

EESC UN2100	EARTH'S ENVIRO SYST: CLIM SYST
EESC UN2200	EARTH'S ENVIRONMENTAL SYSTEMS: THE SOLID EARTH
EESC UN2300	EARTH'S ENVIRO SYST: LIFE SYST

Depth and Breadth Courses

9 points minimum (three courses):

Any three additional 1000, 2000, 3000, or 4000-level EESC courses.

Minor in Climate System Science

Please read Guidelines for all Earth Science, Environmental Science, Climate System Science, and Climate and Sustainability Majors, Minors, Concentrators, and Special Concentrators above.

The minor in Climate System Science requires a minimum of 16.5 points, distributed as follows:

Foundational Courses

7.5 points (two courses):

Both required:

EESC UN2100	EARTH'S ENVIRO SYST: CLIM SYST
EESC UN1009	GLOBAL WARMING FOR GLOBAL LEADERS

Climate System Module

6 points minimum (any two courses below):

Two courses from the lists below:

EESC UN1030	OCEANOGRAPHY
EESC UN1201	Environmental Risks and Disasters
EESC UN2200	EARTH'S ENVIRONMENTAL SYSTEMS: THE SOLID EARTH
EESC UN2300	EARTH'S ENVIRO SYST: LIFE SYST
EESC UN2330	SCIENCE FOR SUSTAINABLE DEVPT
Paleoclimate Courses	
EESC GU4235	SEA LEVEL CHANGE
EESC GU4330	INTRO-TERRESTRIAL PALEOCLIMATE
EESC GU4480	Paleobiology and Earth System History
EESC GU4920	PALEOCEANOGRAPHY
EESC GU4937	CENOZOIC PALEOCEANOGRAPHY
Modern Climate Courses	
EESC UN3031	CHEMISTRY OF CLIMATE
EESC UN3109	CLIMATE PHYSICS
EESC GU4008	Introduction to Atmospheric Science
EESC GU4020	HUMANS # THE CARBON CYCLE
EESC GU4040	CLIM THERMODYN/ENERGY TRANSFER
EESC GU4925	INTRO TO PHYSICAL OCEANOGRAPHY
EESC GU4930	EARTH'S OCEANS # ATMOSPHERE
Other Climate System Courses	
EESC BC3109 Hydrology	
EESC UN3101	Geochemistry for a Habitable Planet
EESC UN3201	SOLID EARTH DYNAMICS
EESC GU4220	GLACIOLOGY
EESC GU4835	Wetlands and Climate Change
EESC GU4885	CHEMISTRY OF CONTINENTL WATERS
EESC GU4923	Biological Oceanography
EESC GU4924	INTRO TO ATMOSPHERIC CHEMISTRY
EESC GU4926	INTRO TO CHEMICAL OCEANOGRAPHY
Supporting EESC Courses	
EESC UN3400	COMPUTATIONAL EARTH SCIENCE
EESC GU4210	GEOPHYSICAL FLUID DYNAMICS
EESC GU4223	SEDIMENTARY GEOLOGY
EESC GU4230	CRUSTAL DEFORMATION
EESC GU4887	ISOTOPE GEOLOGY I
EESC GU4888	Stable Isotope Geochemistry

Climate Solutions, Justice, Policy and Communication

3 points minimum (any one course below):

Solutions Courses	
EESC BC3045 RESPONDING TO CLIMATE CHANGE (Barnard College)	
ARCH UN3120	CITY,LANDSCAPE, # ECOLOGY
EAEE E2002	
EAEE E2100	A BETTER PLANET BY DESIGN
EAEE E4001	INDUST ECOLOGY-EARTH RESOURCES
EAEE E4002	ALTERNATIVE ENERGY RESOURCES
EAEE E4006	Field methods for environmental engineering
EAEE E4300	INTRO TO CARBON MANAGEMENT
EAEE E4302	CARBON CAPTURE
EAEE E4301	CARBON STORAGE
EAEE E4305	CO2 UTILIZATION AND CONVERSION
CIEE E3250	
MECE E4211	ENERGY SOURCES AND CONVERSION
SDEV GU4250	CLIMATE CHANGE: RESILIENCE # ADAPTATION
Climate Justice, Policy, Economics	
ANTH BC3932 CLIMATE CH./GLOB. MIGRATION/HUMAN RIGHTS (Barnard College)	
ANTH V3861	
ARCH UN3400	ENVIRONMENTAL VISUALIZATIONS OF NYC
ECON BC3039 ENVIRONMENTAL & NAT. RES. ECONOMICS (Barnard College)	
ECON BC3040 ENVIRONMENTAL LAW (Barnard College)	
ECON UN2257	THE GLOBAL ECONOMY
ECON GU4750	GLOBALIZATION # ITS RISKS
POLS UN3648	GOVERNING THE GLOBAL ECONOMY
POLS GU4814	GLOBAL ENERGY: SECURITY/GEOPOL
POLS GU4863	INTERNATIONAL POLITICAL ECONOMY OF DEVELOPING COUNTRIES
SDEV UN3355	CLIMATE CHANGE AND LAW
SDEV UN3360	DISASTERS AND DEVELOPMENT

Minor in Earth and Space

Please read Guidelines for all Earth Science, Environmental Science, Climate System Science, and Climate and Sustainability Majors, Minors, Concentrators, and Special Concentrators above.

The minor in Earth and Space requires a minimum of 15 points, distributed as follows:

Introductory Course

3 points minimum (one course):

One of the following:

ASTR UN1453	ANOTHER EARTH
ASTR BC1753	LIFE IN THE UNIVERSE
EESC UN2300	EARTH'S ENVIRO SYST: LIFE SYST

Astronomy Courses

6 points minimum (two courses):

Two of of the following:	
ASTR UN1403	EARTH, MOON, AND PLANETS
ASTR UN1404	STARS, GALAXIES # COSMOLOGY
ASTR UN1420	Galaxies and Cosmology
ASTR UN1836	STARS AND ATOMS
Or the following ASTR sequence:	
ASTR UN2001	INTRO TO ASTROPHYSICS I
ASTR UN2002	INTRO TO ASTROPHYSICS II

DEES Courses

6 points minimum (two courses):

One of of the following:	
EESC UN2200	EARTH'S ENVIRONMENTAL SYSTEMS: THE SOLID EARTH
EESC UN3201	SOLID EARTH DYNAMICS
Plus one of the following:	
EESC UN2100	EARTH'S ENVIRO SYST: CLIM SYST
EESC UN3101	Geochemistry for a Habitable Planet

For Students who entered Columbia in or before the 2023-24 academic year

Concentrations are available to students who entered Columbia in or before Fall 2023. The requirements for the Bachelor of Arts degree, and the role of the concentration in those requirements, can be found in the Academic Requirements section of the Bulletin dated the academic year when the student matriculated at Columbia and the Bulletin dated the academic year when the student was a sophomore and declared programs of study.

Concentrations are not available to students who entered Columbia in or after Fall 2024.

Concentration in Earth Science

Please read Guidelines for all Earth Science, Environmental Science, Climate System Science, and Climate and Sustainability Majors, Concentrators, and Special Concentrators above.

The concentration in Earth science requires a minimum of 24 points, distributed as follows:

Foundation Courses

EESC UN2100	EARTH'S ENVIRO SYST: CLIM SYST
or EESC UN2300	EARTH'S ENVIRO SYST: LIFE SYST
EESC UN2200	EARTH'S ENVIRONMENTAL SYSTEMS: THE SOLID EARTH

Supporting Mathematics and Science Courses

Two science or mathematics courses (6-7 points) selected from among those listed for the Earth science major above.

