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 major in Earth and environmental sciences provides 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 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 & Sustainability Majors and Minors:
DUS: Joerg Schaefer, dees-dus@columbia.edu

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. Students who wish to be considered should contact the director of undergraduate studies early in their senior year.

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 Wentzovich

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, and Climate System Science Majors, Minors, Concentrators, and Special Concentrators

Advising

All majors 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 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 can not be used toward meeting the requirements of any of the majors, concentrations, or special concentrations.
4. The following course is not suitable for undergraduates and can not be used toward meeting any of the requirements for the majors, concentrations, or special concentrations: EESC GU4930 EARTH’S OCEANS # ATMOSPHERE.

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 Majors, Minors, Concentrators, and Special Concentrators above.

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

Foundation Courses

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>EESC UN2200</td>
<td>EARTH’S ENVIRONMENTAL SYSTEMS: THE SOLID EARTH</td>
</tr>
<tr>
<td>EESC UN2100</td>
<td>EARTH’S ENVIRO SYST: CLIM SYST</td>
</tr>
<tr>
<td>EESC UN2300</td>
<td>EARTH’S ENVIRO SYST: LIFE SYST</td>
</tr>
</tbody>
</table>

Select one of the following:

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)

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH UN1101</td>
<td>CALCULUS I</td>
</tr>
</tbody>
</table>

Select one of the following three-course sequences:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM UN1403</td>
<td>GENERAL CHEMISTRY I-LECTURES</td>
</tr>
<tr>
<td>- CHEM UN1404</td>
<td>and GENERAL CHEMISTRY II-LECTURES</td>
</tr>
<tr>
<td>- PHYS UN1201</td>
<td>and GENERAL PHYSICS I</td>
</tr>
<tr>
<td>CHEM UN1403</td>
<td>GENERAL CHEMISTRY I-LECTURES</td>
</tr>
<tr>
<td>- PHYS UN1201</td>
<td>and GENERAL PHYSICS I</td>
</tr>
<tr>
<td>- PHYS UN1202</td>
<td>and GENERAL PHYSICS II</td>
</tr>
</tbody>
</table>

Capstone Experience

Select one of the following:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>EESC BC3800</td>
<td>ENVIR SCIENCE SENIOR SEM I</td>
</tr>
<tr>
<td>- EESC UN3901</td>
<td>SENIOR SEM II</td>
</tr>
<tr>
<td>EESC BC3801</td>
<td>ENVIR SCIENCE SENIOR SEM II</td>
</tr>
<tr>
<td>- EESC UN3901</td>
<td>SENIOR SEM II</td>
</tr>
</tbody>
</table>

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 include:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>EESC UN2100</td>
<td>EARTH’S ENVIRO SYST: CLIM SYST</td>
</tr>
<tr>
<td>EESC UN2300</td>
<td>EARTH’S ENVIRO SYST: LIFE SYST</td>
</tr>
<tr>
<td>EESC UN3010</td>
<td>FIELD GEOLOGY</td>
</tr>
<tr>
<td>EESC BC3017</td>
<td>ENVIRONMENTAL DATA ANALYSIS</td>
</tr>
<tr>
<td>EESC GU4050</td>
<td>GLOBAL ASMT-REMOTE SENSING</td>
</tr>
<tr>
<td>EESC GU4600</td>
<td>EARTH RESOURCES # SUSTAIN DEV</td>
</tr>
<tr>
<td>EESC GU4917</td>
<td>THE EARTH/HUMAN INTERACTIONS</td>
</tr>
<tr>
<td>ECEE E2002</td>
<td></td>
</tr>
</tbody>
</table>

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.

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 areas of Earth science. Students should include at least one of the following in their course of study:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>EESC UN3101</td>
<td>Geochemistry for a Habitable Planet</td>
</tr>
<tr>
<td>or EESC UN3201</td>
<td>SOLID EARTH DYNAMICS</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>EESC GU4090</td>
<td>INTRO TO GEOCHRONOLOGY</td>
</tr>
<tr>
<td>EESC GU4113</td>
<td>Mineralogy and Mineral Resources</td>
</tr>
</tbody>
</table>

Climate System Science
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 BC3020 Ecotoxicology
EESC GU4090 INTRO TO GEochRONOLGY
EESC GU4113 Mineralogy and Mineral Resources
EESC GU4701 Introduction to Igneous Petrology
EESC GU4885 CHEMISTRY OF CONTINENTAL WATERS
EESC GU4887 ISOPO TE GEOLOGY I
EESC GU4926 INTRO TO CHEMICAL OCEANOGRAPHY

It is recommended that students focusing in geochemistry take CHEM UN103-CHEM UN104 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 UN103 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 GU4233 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 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 ENVIRONMENTAL SYSTEMS: THE SOLID EARTH
EESC UN2200 EARTH’S ENVIRONMENTAL SYSTEMS: CLIM SYST
EESC UN2300 EARTH’S ENVIRONMENTAL SYSTEMS: 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 UN103 GENERAL CHEMISTRY I-LECTURES
- CHEM UN104 and GENERAL CHEMISTRY II-LECTURES
- PHYS UN1201 and GENERAL PHYSICS I
CHEM UN103 GENERAL CHEMISTRY I-LECTURES
- PHYS UN1201 and GENERAL PHYSICS I
- PHYS UN1202 and GENERAL PHYSICS II
CHEM UN103 GENERAL CHEMISTRY I-LECTURES
- EEBB UN2001 and ENVIRONMENTAL BIOLOGY I
- PHYS UN1201 and GENERAL PHYSICS I

Capstone Experience
EESC BC3800 ENVIR SCIENCE SENIOR SEM I
or EESC BC3801 ENVIR SCIENCE SENIOR SEM II
EESC UN3901 SENIOR SEMI NAR

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.

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. Students should include at least one of the following in their course of study:

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

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
  - ISOTOP GEOL 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

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**Major in Climate System Science**

Please read Guidelines for all Earth Science, Environmental Science, & Climate System Science 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
- 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 GU4925
  - INTRO TO PHYSICAL 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 GU220
  - 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
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 Anthropology of the Anthropocene
- ARCH UN3400 ENVIRONMENTAL VISUALIZATIONS OF NYC
- ECON BC3039 ENVIRONMENTAL & NAT. RES. ECONOMICS (Barnard College)
- ECON BC3040 ENVIRONMENTAL LAW (Barnard College)
- ECON UN3527 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

**Climate System Capstone**

3 points minimum (one course):

- EESC 3xxx Undergraduate Research Project (course is under development)
- 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

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 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 GU4880 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

Minor in Earth and Environmental Science

Please read Guidelines for all Earth Science, Environmental Science, & Climate System Science Majors, Minors, Concentrators, and Special Concentrators above.
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 CONTINENTAL 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 Ecolgy-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 Anthropology of the Anthropocene
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 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 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 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 Fall 2023
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 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
- 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
- EESC UN3201  SOLID EARTH DYNAMICS

One additional course chosen from those listed under Depth Requirement or Breadth 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, and Climate System Science 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
- 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.

**Special Concentration in Environmental Science for Majors in Environmental Biology**
Please read Guidelines for all Earth Science, Environmental Science, and Climate System Science 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 above. Students must complete the environmental science major in order to receive credit for the special concentration.

**Foundation Courses**
- 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  GENERAL CHEMISTRY I-LECTURES and GENERAL CHEMISTRY II-LECTURES
- CHEM UN1604  2ND TERM GEN CHEM (INTEGRATIVE) and Intensive General Chemistry Laboratory
- CHEM UN2507  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 and 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 Majors, Concentrators, and Special Concentrators above.

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

<table>
<thead>
<tr>
<th>Foundation Courses</th>
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<tbody>
<tr>
<td>EESC UN2100</td>
<td>EARTH’S ENVIRO SYST: CLIM SYST</td>
</tr>
<tr>
<td>EESC UN2200</td>
<td>EARTH’S ENVIRONMENTAL SYSTEMS: THE SOLID EARTH</td>
</tr>
<tr>
<td>EESC UN2300</td>
<td>EARTH’S ENVIRO SYST: LIFE SYST</td>
</tr>
</tbody>
</table>

**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:

<table>
<thead>
<tr>
<th>EESC UN3101</th>
<th>Geochemistry for a Habitable Planet</th>
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</thead>
<tbody>
<tr>
<td>or EESC UN3201</td>
<td>SOLID EARTH DYNAMICS</td>
</tr>
</tbody>
</table>

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 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 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 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 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 | GENERAL CHEMISTRY I-LECTURES |
| CHEM UN1404 | and GENERAL CHEMISTRY II-LECTURES |
| CHEM UN1604 | 2ND TERM GEN CHEM (INTENSIVE) |
| CHEM UN2507 | 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 and Research Design |
| EEEB UN3005 | INTRO-STATE-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 2023
EESC UN1001 DINOSAURS AND HISTORY OF LIFE. 4.00 points.
CC/GS: Partial Fulfillment of Science Requirement
Given in alternate years.