Depth and Breadth and Related Fields Requirements

A minimum of 9 points (typically three courses) is required as follows:

EESC UN3101	Geochemistry for a Habitable Planet
or EESC UN3201	SOLID EARTH DYNAMICS
One additional course chosen from those listed under Depth Requirement for the earth science major above.	
The third course selected from those listed under either Depth Requirement or Breadth and Related Fields Requirement for the earth science major above.	

Concentration in Environmental Science

Please read Guidelines for all Earth Science, Environmental Science, Climate System Science, and Climate and Sustainability Majors, Concentrators, and Special Concentrators above.

The concentration in environmental science requires a minimum of 25.5 points, distributed as follows:

Foundation Courses

EESC UN2100	EARTH'S ENVIRO SYST: CLIM SYST
EESC UN2200	EARTH'S ENVIRONMENTAL SYSTEMS: THE SOLID EARTH
EESC UN2300	EARTH'S ENVIRO SYST: LIFE SYST

Supporting Mathematics and Science Courses

Two science or mathematics courses (6-7 points) selected from among those listed for the environmental science major above.

Depth and Breadth and Related Fields Requirements

A minimum of 6 points (two courses) is required as follows:

EESC UN3101	Geochemistry for a Habitable Planet
or EESC UN3201	SOLID EARTH DYNAMICS
One additional course selected from those listed under either Depth Requirement or Breadth and Related Fields Requirement for the environmental science major above.	

Special Concentration in Environmental Science for Majors in Environmental Biology

Please read Guidelines for all Earth Science, Environmental Science, Climate System Science, and Climate and Sustainability Majors, Concentrators, and Special Concentrators above.

The Department of Earth and Environmental Sciences sponsors a special concentration which must be done in conjunction with the environmental biology major. Students should be aware that they must complete the environmental biology major in order to receive credit for the special concentration.

The special concentration in environmental science requires a minimum of 31.5 points, distributed as follows:

Introductory Environmental Science (13.5 points)

EESC UN2100	EARTH'S ENVIRO SYST: CLIM SYST
EESC UN2200	EARTH'S ENVIRONMENTAL SYSTEMS: THE SOLID EARTH
EESC UN2300	EARTH'S ENVIRO SYST: LIFE SYST

Introductory Science (6 points)

Two courses in chemistry, physics, mathematics, or environmental biology from the supporting mathematics and science list for the environmental science major above.

Advanced Environmental Science (12 points)

Four courses at the 3000-level or above chosen from those recommended for the environmental science major above.

Advanced courses used to fulfill requirements in the environmental biology major cannot count toward requirements for the special concentration.

Special Concentration in Environmental Biology for Majors in Environmental Science

Please read Guidelines for all Earth Science, Environmental Science, Climate System Science, and Climate and Sustainability Majors, Concentrators, and Special Concentrators above.

The Department of Ecology, Evolution, and Environmental Biology sponsors a special concentration which must be done in conjunction with the environmental science major. Students should be aware that they must complete the environmental science major in order to receive credit for the special concentration.

The special concentration in environmental biology requires a minimum of 39 points, distributed as follows:

Introductory Environmental Biology and Environmental Science (17 points)

EEEB UN2001	ENVIRONMENTAL BIOLOGY I
EESC UN2100	EARTH'S ENVIRO SYST: CLIM SYST
EESC UN2200	EARTH'S ENVIRONMENTAL SYSTEMS: THE SOLID EARTH
EEEB UN2002	ENVIRONMENTAL BIOLOGY II

Introductory Science (13 points)

Select one of the following chemistry sequences:

CHEM UN1403 & CHEM UN1404	GENERAL CHEMISTRY I-LECTURES and GENERAL CHEMISTRY II-LECTURES
CHEM UN1604 & CHEM UN2507	2ND TERM GEN CHEM (INTENSIVE) and Intensive General Chemistry Laboratory
One term of statistics such as the following:	
STAT UN1101	INTRODUCTION TO STATISTICS
STAT UN1201	CALC-BASED INTRO TO STATISTICS
BIOL BC2286	STATISTICS # RESEARCH DESIGN
EEEB UN3005	INTRO-STAT-ECOLOGY # EVOL BIOL
EEEB UN3087	CONSERVATION BIOLOGY

Advanced Environmental Biology (9 points)

Three additional advanced EEEB courses (3000-level and above), each chosen from a different curricular area (evolution/genetics, ecology/behavior/conservation, anatomy/physiology/diversity, biology laboratory courses).

Advanced courses used to fulfill requirements in the environmental science major cannot count toward requirements for the special concentration.

Sustainable Development

Students interested in sustainable development should refer to the *Sustainable Development* section in this Bulletin.

Students interested in sustainable development should refer to the *Sustainable Development* section in this Bulletin.

Concentration in Environmental Science

Please read Guidelines for all Earth Science, Environmental Science, Climate System Science, and Climate and Sustainability Majors, Concentrators, and Special Concentrators above.

The concentration in environmental science requires a minimum of 25.5 points, distributed as follows:

Foundation Courses

EESC UN2100	EARTH'S ENVIRO SYST: CLIM SYST
EESC UN2200	EARTH'S ENVIRONMENTAL SYSTEMS: THE SOLID EARTH
EESC UN2300	EARTH'S ENVIRO SYST: LIFE SYST

Supporting Mathematics and Science Courses

Two science or mathematics courses (6-7 points) selected from among those listed for the environmental science major above.

Depth and Breadth and Related Fields Requirements

A minimum of 6 points (two courses) is required as follows:

EESC UN3101	Geochemistry for a Habitable Planet
or EESC UN3201	SOLID EARTH DYNAMICS
One additional course selected from those listed under either Depth Requirement or Breadth and Related Fields Requirement for the environmental science major above.	

Special Concentration in Environmental Science for Majors in Environmental Biology

Please read Guidelines for all Earth Science, Environmental Science, Climate System Science, and Climate and Sustainability Majors, Concentrators, and Special Concentrators above.

The Department of Earth and Environmental Sciences sponsors a special concentration which must be done in conjunction with the environmental biology major. Students should be aware that they must complete the environmental biology major in order to receive credit for the special concentration.

The special concentration in environmental science requires a minimum of 31.5 points, distributed as follows:

Introductory Environmental Science (13.5 points)

EESC UN2100	EARTH'S ENVIRO SYST: CLIM SYST
EESC UN2200	EARTH'S ENVIRONMENTAL SYSTEMS: THE SOLID EARTH
EESC UN2300	EARTH'S ENVIRO SYST: LIFE SYST

Introductory Science (6 points)

Two courses in chemistry, physics, mathematics, or environmental biology from the supporting mathematics and science list for the environmental science major above.

Advanced Environmental Science (12 points)

Four courses at the 3000-level or above chosen from those recommended for the environmental science major above.

Advanced courses used to fulfill requirements in the environmental biology major cannot count toward requirements for the special concentration.

Special Concentration in Environmental Biology for Majors in Environmental Science

Please read Guidelines for all Earth Science, Environmental Science, Climate System Science, and Climate and Sustainability Majors, Concentrators, and Special Concentrators above.

The Department of Ecology, Evolution, and Environmental Biology sponsors a special concentration which must be done in conjunction with the environmental science major. Students should be aware that they must complete the environmental science major in order to receive credit for the special concentration.

The special concentration in environmental biology requires a minimum of 39 points, distributed as follows:

Introductory Environmental Biology and Environmental Science (17 points)

EEEB UN2001	ENVIRONMENTAL BIOLOGY I
EESC UN2100	EARTH'S ENVIRO SYST: CLIM SYST
EESC UN2200	EARTH'S ENVIRONMENTAL SYSTEMS: THE SOLID EARTH
EEEB UN2002	ENVIRONMENTAL BIOLOGY II

Introductory Science (13 points)

Select one of the following chemistry sequences:

CHEM UN1403 & CHEM UN1404	GENERAL CHEMISTRY I-LECTURES and GENERAL CHEMISTRY II-LECTURES
CHEM UN1604 & CHEM UN2507	2ND TERM GEN CHEM (INTENSIVE) and Intensive General Chemistry Laboratory
One term of statistics such as the following:	
STAT UN1101	INTRODUCTION TO STATISTICS
STAT UN1201	CALC-BASED INTRO TO STATISTICS
BIOL BC2286	STATISTICS # RESEARCH DESIGN
EEEB UN3005	INTRO-STAT-ECOLOGY # EVOL BIOL
EEEB UN3087	CONSERVATION BIOLOGY

Advanced Environmental Biology (9 points)

Three additional advanced EEEB courses (3000-level and above), each chosen from a different curricular area (evolution/genetics, ecology/behavior/conservation, anatomy/physiology/diversity, biology laboratory courses).

Advanced courses used to fulfill requirements in the environmental science major cannot count toward requirements for the special concentration.

Fall 2024

EESC UN1030 OCEANOGRAPHY. *3.00 points*.
CC/GS: Partial Fulfillment of Science Requirement
Enrollment limited to 160.

Explore the geology of the sea floor, understand what drives ocean currents and how ocean ecosystems operate. Case studies and discussions centered on ocean-related issues facing society

Fall 2025: EESC UN1030

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
EESC 1030	001/11409	T Th 11:40am - 12:55pm Room TBA	Baerbel Hoenisch	3.00	0/160

EESC UN1201 Environmental Risks and Disasters. *3 points*.
CC/GS: Partial Fulfillment of Science Requirement
Priority given to first-years and sophomores.

Prerequisites: high school science and math.
An introduction to risks and hazards in the environment. Different types of hazards are analyzed and compared: natural disasters, such as tornados, earthquakes, and meteorite impacts; acute and chronic health effects caused by exposure to radiation and toxic substances such as radon, asbestos, and arsenic; long-term societal effects due to environmental change, such as sea level rise and global warming. Emphasizes the basic physical principles controlling the hazardous phenomena and develops simple quantitative methods for making scientifically reasoned assessments of the threats (to health and wealth) posed by various events, processes, and exposures. Discusses methods of risk mitigation and sociological, psychological, and economic aspects of risk control and management.

EESC UN1600 EARTH RESOURCES # SUSTAIN DEV. *3.00 points*.
CC/GS: Partial Fulfillment of Science Requirement

Prerequisites: none; high school chemistry recommended.
Prerequisites: none; high school chemistry recommended. Survey of the origin and extent of mineral resources, fossil fuels, and industrial materials, that are non renewable, finite resources, and the environmental consequences of their extraction and use, using the textbook Earth Resources and the Environment, by James Craig, David Vaughan and Brian Skinner. This course will provide an overview, but will include focus on topics of current societal relevance, including estimated reserves and extraction costs for fossil fuels, geological storage of CO2, sources and disposal methods for nuclear energy fuels, sources and future for luxury goods such as gold and diamonds, and special, rare materials used in consumer electronics (e.g. ;Coltan; mostly from Congo) and in newly emerging technologies such as superconducting magnets and rechargeable batteries (e.g. heavy rare earth elements, mostly from China). Guest lectures from economists, commodity traders and resource geologists will provide ;real world; input. Discussion Session Required

Fall 2025: EESC UN1600

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
EESC 1600	001/11428	T Th 1:10pm - 2:25pm Room TBA	Peter Kelemen	3.00	0/150

EESC UN2100 EARTH'S ENVIRO SYST: CLIM SYST. *4.50 points*.
Prerequisites: high school algebra. Recommended preparation: high school chemistry and physics; and one semester of college science. Origin and development of the atmosphere and oceans, formation of winds, storms and ocean currents, reasons for changes through geologic time. Recent influence of human activity: the ozone hole, global warming, water pollution. Laboratory exploration of topics through demonstrations, experimentation, computer data analysis, and modeling. Students majoring in Earth and Environmental Sciences should plan to take EESC W2100 before their senior year to avoid conflicts with Senior Seminar

Spring 2025: EESC UN2100

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
EESC 2100	001/13543	T Th 10:10am - 11:25am 603 Schermerhorn Hall	Mingfang Ting, Gisela Winckler	4.50	45/60
EESC 2100	001/13543	T 4:10pm - 7:00pm 555 Ext Schermerhorn Hall	Mingfang Ting, Gisela Winckler	4.50	45/60

Fall 2025: EESC UN2100

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
EESC 2100	001/11410	T Th 10:10am - 11:25am 603 Schermerhorn Hall	Jerry McManus	4.50	0/40
EESC 2100	001/11410	T 4:10pm - 7:00pm 555 Ext Schermerhorn Hall	Jerry McManus	4.50	0/40

EESC UN2200 EARTH'S ENVIRONMENTAL SYSTEMS: THE SOLID EARTH. *4.50 points*.
CC/GS: Partial Fulfillment of Science Requirement
Priority given to Columbia and Barnard earth science, environmental science, and environmental biology majors should enrollment limits be necessary.

Prerequisites: high school algebra and chemistry. Recommended preparation: high school physics.
Recommended preparation: high school chemistry and physics; and one semester of college science. Exploration of how the solid Earth works, today and in the past, focusing on Earth in the Solar system, continents and oceans, the Earth's history, mountain systems on land and sea, minerals and rocks, weathering and erosion, glaciers and ice sheets, the hydrological cycle and rivers, geochronology, plate tectonics, earthquakes, volcanoes, energy resources. Laboratory exploration of topics through examination of rock samples, experimentation, computer data analysis, field exercises, and modeling. Columbia and Barnard majors should plan to take W2200 before their senior year to avoid conflicts with the Senior Seminar

Spring 2025: EESC UN2200

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
EESC 2200	001/13546	T Th 2:40pm - 3:55pm 603 Schermerhorn Hall	Steven Goldstein, Sidney Hemming, Sedelia Rodriguez	4.50	33/40
EESC 2200	001/13546	T 4:10pm - 7:00pm 603 Schermerhorn Hall	Steven Goldstein, Sidney Hemming, Sedelia Rodriguez	4.50	33/40
EESC 2200	002/18428	T 2:40pm - 3:55pm 603 Schermerhorn Hall	Steven Goldstein, Sidney Hemming, Sedelia Rodriguez	4.50	10/20
EESC 2200	002/18428	Th 4:10pm - 7:00pm 555 Ext Schermerhorn Hall	Steven Goldstein, Sidney Hemming, Sedelia Rodriguez	4.50	10/20

Fall 2025: EESC UN2200

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
EESC 2200	001/11411	T Th 1:10pm - 2:25pm 603 Schermerhorn Hall	Jonathan Kingslake, Jacqueline Austermann	4.50	0/40
EESC 2200	001/11411	Th 4:10pm - 7:00pm 603 Schermerhorn Hall	Jonathan Kingslake, Jacqueline Austermann	4.50	0/40