Prerequisites: Recommended preparation: basic high school science and math.
Prerequisites: Recommended preparation: basic high school science and math. Lab is a hands-on introduction to geochronology, paleontology, and historical geology with field trips. (See W1401 for lectures only.) Dinosaurs: a spectacular example of a common, highly successful form of life, dominant for 135 million years. Where did they come from? Why were they so successful? Why did they die out? … or did they? A basic introduction to the historical sciences and the interface between geology and biology

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

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 UN2100 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.

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.

EESC UN2330 SCIENCE FOR SUSTAINABLE DEVELOPMENT. 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.
EESC UN3101 Geochemistry for a Habitable Planet. 3 points.
Prerequisites: Any 1000-level or 2000-level EESC course; MATH UN1101 Calculus I and CHEM UN1403 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 oceans, and have maintained its surface at a comfortable temperature. Students will participate in a hands-on geochemistry project at Lamont-Doherty Earth Observatory.

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.

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.

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 instructor’s 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.

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.

EESC GU4113 Mineralogy and Mineral Resources. 4.00 points.
Prerequisites: introductory geology or the equivalent, elementary college physics and chemistry, or the instructor’s permission.
Prerequisites: introductory geology or the equivalent, elementary college physics and chemistry, or the instructors permission. Minerals come in dazzling colors, amazing shapes and with interesting optical effects. But mineralogy is also an essential tool for the understanding of Earth evolution. Minerals represent fundamental building blocks of the Earth system and planetary bodies. Minerals form through geological and biological processes such as igneous, metamorphic and sedimentary from high to low temperatures, from the deep interior to the Earth’s surface and related to volcanism, tectonics, weathering, climate and life. Minerals are one of our most important sources of information on such processes through Earth’s history. Minerals also represent important natural resources and are fundamental to the global economy and modern technology as we know it. In this course, we will approach mineralogy from the standpoint of earth and environmental sciences, the study of mineralogy however is of interest to many other sciences including Material Sciences, Planetology, Archeology, Biology, Chemistry and Physics with most of the 20 Nobel Prizes awarded for research involving crystals being in these last fields. The goal of this class is to (1) understand the physical and chemical properties of minerals, (2) learn techniques of mineral identification with an emphasis on optical mineralogy, (3) understand the relationship between minerals and the broader geological context.
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.

Fall 2024: EESC GU4330

<table>
<thead>
<tr>
<th>Course Number</th>
<th>Section/Call Number</th>
<th>Times/Location</th>
<th>Instructor</th>
<th>Points</th>
<th>Enrollment</th>
</tr>
</thead>
<tbody>
<tr>
<td>EESC 4330</td>
<td>001/11467</td>
<td>T Th 10:10am - 11:25am 555 Ext Schermerhorn Hall</td>
<td>Jorg Schafer</td>
<td>3.00</td>
<td>30/30</td>
</tr>
</tbody>
</table>

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 2024: EESC GU4600

<table>
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<tr>
<th>Course Number</th>
<th>Section/Call Number</th>
<th>Times/Location</th>
<th>Instructor</th>
<th>Points</th>
<th>Enrollment</th>
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</thead>
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<tr>
<td>EESC 4600</td>
<td>001/11468</td>
<td>T Th 1:10pm - 2:25pm 301 Uris Hall</td>
<td>Peter Kelemen</td>
<td>3.00</td>
<td>22/30</td>
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</tbody>
</table>

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.