EESC UN2330 SCIENCE FOR SUSTAINABLE DEVPT. *3.00 points*.
CC/GS: Partial Fulfillment of Science Requirement

The course provides students with an understanding of Earth's natural systems that is essential to addressing the multi-faceted issues of sustainable development. After completing the course, students should be able to incorporate scientific approaches and perspectives into their research in other fields or policy decisions and be able to use scientific methods of data analysis. The semester will highlight the climate system and solutions from both physical and ecological perspectives; water resources; food production and the cycling of nutrients; and the role of biodiversity in sustainable development. The course emphasizes key scientific concepts such as uncertainty, experimental versus observational approaches, prediction and predictability, the use of models, and other essential methodological aspects

Fall 2025: EESC UN2330

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
EESC 2330	001/11412	T Th 2:40pm - 3:55pm Room TBA	Jenna Lawrence, John Mutter	3.00	0/120

EESC UN3031 CHEMISTRY OF CLIMATE. *3.00 points*.
By the end of this course, students will understand: The biogeochemical cycles driving the composition of trace gas and aerosol species that are both long- and short-lived in the atmosphere that influence climate by directly interacting with radiation (i.e. greenhouse gases (GHGs) such as carbon dioxide, methane, nitrous oxide, ozone, CFCs, aerosols) and those that do so mainly by altering the concentrations of other gases (OH, NOx, etc.); The effects of these gas and aerosol species on climate and atmospheric composition; Climate mitigation strategies that are being considered in response to climate warming. This course is designed for undergraduate students seeking a quantitative introduction to climate and climate change science. EESC V2100 (Climate Systems) is not a prerequisite, but can also be taken for credit if it is taken before this course

Fall 2025: EESC UN3031

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
EESC 3031	001/11413	T Th 2:40pm - 3:55pm 417 Schermerhorn Hall	Roisin Commane	3.00	0/25

EESC UN3101 Geochemistry for a Habitable Planet. *3 points*.
Prerequisites: any 1000-level or 2000-level EESC course; *MATH V1101* Calculus I and *CHEM W1403* General Chemistry I or their equivalents.
The origin, evolution, and future of our planet, based on the book *How to Build a Habitable Planet* by Wallace S. Broecker. This course will focus on the geochemical processes that built Earth from solar material, led to its differentiation into continents and ocean, and have maintained its surface at a comfortable temperature. Students will participate in a hands-on geochemistry project at Lamont-Doherty Earth Observatory.

Fall 2025: EESC UN3101

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
EESC 3101	001/11414	T Th 11:40am - 12:55pm 603 Schermerhorn Hall	Terry Plank	3	0/25

EESC UN3400 COMPUTATIONAL EARTH SCIENCE. *3.00 points*.
Prerequisites: Required: at least a semester of calculus and physics; any 1000-level or 2000-level EESC course. Computer models are essential for understanding the behavior of complex natural systems in geosciences. This course is an introduction to writing computer models to simulate Earth processes. Students will learn methods for numerical modeling of a variety of geoscience topics, such as nonlinear systems of air chemistry, ocean currents, atmospheric dispersion, and more. Simulations will be created by learning to program with a user-friendly language (Python). Student learning will be facilitated through a combination of lectures, in-class exercises, homework assignments and a final project on a student-selected topic

Fall 2025: EESC UN3400

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
EESC 3400	001/11415	T Th 11:40am - 12:55pm Room TBA	William Menke	3.00	0/15

EESC UN3901 SENIOR SEMINAR. *3.00 points*.
Prerequisites: *EESC BC3800* or *EESC BC3801* and a good grounding in basic sciences.
Guided, independent, in-depth research culminating in the senior thesis in the spring. Includes discussion about scientific presentations and posters, data analysis, library research methods and scientific writing. Students review work in progress and share results through oral reports. Weekly seminar to review work in progress and share results through oral and written reports

Spring 2025: EESC UN3901

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
EESC 3901	001/13701	Th 4:10pm - 6:00pm 405 Milbank Hall	Maureen Raymo, Sidney Hemming	3.00	23/50

Fall 2025: EESC UN3901

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
EESC 3901	001/11416	Th 4:10pm - 7:00pm Room TBA	Maureen Raymo	3.00	0/50

EESC UN3904 INDEPENDENT RESEARCH IN CLIMATE SYSTEM SCIENCE. *3.00 points*.
In this course, students develop and complete a one-semester independent research project in an area of Climate System Science. Each student works closely with a research Mentor, and the course experience for all students is coordinated with a course Instructor. This course fulfills the Capstone experience for the Climate System Science major in DEES. This course cannot be combined with one semester of Senior Seminar UN3901, which is designed as a 1-year course

Fall 2025: EESC UN3904

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
EESC 3904	001/11417	Th 8:40am - 9:55am 603 Schermerhorn Hall	Jacqueline Austermann	3.00	0/10

EESC GU4008 Introduction to Atmospheric Science. *3 points*.
CC/GS: Partial Fulfillment of Science Requirement

Prerequisites: advanced calculus and general physics, or the instructor's permission.
Basic physical processes controlling atmospheric structure: thermodynamics; radiation physics and radiative transfer; principles of atmospheric dynamics; cloud processes; applications to Earth's atmospheric general circulation, climatic variations, and the atmospheres of the other planets.

Fall 2025: EESC GU4008

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
EESC 4008	001/11418	T 4:10pm - 6:40pm 417 Schermerhorn Hall	Lorenzo Polvani	3	0/40

EESC GU4020 HUMANS # THE CARBON CYCLE. *3.00 points*.
Prerequisites: One semester of college-level calculus and chemistry; Plus one semester of college-level physics or geoscience. Or instructor's permission. The accelerating climate change of the current day is driven by humanity's modifications to the global carbon cycle. This course offers an introduction basic science of the carbon cycle, with a focus on large-scale processes occurring on annual to centennial timescales. Students will leave this course with an understanding of the degree to which the global carbon cycle is understood and quantified, as well as the key uncertainties that are the focus of current research. We will build understanding of the potential pathways, and the significant challenges, to limiting global warming to 2o C as intended by the 2015 Paris Climate Agreement. The course will begin with a brief review of climate science basics and the role of CO2 in climate and climate change (weeks 1-2). In weeks 3-4, the natural reservoirs and fluxes that make up the global carbon cycle will be introduced. In week 5-6, anthropogenic emissions and the observed changes in climate associated with increasing atmospheric CO2 will be discussed. In weeks 7-11, we will learn about how the land biosphere and ocean are mitigating the increase in atmospheric CO2 and the feedbacks that may substantially modify these natural sinks. In weeks 12-13, the international policy process and the potential for carbon cycle management will be the focus. In weeks 14, students will present their final projects

EESC GU4050 GLOBAL ASSMT-REMOTE SENSING. *3.00 points*.
CC/GS: Partial Fulfillment of Science Requirement
Enrollment limited to 24. Priority given to graduate students in the natural sciences and engineering.

Prerequisites: Course Cap 20 students. Priority given to graduate students in the natural sciences and engineering. Advanced level undergraduates may be admitted with the instructor's permission. Calculus I and Physics I & II are required for undergraduates who wish to take this course.
Prerequisites: Course Cap 20 students. Priority given to graduate students in the natural sciences and engineering. Advanced level undergraduates may be admitted with the instructors permission. Calculus I and Physics I # II are required for undergraduates who wish to take this course. General introduction to fundamentals of remote sensing; electromagnetic radiation, sensors, interpretation, quantitative image analysis and modeling. Example applications in the Earth and environmental sciences are explored through the analysis of remote sensing imagery in a state-or-the-art visualization laboratory

Fall 2025: EESC GU4050

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
EESC 4050	001/11419	Th 5:40pm - 6:55pm 417 Schermerhorn Hall	Christopher Small	3.00	0/20
EESC 4050	001/11419	F 9:00am - 10:45am Room TBA	Christopher Small	3.00	0/20

EESC GU4230 CRUSTAL DEFORMATION. *3.00 points*.
Prerequisites: introductory geology and one year of calculus. Recommended preparation: higher levels of mathematics.
Prerequisites: Introductory geology and one year of calculus. Recommended preparation: One semester of college physics. Introduction to the fundamental concepts of structure and deformation processes in the Earth's crust. Fundamental theories of stress and strain, rock behavior in both brittle and ductile fields, large-scale crustal contractional and extensional structures with focus on their geometries and mechanics of formation. Introduction to the principles of earthquake mechanics with emphasis on physical processes. Laboratory sessions (part of the lecture) will cover techniques of structural analysis, recognition and interpretation of structures on geologic maps, and construction of interpretative cross sections

EESC GU4330 INTRO-TERRESTRIAL PALEOCLIMATE. *3.00 points*.
CC/GS: Partial Fulfillment of Science Requirement
Given in alternate years.

Understanding the fundamental processes driving our Climate System is more important than ever. In this course, I will give an overview of the archives in which evidence of terrestrial paleoclimate is preserved, the approaches to developing and applying proxies of climate from these archives, approaches for constraining the time represented by the information, and interpretations that have been developed from such archives. Important archives to be included are ice cores, caves, wetlands, lakes, trees, and moraines. The time interval covered will be mostly the last few tens of thousands of years, and chronometers based on radiocarbon, U-series and cosmogenic nuclide dating will be presented. A particular emphasis will be put on natural climate processes and interactions that are relevant for the ongoing climate crisis and potential solutions, including a Climate Justice module toward the end of the course. The course will consist of formal lectures that alternate with recitation and discussing examples and problem solving

EESC GU4600 EARTH RESOURCES # SUSTAIN DEV. *3.00 points*.
CC/GS: Partial Fulfillment of Science Requirement

Prerequisites: none; high school chemistry recommended.
Prerequisites: none; high school chemistry recommended. This course is open to graduate students, and juniors and seniors within DEES, Sus Dev, Engineering, Chemistry, Physics, and APAM - or with the instructors permission. Survey of the origin and extent of mineral resources, fossil fuels, and industrial materials, that are non renewable, finite resources, and the environmental consequences of their extraction and use, using the textbook Earth Resources and the Environment, by James Craig, David Vaughan and Brian Skinner. This course will provide an overview, but will include focus on topics of current societal relevance, including estimated reserves and extraction costs for fossil fuels, geological storage of CO2, sources and disposal methods for nuclear energy fuels, sources and future for luxury goods such as gold and diamonds, and special, rare materials used in consumer electronics (e.g. ;Coltan; mostly from Congo) and in newly emerging technologies such as superconducting magnets and rechargeable batteries (e.g. heavy rare earth elements, mostly from China). Guest lectures from economists, commodity traders and resource geologists will provide ;real world; input

Fall 2025: EESC GU4600

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
EESC 4600	001/11429	T Th 1:10pm - 2:25pm Room TBA	Peter Kelemen	3.00	0/25

EESC GU4887 ISOTOPE GEOLOGY I. *3.00 points*.
CC/GS: Partial Fulfillment of Science Requirement
Given in alternate years.

Prerequisites: basic background in chemistry and physics.
Prerequisites: For graduate students, basic background in chemistry, physics and earth science. For undergraduates, basic background in chemistry and physics, plus EESC UN2200 Solid Earth and EESC UN3101 Geochemistry for a Habitable Planet, or permission from the instructor. An introduction to the processes that drive the universe, the formation of our solar system, and the history and evolution of our planet. Topics include stellar evolution and nucleosynthesis (origin of the elements), principles of radioactive decay and geochronology, composition of the solar system and the Earth, evolution of the mantle and crust, and using isotopes to trace to geological processes

EESC GU4923 Biological Oceanography. *3 points*.
CC/GS: Partial Fulfillment of Science Requirement
Given in alternate years. Enrollment limited to 24. Priority given to graduate students and then graduating seniors.

Prerequisites: introductory college-level biology and chemistry.
An overview of the biology and ecology of the oceans with a focus on the interaction between marine organisms and the physics and chemistry of the oceans.

EESC GU4925 INTRO TO PHYSICAL OCEANOGRAPHY. *3.00 points*.
CC/GS: Partial Fulfillment of Science Requirement

Prerequisites: Recommended preparation: a solid background in mathematics, physics, and chemistry.
Prerequisites: Recommended preparation: a solid background in mathematics, physics, and chemistry. Topics: Physical properties of seawater, hydrography (water masses and their distribution), dispersal (advection and diffusion), ocean dynamics (Navier Stokes equation), processes (eddies, waves, tides), large-scale circulation (wind-driven gyres, overturning circulation)

Fall 2025: EESC GU4925

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
EESC 4925	001/11422	T Th 8:40am - 9:55am 417 Schermerhorn Hall	Andreas Thurnherr	3.00	0/20

EESC GU4949 Introduction to Seismology. *3 points*.
CC/GS: Partial Fulfillment of Science Requirement

Prerequisites: advanced calculus and general physics, or the instructor's permission.
Methods and underpinnings of seismology including seismogram analysis, elastic wave propogation theory, earthquake source characterization, instrumentation, inversion of seismic data to infer Earth structure.

Spring 2025

EESC UN1006 WHAT'S NEW IN EARTH, ENVIRONMENTAL, AND CLIMATE SCIENCE?. *1.00 point*.
This course provides an overview of current research at the world-renowned Lamont-Doherty Earth Observatory. Various Lamont researchers will present their latest research in earth, environmental, and climate science, providing students a cross-section of research projects across the LDEO divisions. Students are expected to attend each class, and meaningfully participate in class discussion

Spring 2025: EESC UN1006

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
EESC 1006	001/17429	Th 4:10pm - 5:25pm 603 Schermerhorn Hall	Terry Plank	1.00	31/30

EESC UN1010 GEOLO EXCUR TO DEATH VALLEY,CA. *2.00 points*.
Enrollment limited to 20.