Fall 2024: EESC GU4923

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<tr>
<th>Course Number</th>
<th>Section/Call Number</th>
<th>Times/Location</th>
<th>Instructor</th>
<th>Points</th>
<th>Enrollment</th>
</tr>
</thead>
<tbody>
<tr>
<td>EESC 4923</td>
<td>001/11470</td>
<td>T Th 1:10pm - 2:25pm 417 Schermerhorn Hall</td>
<td>Andrew Juhl</td>
<td>3</td>
<td>25/25</td>
</tr>
</tbody>
</table>

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 2024: EESC GU4925

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<tr>
<th>Course Number</th>
<th>Section/Call Number</th>
<th>Times/Location</th>
<th>Instructor</th>
<th>Points</th>
<th>Enrollment</th>
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<tr>
<td>EESC 4925</td>
<td>001/11471</td>
<td>T Th 8:40am - 9:55am 417 Schermerhorn Hall</td>
<td>Andreas Thurnherr</td>
<td>3.00</td>
<td>6/30</td>
</tr>
</tbody>
</table>

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 propagation theory, earthquake source characterization, instrumentation, inversion of seismic data to infer Earth structure.

Fall 2024: EESC GU4949

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<th>Course Number</th>
<th>Section/Call Number</th>
<th>Times/Location</th>
<th>Instructor</th>
<th>Points</th>
<th>Enrollment</th>
</tr>
</thead>
<tbody>
<tr>
<td>EESC 4949</td>
<td>001/11472</td>
<td>T Th 11:40am - 12:55pm 555 Ext Schermerhorn Hall</td>
<td>Felix Waldhauser</td>
<td>3</td>
<td>5/25</td>
</tr>
</tbody>
</table>
Spring 2024

EESC UN1009 GLOBAL WARMING FOR GLOBAL LEADERS. 3.00 points.
Global Warming will dominate civic discourse and inform economic, social, and governmental policies throughout the 21st century, in all walks of life. This course will cover the basics of climate science, anthropogenic global warming, proposed solutions and policy challenges facing society in response to our changing planet. This course will increase your confidence and ability to engage in public discourse on the subject of climate change, climate change solutions, and public policy concerning our collective future.

Spring 2024: EESC UN1009

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<tr>
<th>Course Number</th>
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<th>Times/Location</th>
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<th>Enrollment</th>
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</thead>
<tbody>
<tr>
<td>EESC 1009</td>
<td>001/12410</td>
<td>T Th 11:40am - 12:55pm</td>
<td>Baerbel Hoenisch, Maureen Raymo</td>
<td>3.00</td>
<td>170/200</td>
</tr>
<tr>
<td>EESC 1009</td>
<td>AU1/18951</td>
<td>T Th 11:40am - 12:55pm</td>
<td>Maureen Raymo, Baerbel Hoenisch</td>
<td>3.00</td>
<td>9/11</td>
</tr>
</tbody>
</table>

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, and no later than November 12. 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 2024: EESC UN1010

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<th>Course Number</th>
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<tbody>
<tr>
<td>EESC 1010</td>
<td>001/12416</td>
<td>F 5:30pm - 7:00pm</td>
<td>Folarin Kolawole</td>
<td>2.00</td>
<td>20/20</td>
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</table>

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 2024: EESC UN2100

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<tr>
<th>Course Number</th>
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<tbody>
<tr>
<td>EESC 2100</td>
<td>001/12424</td>
<td>T Th 10:10am - 11:25am</td>
<td>Gisela Winckler, Mingfang Ting</td>
<td>4.50</td>
<td>39/50</td>
</tr>
<tr>
<td>EESC 2100</td>
<td>001/12424</td>
<td>T 4:10pm - 7:00pm</td>
<td>Gisela Winckler, Mingfang Ting</td>
<td>4.50</td>
<td>39/50</td>
</tr>
<tr>
<td>EESC 2100</td>
<td>002/16962</td>
<td>T Th 1:10pm - 2:25pm</td>
<td>Michela Biasutti, Jennifer Middleton</td>
<td>4.50</td>
<td>15/25</td>
</tr>
<tr>
<td>EESC 2100</td>
<td>002/16962</td>
<td>W 4:10pm - 7:00pm</td>
<td>Michela Biasutti, Jennifer Middleton</td>
<td>4.50</td>
<td>15/25</td>
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Fall 2024: EESC UN2100

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<th>Course Number</th>
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<tbody>
<tr>
<td>EESC 2100</td>
<td>001/11445</td>
<td>T Th 10:10am - 11:25am</td>
<td>Jerry McManus, Suzana De Camargo</td>
<td>4.50</td>
<td>40/40</td>
</tr>
<tr>
<td>EESC 2100</td>
<td>001/11445</td>
<td>T 4:10pm - 7:00pm</td>
<td>Jerry McManus, Suzana De Camargo</td>
<td>4.50</td>
<td>40/40</td>
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</table>
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.

<table>
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<tr>
<th>Course Number</th>
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<th>Enrollment</th>
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<tbody>
<tr>
<td>EESC 2200</td>
<td>001/12441</td>
<td>T Th 2:40pm - 3:55pm 603 Schermerhorn Hall</td>
<td>Sidney Hemming, Steven Goldstein</td>
<td>4.50</td>
<td>51/55</td>
</tr>
<tr>
<td>EESC 2200</td>
<td>001/12441</td>
<td>T 4:10pm - 7:00pm 603 Schermerhorn Hall</td>
<td>Sidney Hemming, Steven Goldstein</td>
<td>4.50</td>
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Fall 2024: EESC UN2200

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<th>Course Number</th>
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<tbody>
<tr>
<td>EESC 2200</td>
<td>001/11446</td>
<td>Th 1:10pm - 2:25pm 603 Schermerhorn Hall</td>
<td>Anne Becel, Yves Moussallam</td>
<td>4.50</td>
<td>34/40</td>
</tr>
<tr>
<td>EESC 2200</td>
<td>001/11446</td>
<td>Th 4:10pm - 7:00pm 603 Schermerhorn Hall</td>
<td>Anne Becel, Yves Moussallam</td>
<td>4.50</td>
<td>34/40</td>
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</tbody>
</table>

EESC UN2300 EARTH'S ENVIRONMENTAL SYSTEMS: 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 EEB 2002.

Spring 2024: EESC UN2300

<table>
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<tr>
<th>Course Number</th>
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<th>Enrollment</th>
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<tbody>
<tr>
<td>EESC 2300</td>
<td>001/12449</td>
<td>M W 11:40am - 12:55pm 313 Fayerweather</td>
<td>Paul Olsen, Matthew Palmer, Sonya Dyhrman</td>
<td>4.50</td>
<td>49/50</td>
</tr>
</tbody>
</table>

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

The centerpiece of this course is a geological field trip during Spring Break in Barbados. The class will meet weekly before the trip to prepare for it and after the trip to synthesize what was learned and to create a field guide. Subjects to be covered: plate tectonics, convergent plate margins and accretionary prisms, local Barbados geology; ice ages, Milankovitch cycles, sea level; introduction to coral reefs and fossil coral reef geology; Barbados terrestrial ecology, limestone caves, hydrology, dating methods; overview of Barbados history, economy, culture. In order to observe the modern-day coral reef (the modern day live analog to the fossil coral reefs we will see) the class will go snorkeling. In order to observe the effects of cave formation and water flow in limestone terrains the class will participate in an extensive visit to a cave. The class will also participate in an exercise in geological mapping of a series of coral reef terraces. Priority: Priority is given to junior and senior majors and concentrators in Earth Science or Environmental Science at Columbia College and the School of General Studies, and Barnard College Environmental Science majors and minors. Others (non-DEES majors and non-Barnard Environmental Science students) may also be allowed to enroll if space permits. All students need permission of the instructor. Students who sign up will be put on a waitlist and will be considered after contacting the instructor.

Students who sign up will be put on a waitlist and will be considered after contacting the instructor.

Spring 2024: EESC UN3010

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<tr>
<th>Course Number</th>
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<th>Times/Location</th>
<th>Instructor</th>
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<th>Enrollment</th>
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<tbody>
<tr>
<td>EESC 3010</td>
<td>001/12475</td>
<td>T 7:30pm - 9:20pm 603 Schermerhorn Hall</td>
<td>Sidney Hemming, Steven Goldstein</td>
<td>3.00</td>
<td>20/23</td>
</tr>
</tbody>
</table>

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 2024: EESC UN3109

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<tr>
<td>EESC 3109</td>
<td>001/12499</td>
<td>T Th 10:10am - 11:25am 555 Ext Schermerhorn Hall</td>
<td>Adam Sobel</td>
<td>3.00</td>
<td>6/25</td>
</tr>
</tbody>
</table>
**EESC UN3201 SOLID EARTH DYNAMICS. 3.00 points.**
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 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, Earth’s magnetic field, and flow of glaciers and ice sheets.