The trip is restricted to first-years and sophomores from Columbia College/General Studies, Barnard College, and the School of Engineering and Applied Science. Early application is advised, please visit the course website below for the application deadline. A spring-break excursion focused on the geology of Death Valley and adjacent areas of the eastern California desert. Discussion sessions ahead of the trip provide necessary background. Details at: https://eesc.columbia.edu/content/eesc-un1010

Spring 2025: EESC UN1010

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
EESC 1010	001/13541	F 5:30pm - 7:00pm 555 Ext Schermerhorn Hall	Folarin Kolawole	2.00	20/20

EESC UN2100 EARTH'S ENVIRO SYST: CLIM SYST. *4.50 points*.
Prerequisites: high school algebra. Recommended preparation: high school chemistry and physics; and one semester of college science. Origin and development of the atmosphere and oceans, formation of winds, storms and ocean currents, reasons for changes through geologic time. Recent influence of human activity: the ozone hole, global warming, water pollution. Laboratory exploration of topics through demonstrations, experimentation, computer data analysis, and modeling. Students majoring in Earth and Environmental Sciences should plan to take EESC W2100 before their senior year to avoid conflicts with Senior Seminar

Spring 2025: EESC UN2100

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
EESC 2100	001/13543	T Th 10:10am - 11:25am 603 Schermerhorn Hall	Mingfang Ting, Gisela Winckler	4.50	45/60
EESC 2100	001/13543	T 4:10pm - 7:00pm 555 Ext Schermerhorn Hall	Mingfang Ting, Gisela Winckler	4.50	45/60

Fall 2025: EESC UN2100

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
EESC 2100	001/11410	T Th 10:10am - 11:25am 603 Schermerhorn Hall	Jerry McManus	4.50	0/40
EESC 2100	001/11410	T 4:10pm - 7:00pm 555 Ext Schermerhorn Hall	Jerry McManus	4.50	0/40

EESC UN2200 EARTH'S ENVIRONMENTAL SYSTEMS: THE SOLID EARTH. *4.50 points*.
CC/GS: Partial Fulfillment of Science Requirement
Priority given to Columbia and Barnard earth science, environmental science, and environmental biology majors should enrollment limits be necessary.

Prerequisites: high school algebra and chemistry. Recommended preparation: high school physics.
Recommended preparation: high school chemistry and physics; and one semester of college science. Exploration of how the solid Earth works, today and in the past, focusing on Earth in the Solar system, continents and oceans, the Earth's history, mountain systems on land and sea, minerals and rocks, weathering and erosion, glaciers and ice sheets, the hydrological cycle and rivers, geochronology, plate tectonics, earthquakes, volcanoes, energy resources. Laboratory exploration of topics through examination of rock samples, experimentation, computer data analysis, field exercises, and modeling. Columbia and Barnard majors should plan to take W2200 before their senior year to avoid conflicts with the Senior Seminar

Spring 2025: EESC UN2200

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
EESC 2200	001/13546	T Th 2:40pm - 3:55pm 603 Schermerhorn Hall	Steven Goldstein, Sidney Hemming, Sedelia Rodriguez	4.50	33/40
EESC 2200	001/13546	T 4:10pm - 7:00pm 603 Schermerhorn Hall	Steven Goldstein, Sidney Hemming, Sedelia Rodriguez	4.50	33/40
EESC 2200	002/18428	T 2:40pm - 3:55pm 603 Schermerhorn Hall	Steven Goldstein, Sidney Hemming, Sedelia Rodriguez	4.50	10/20
EESC 2200	002/18428	Th 4:10pm - 7:00pm 555 Ext Schermerhorn Hall	Steven Goldstein, Sidney Hemming, Sedelia Rodriguez	4.50	10/20

Fall 2025: EESC UN2200

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
EESC 2200	001/11411	T Th 1:10pm - 2:25pm 603 Schermerhorn Hall	Jonathan Kingslake, Jacqueline Austermann	4.50	0/40
EESC 2200	001/11411	Th 4:10pm - 7:00pm 603 Schermerhorn Hall	Jonathan Kingslake, Jacqueline Austermann	4.50	0/40

EESC UN2300 EARTH'S ENVIRO SYST: LIFE SYST. *4.50 points*.
CC/GS: Partial Fulfillment of Science Requirement
Priority given to Columbia and Barnard earth science, environmental science, and environmental biology majors should enrollment limits be reinstated.

Prerequisites: high school algebra. Recommended preparation: high school chemistry and physics.
Prerequisites: high school algebra. Recommended preparation: high school chemistry and physics. Role of life in biogeochemical cycles, relationship of biodiversity and evolution to the physical Earth, vulnerability of ecosystems to environmental change; causes and effects of extinctions through geologic time (dinosaurs and mammoths) and today. Exploration of topics through laboratories, data analysis, and modeling. REQUIRED LAB: EESC UN2310. Students will be expected to choose a lab section during the first week of class from the options listed in the Directory of Classes. Co-meets with EEEB 2002

Spring 2025: EESC UN2300

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
EESC 2300	001/14334	M W 11:40am - 12:55pm 833 Seeley W. Mudd Building	Paul Olsen, Matthew Palmer, Sonya Dyhrman	4.50	25/50

EESC UN3010 FIELD GEOLOGY. *3.00 points*.
Fee: to be determined.

This is a field geology course focusing on the Apennine Mountains of central Italy, where a developing “accretionary prism” (associated with oceanic crust subduction) can be observed directly. Students will learn how to interpret the evolution of paleo-environments from the sediment lithologies, textures, fossils, compositions; and the tectonic history from the present day spatial and structural relationships. The rocks range from early Mesozoic oceanic crust and sediments to late Cenozoic sediments impacted by the rise of the Alps. The course visits several classic geological localities, including the Gubbio site of the discovery that the dinosaur extinction was caused by a meteorite, a Carrara Marble quarry (favored by Michelangelo for his sculptures), evaporite sediments from the dry-down of the Mediterranean, the magnificent Frasassi Cave, and effects of recent earthquakes. Priority: This course has a limited number of spaces, and enrollment requires the instructors' permission. Students interested in enrolling are instructed to contact the instructors by email. Priority is given to Columbia College and General Studies senior and junior majors and minors in the Department of Earth and Environmental Sciences, and Barnard senior and junior majors and minors in Environmental Science. Barnard students must receive permission from the Barnard Environmental Science department chair in order to receive the subsidy

Spring 2025: EESC UN3010

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
EESC 3010	001/17680	T 7:30pm - 9:20pm 603 Schermerhorn Hall	Steven Goldstein, Sidney Hemming	3.00	14/15

EESC UN3109 CLIMATE PHYSICS. *3.00 points*.
This is a calculus-based treatment of climate system physics and the mechanisms of anthropogenic climate change. By the end of this course, students will understand: how solar radiation and rotating fluid dynamics determine the basic climate state, mechanisms of natural variability and change in climate, why anthropogenic climate change is occurring, and which scientific uncertainties are most important to estimates of 21st century change. This course is designed for undergraduate students seeking a quantitative introduction to climate and climate change science. EESC V2100 (Climate Systems) is not a prerequisite, but can also be taken for credit if it is taken before this course

Spring 2025: EESC UN3109

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
EESC 3109	001/13558	T Th 10:10am - 11:25am 555 Ext Schermerhorn Hall	Adam Sobel	3.00	15/25

EESC UN3201 SOLID EARTH DYNAMICS. *3.00 points*.
Prerequisites: any 1000-level or 2000-level EESC course; *MATH V1101* Calculus I and *PHYS W1201* General Physics I or their equivalents. Concurrent enrollment in *PHYS W1201* is acceptable with the instructor's permission.
Prerequisites: any 1000-level or 2000-level EESC course; MATH UN1101 Calculus I and PHYS UN1201 General Physics I or their equivalents. Concurrent enrollment in PHYS UN1201 is acceptable with the instructors permission. Properties and processes affecting the evolution and behavior of the solid Earth. This course will focus on the geophysical processes that build mountains and ocean basins, drive plate tectonics, and otherwise lead to a dynamic planet. Topics include heat flow and mantle circulation, earthquakes and seismic waves, gravity, Earths magnetic field, and flow of glaciers and ice sheets

Spring 2025: EESC UN3201

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
EESC 3201	001/13700	T Th 11:40am - 12:55pm 417 Schermerhorn Hall	Meredith Nettles	3.00	19/25

EESC UN3328 Glacial Geomorphology. *3.00 points*.
This course focuses on the impact of glaciers on landscapes. We will learn about the interactions and feedbacks between landscapes and climate. We will cover what is known about glacial geomorphology, as well as the modern research methods and outstanding scientific problems

Spring 2025: EESC UN3328

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
EESC 3328	001/17550	T Th 1:10pm - 2:25pm 555 Ext Schermerhorn Hall	William Menke	3.00	12/25

EESC UN3901 SENIOR SEMINAR. *3.00 points*.
Prerequisites: *EESC BC3800* or *EESC BC3801* and a good grounding in basic sciences.
Guided, independent, in-depth research culminating in the senior thesis in the spring. Includes discussion about scientific presentations and posters, data analysis, library research methods and scientific writing. Students review work in progress and share results through oral reports. Weekly seminar to review work in progress and share results through oral and written reports

Spring 2025: EESC UN3901

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
EESC 3901	001/13701	Th 4:10pm - 6:00pm 405 Milbank Hall	Maureen Raymo, Sidney Hemming	3.00	23/50

Fall 2025: EESC UN3901

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
EESC 3901	001/11416	Th 4:10pm - 7:00pm Room TBA	Maureen Raymo	3.00	0/50

EESC GU4009 CHEMICAL GEOLOGY. *3.00 points*.
Given in alternate years.

Prerequisites: physical chemistry or the instructor's permission.
This course will examine geological problems from a standpoint of thermodynamic and kinetic theory. Theoretical thermodynamic concepts will be used to derive the crystallization depth and temperature of metamorphic and magmatic minerals, describe the solubility of volatile species in magmas, predict the composition of volcanic gas mixtures, model the nucleation and growth of crystals and bubbles in a melt and determine the chemical interaction between water and rock at the Earth's surface. Kinetic treatments on the diffusion of heat and matter through crystals and melts will be used to constrain the timing of geological processes. Recommended preparation: Knowledge of mathematics at the level of partial differential equations; mineralogy (EESC 4113); and petrology (EESC 4701); or permission of the instructor

Spring 2025: EESC GU4009

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
EESC 4009	001/13561	T Th 1:10pm - 2:25pm 506 Schermerhorn Hall	Yves Moussallam	3.00	6/25

EESC GU4040 CLIM THERMODYN/ENERGY TRANSFER. *3.00 points*.
Given in alternate years.

Prerequisites: *EESC W4008*, advanced calculus, and general physics, or the instructor's permission.
Thermodynamics of atmospheric and oceanic processes fundamental to the climate system. Physical mechanisms of vertical energy transfer: surface fluxes, boundary layers and convection

Spring 2025: EESC GU4040

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
EESC 4040	001/13567	T Th 2:40pm - 3:55pm 558 Ext Schermerhorn Hall	Adam Sobel	3.00	5/25

EESC GU4085 GEODYNAMICS. *3.00 points*.
CC/GS: Partial Fulfillment of Science Requirement
Given in alternate years.

Prerequisites: calculus, differential equations, introductory physics.
An introduction to how the Earth and planets work. The focus is on physical processes that control plate tectonics and the evolution of planetary interiors and surfaces; analytical descriptions of these processes; weekly physical model demonstrations

Spring 2025: EESC GU4085

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
EESC 4085	001/13571	T Th 2:40pm - 3:55pm 555 Ext Schermerhorn Hall	W Buck	3.00	7/25

EESC GU4210 GEOPHYSICAL FLUID DYNAMICS. *3.00 points*.
Required course for M.A./Ph.D. candidates focusing in physical oceanography and atmospheric sciences. Elective for undergraduate majors in the Department of Earth and Environmental Sciences.

Prerequisites: *APMA E3101*, *APMA E3201* or equivalents and *APPH E4200* or equivalent or the instructor's permission.
Prerequisites: APMA E3101, APMA E3201 or equivalents and APPH E4200 or equivalent or the instructors permission. Fundamental concepts in the dynamics of rotating stratified flows. Geostrophic and hydrostatic balances, potential vorticity, f and beta plane approximations, gravity and Rossby waves, geostrophic adjustment and quasigeostrophy, baroclinic and barotropic instabilities

Spring 2025: EESC GU4210

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
EESC 4210	001/17430	T Th 8:40am - 9:55am 555 Ext Schermerhorn Hall	Dhruv Balwada	3.00	8/25

EESC GU4243 CLIMATE PREDICTION CHALLENGES WITH MACHINE LEARNING. *3.00 points*.
This course is a project-based learning (PBL) course where teams of climate science and data science students collaborate to create machine learning predictive models for challenges inspired by ongoing climate data science research. Students from different background will apply their prior knowledge, work together and teach each other in high-paced collaborative projects. Through a sequence of mini-projects, i.e., "challenges", this course provides students a deeper understanding of using machine learning for climate science and support predictive capabilities. It provides training on a broad set of practical skills for climate data science research (e.g., handling geoscience data formats, data curation, cleaning and transformation, building ML workflow, and collaboration using cloud computing resources, Git and/or GitHub). It will also offer discussions on the opportunities and challenges of using climate science and projections in decision processes. Minimal formal instruction on statistics, data science, machine learning, or climate science will be given. Project cycles run every 4 weeks, where we will have mini-group data projects. Groups will be formed randomly with students from both climate science and data science background. Project products will be peer-reviewed, in addition to evaluation by the instructional team

Spring 2025: EESC GU4243

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
EESC 4243	001/17684	T 4:10pm - 6:40pm 903 School Of Social Work	Galen McKinley	3.00	19/20

EESC GU4630 AIR-SEA INTERACTION. *3.00 points*.
Given in alternate years. Enrollment limited to 20. Priority based on seniority (graduate students, graduating seniors, etc.).

Prerequisites: solid background in mathematics, physics, and chemistry. Some background in fluid mechanics (as in EESC W4925/APPH E4200) or the instructors permission. An overview of oceanic and atmospheric boundary layers including fluxes of momentum, heat, mass, (eg. moisture salt) and gases between the ocean and atmosphere; vertical distribution of energy sources and sinks at the interface including the importance of surface currents; forced upper ocean dynamics, the role of surface waves on the air-sea exchange processes and ocean mixed layer processes

Spring 2025: EESC GU4630

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
EESC 4630	001/14863	T Th 2:40pm - 3:55pm 417 Schermerhorn Hall	Christopher Zappa	3.00	5/25

EESC GU4924 INTRO TO ATMOSPHERIC CHEMISTRY. *3.00 points*.
CC/GS: Partial Fulfillment of Science Requirement

Prerequisites: Physics W1201, Chemistry W1403, Calculus III, or equivalent or the instructor's permission. *EESC W2100* preferred.
Prerequisites: Physics W1201, Chemistry W1403, Calculus III, or equivalent or the instructors permission. EESC W2100 preferred. Physical and chemical processes determining atmospheric composition and the implications for climate and regional air pollution. Basics of physical chemistry relevant to the atmosphere: spectroscopy, photolysis, and reaction kinetics. Atmospheric transport of trace gas species. Atmosphere-surface-biosphere interactions. Stratospheric ozone chemistry. Tropospheric hydrocarbon chemistry and oxidizing power. Legacy effects of photochemical smog and acid rain. Current impacts of aerosol pollution and climate impacts of pollution reduction

Spring 2025: EESC GU4924

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
EESC 4924	001/17682	T Th 10:10am - 11:25am 417 Schermerhorn Hall	Roisin Commane	3.00	19/25

EESC GU4926 INTRO TO CHEMICAL OCEANOGRAPHY. *3.00 points*.
Given in alternate years.