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<th>Course Number</th>
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<th>Times/Location</th>
<th>Instructor</th>
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<th>Enrollment</th>
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<tbody>
<tr>
<td>EESC 3201</td>
<td>001/12507</td>
<td>T Th 11:40am - 12:55pm 417 Schermerhorn Hall</td>
<td>Meredith Nettles</td>
<td>3.00</td>
<td>25/30</td>
</tr>
</tbody>
</table>

**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.

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<th>Enrollment</th>
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<tr>
<td>EESC 3901</td>
<td>001/12520</td>
<td>Th 4:10pm - 6:00pm 202 Altschul Hall</td>
<td>Elizabeth Cook, Jacqueline Austermann, Sidney Hemming</td>
<td>3.00</td>
<td>21/50</td>
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**Fall 2024: EESC UN3901**

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<th>Instructor</th>
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<th>Enrollment</th>
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</thead>
<tbody>
<tr>
<td>EESC 3901</td>
<td>001/11460</td>
<td>Th 4:10pm - 6:00pm 420 Pupin Laboratories</td>
<td>Sidney Hemming, Spahr Webb</td>
<td>3.00</td>
<td>21/50</td>
</tr>
</tbody>
</table>

**EESC GU4090 INTRO TO GEochronology. 3.00 points.**
CC/GS: Partial Fulfillment of Science Requirement Given in alternate years.
Prerequisites: one term of college-level calculus, and solid Earth system science or its equivalent. An overview of approaches to estimating ages of sedimentary sequences and events in Earth history-to be co-listed at Stony Brook and Rutgers. Intended for students with good backgrounds in the physical sciences, who want to use geochronological techniques in their studies. Because of the hands-on nature of geochronology and thermochronology, we are going to run the course as a series of 5 workshops held on Saturdays (possibly a Sunday depending on scheduling).

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<tbody>
<tr>
<td>EESC 4090</td>
<td>001/12529</td>
<td>Sa 10:00am - 4:00pm 603 Schermerhorn Hall</td>
<td>Sidney Hemming</td>
<td>3.00</td>
<td>10/20</td>
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**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

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<th>Instructor</th>
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<th>Enrollment</th>
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<tr>
<td>EESC 4210</td>
<td>001/12539</td>
<td>T Th 8:40am - 9:55am 555 East Schermerhorn Hall</td>
<td>Dhruv Balwada</td>
<td>3.00</td>
<td>15/35</td>
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</table>

**EESC GU4300 THE EARTH’S DEEP INTERIOR. 3.00 points.**
Prerequisites: Vector calculus, differential equations, one year of college physics (mechanics, electromagnetism, waves) An overview of the geophysical study of the Earth, drawing upon geodesy, gravity, seismology, thermal studies, geomagnetism, materials science, and some geochemistry. Covers the principal techniques by which discoveries have been made, and are made, in deep Earth structure. Describes fundamental properties and features of the crust, mantle, and core

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<tr>
<td>EESC 4300</td>
<td>001/12544</td>
<td>T Th 10:10am - 11:25am 506 Schermerhorn Hall</td>
<td>Goran Ekstrom</td>
<td>3.00</td>
<td>8/30</td>
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</table>
EESC GU4560 THE ECOLOGY OF TREELINE IN A CHANGING CLIMATE. 3.00 points.
Prerequisites: Introductory Biology, Earth Science and one course in ecology recommended. Treelines are the boundaries between forests and low stature alpine and tundra vegetation, thought to be controlled by climate and therefore likely to respond to climate change. In 1807 Alexander von Humboldt and Aimé Bonpland described treeline as a global phenomenon and a bioclimatological reference that all other vegetation could be referenced against. Despite being clearly linked to climate, the mechanisms that control treeline formation and persistence remain an active area of scientific research and debate. The lack of a complete mechanistic understanding of how climate controls the location of treeline opens the important question of how treeline will respond to climate change. Furthermore, while physical site characteristics determine the potential location of treeline, trees may be absent for a variety of factors, complicating the predicted ecosystem response to a changing climate. These factors include local peculiarities of the environment, a regional lack of capable species, or a multitude of disturbances, including those caused by humans. This course is focused on the ecology treeline in light of global climate change and will provide students with a foundational understanding of fundamental ecological concepts as they pertain to this important ecological boundary between ecosystems and biomes. In addition, students will learn to (1) find, read, and discuss the primary scientific literature, and (2) communicate ecology concepts as they pertain to this important ecological boundary between ecosystems and biomes. 