Prerequisites: the instructor's permission for students without one year of chemistry. Course open to undergraduates with one year of chemistry. Recommended preparation: a solid background in mathematics, physics, and chemistry.
Prerequisites: Recommended preparation: one year of chemistry. The course covers: Factors controlling the concentration and distribution of dissolved chemical species within the sea; the physical chemistry of seawater; ocean circulation and biogeochemical processes that interact with each other to influence the distribution and fate of elements in the ocean. The course examines in some detail the two-way interaction between marine ecosystems and their chemical environment, and the implications of these interactions for distributions in the ocean of carbon, nutrients and trace metals. Although this course does not cover specific strategies that have been proposed for marine Carbon Dioxide Removal (mCDR) and ocean storage of carbon, it will cover the basic processes and principles underlying ocean mCDR strategies

Spring 2025: EESC GU4926

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
EESC 4926	001/13589	T Th 11:40am - 12:55pm 555 Ext Schermerhorn Hall	Robert Anderson	3.00	21/30

EESC GU4937 CENOZOIC PALEOCEANOGRAPHY. *3.00 points*.
Given in alternate years. Enrollment limited to 20 students EESC (DEES) graduate students have priority..

Prerequisites: college-level geology helpful but not required.
Prerequisites: college-level geology helpful but not required. Introduces the physical, chemical and biological processes that govern how and where ocean sediments accumulate. Major topics addressed are: modes of biogenic, terrigenous and authigenic sedimentation, depositional environments, pore fluids and sediment geochemistry, diagenesis, as well as biostratigraphy and sediment stratigraphic principles and methods. Second half of the semester focuses on major events in Cenozoic paleoceanogrpahy and paleoclimatology including orbital control of climate, long-term carbon cycle, extreme climate regimes, causes of ice ages in Earths history, human evolution, El Niño evolution, and long-term sea level history

Spring 2025: EESC GU4937

Course Number	Section/Call Number	Times/Location	Instructor	Points	Enrollment
EESC 4937	001/13702	T Th 1:10pm - 2:25pm 603 Schermerhorn Hall	Maureen Raymo, Baerbel Hoenisch	3.00	20/30
EESC 4937	AU1/18504	T Th 1:10pm - 2:25pm Room TBA	Baerbel Hoenisch	3.00	4/15

EESC GR6400 COMMUNICATING EARTH # ENVIR SCI. *3.00 points*.
Communicating science well in the context of the earth and environmental sciences is critical. This science communication course will transect specific earth and environmental science disciplines to provide a foundational understanding of what it means to communicate science and how to do so effectively. Within this overarching theme of science communication, students will gain a comprehensive and holistic understanding of how to communicate earth and environmental science across a variety of formats and to a diversity of audiences. Practical outcomes include but are not limited to students learning 1) how to rationalize a research topic, 2) write a hypothesis driven proposal, 3) evaluate proposals, 4) produce clear and compelling graphics, 5) adopt the latest pedagogical approaches, and 6) present science findings to a diversity of audiences

EESC GR6920 DYNAMICS OF CLIMATE. *3.00 points*.
Given in alternate years.

Prerequisites: EESC W4008, and advanced calculus, or the instructor's permission.
Prerequisites: EESC GU4008, and advanced calculus, or the instructors permission. The current climate and its variations over Earth history are interpreted as consequences of fundamental physical processes, including radiative transfer, the atmosphere and ocean circulation, and the carbon cycle. Perturbations to climate, resulting from changing atmospheric composition or insolation, are examined using a combination of simple interpretative models and full Earth System Models

EESC GR6949 ADVANCED SEISMOLOGY I. *3.00 points*.
Given in alternate years.**Not offered during 2023-2024 academic year.**

Prerequisites: a solid background in geophysics, and a knowledge of complex variables.
Seismic waves in layered media, matrix methods, free vibrations of the Earth, dislocation theory, source mechanics

EESC GR9701 SEMINAR IN ADVANCED PETROLOGY. *1.00-2.00 points*. Not offered during 2023-2024 academic year.

In this seminar, we will explore the interactions between volcanism and climate. From week to week, we will discuss research related to the volcano-climate interactions and address questions such as: How do volcanoes affect global climate? How do we reconstruct the climate impact of past volcanic events? How and why are mass extinction events related to supervolcano and flood basalt eruptions? Can long term changes in climate affect volcanism? The course welcomes participation from students with diverse academic backgrounds, reflecting the inherently interdisciplinary nature of the topic, which spans volcanology, atmospheric science, paleoclimatology, geophysics, and more. The seminar will also be open to the broader Lamont community, welcoming drop-ins from all staff, postdocs and students

Of Related Interest

Environmental Science (Barnard)	
EESC BC1001	Environmental Science I
EESC BC1011	Environmental Science I Lab
EESC BC3014	Field Methods in Environmental Science
EESC BC3016	ENVIRONMENTAL MEASURMENTS
EESC BC3017	ENVIRONMENTAL DATA ANALYSIS
EESC BC3025	HYDROLOGY
EESC BC3033	Waste Management
EESC BC3050	BIG DATA WITH PYTHON
EESC BC3200	Ecotoxicology
EESC BC3300	WORKSHOP SUSTAINABLE DEVEL
Physics	
PHYS UN1018	WEAPONS OF MASS DESTRUCTION

Generally Alternate Year Courses

EESC UN1001	DINOSAURS AND HISTORY OF LIFE
EESC UN1201	Environmental Risks and Disasters
EESC UN1401	DINOSAUR # HISTORY OF LIFE-LEC
EESC UN3015	The Earth's Carbon Cycle
EESC GU4009	CHEMICAL GEOLOGY
EESC GU4040	CLIM THERMODYN/ENERGY TRANSFER
EESC GU4085	GEODYNAMICS
EESC GU4113	Mineralogy and Mineral Resources
EESC GU4330	INTRO-TERRESTRIAL PALEOCLIMATE
EESC GU4223	SEDIMENTARY GEOLOGY
EESC GU4300	THE EARTH'S DEEP INTERIOR
EESC GU4630	AIR-SEA INTERACTION
EESC GU4701	Introduction to Igneous Petrology
EESC GU4835	Wetlands and Climate Change
EESC GU4885	CHEMISTRY OF CONTINENTL WATERS
EESC GU4887	ISOTOPE GEOLOGY I
EESC GU4888	Stable Isotope Geochemistry
EESC GU4920	PALEOCEANOGRAPHY
EESC GU4926	INTRO TO CHEMICAL OCEANOGRAPHY
EESC GU4937	CENOZOIC PALEOCEANOGRAPHY
EESC GU4929	Mixing and Dispersion in the Ocean
EESC GU4949	Introduction to Seismology
EESC GR6111	Modern analytical methods in geochemistry
EESC GR6701	Igneous and metamorphic processes during the creation and evolution of the tectonic plates
EESC GR6810	The Carbon Cycle
EESC GR6901	Research Computing for the Earth Sciences
EESC GR6909	Advanced Time Series Analysis
EESC GR6920	DYNAMICS OF CLIMATE
EESC GR6921	ATMOSPHERIC DYNAMICS
EESC GR6922	ATMOSPHERIC RADIATION
EESC GR6928	TROPICAL METEOROLOGY
EESC GR6949	ADVANCED SEISMOLOGY I
EESC GR6930	Ocean Dynamics
EESC GR9500	SEM-PLANT PHYSIOLOGY & EC