Spring 2024: EESC GU4560
Course Number  Section/Call Number  Times/Location  Instructor  Points  Enrollment
EESC 4560  001/12547  T Th 11:40am - 12:55pm  Kevin Griffin  3.00  18/25
506 Schermerhorn Hall

EESC GU4885 CHEMISTRY OF CONTINENTAL WATERS. 3.00 points.
Given in alternate years.
Prerequisites: Recommended preparation: a solid background in basic chemistry.
Prerequisites: Recommended preparation: a solid background in basic chemistry. Introduction to geochemical cycles involving the atmosphere, land, and biosphere; chemistry of precipitation, weathering reactions, rivers, lakes, estuaries, and groundwaters; students are introduced to the use of major and minor ions as tracers of chemical reactions and biological processes that regulate the chemical composition of continental waters.

Spring 2024: EESC GU4885
Course Number  Section/Call Number  Times/Location  Instructor  Points  Enrollment
EESC 4885  001/12552  T Th 11:40am - 12:55pm  Robert Anderson  3.00  20/30
555 E 10th Schermerhorn Hall

EESC GU4920 PALEOCEANOGRAPHY. 3.00 points.
CC/GS: Partial Fulfillment of Science Requirement
Given in alternate years.
Prerequisites: Complements GU4937 Cenozoic Paleceanography, intended as part of a sequence with GU4330 Terrestrial Paleoclimates. For undergrads, UN2100 Earth System: Climate or equivalent, or permission of instructor
Prerequisites: Complements GU4937 Cenozoic Paleceanography, intended as part of a sequence with GU4330 Terrestrial Paleoclimates. For undergrads, UN2100 Earth System: Climate or equivalent, or permission of instructor. The course examines the ocean's response to external climatic forcing such as solar luminosity and changes in the Earth's orbit, and to internal influences such as atmospheric composition, using deep-sea sediments, corals, ice cores and other paleoceanographic archives. A rigorous analysis of the assumptions underlying the use of climate proxies and their interpretations will be presented. Particular emphasis will be placed on amplifiers of climate change during the alternating ice ages and interglacial intervals of the last few million years, such as natural variations in atmospheric greenhouse gases and changes in deep water formation rates, as well as mechanisms of rapid climate change during the late Pleistocene. The influence of changes in the Earth's radiation distribution and boundary conditions on the global ocean circulation, Asian monsoon system and El Nino/Southern Oscillation frequency and intensity, as well as interactions among these systems will be examined using proxy data and models. This course complements W4937 Cenozoic Paleoceanography and is intended as part of a sequence with W4330 Terrestrial Paleoclimates for students with interests in Paleoclimates.

Spring 2024: EESC GU4920
Course Number  Section/Call Number  Times/Location  Instructor  Points  Enrollment
EESC 4920  001/12556  T Th 10:10am - 11:25am  Jerry McManus  3.00  34/32
417 Schermerhorn Hall

EESC GU4924 INTRO TO ATMOSPHERIC CHEMISTRY. 3.00 points.
CC/GS: Partial Fulfillment of Science Requirement
Prerequisites: Compliments GU1201 Chem UN1403, & Math UN1201 (Calc III), or their equivalents. Recommended: EESC UN2100 or EESC GU4008.
Prerequisites: Compliments GU1201 Chem UN1403, 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. Atmospheric evolution and human influence; basics of greenhouse effect, photolysis, reaction kinetics; atmospheric transport of trace species; stratospheric ozone chemistry, tropospheric hydrocarbon chemistry; oxidizing power, nitrogen, oxygen, sulfur; carbon, mercury cycles; chemistry-climate-biosphere interactions; aerosols, smog, acid rain.

Spring 2024: EESC GU4924
Course Number  Section/Call Number  Times/Location  Instructor  Points  Enrollment
EESC 4924  001/12560  T Th 11:40am - 12:55pm  Roisin Commane  3.00  11/30
603 Schermerhorn Hall

Commane Roisin

Climate System Science  17
EESC GU4947 PLATE TECTONICS AND CLIMATE. 3.00 points.
CC/GS: Partial Fulfillment of Science Requirement
Given in alternate years.

Prerequisites: course in solid earth geology or geophysics; solid background in math and physics.
What produced the change from the hothouse to the ice house Earth in the last ~60 million years? What caused earlier ice ages and huge swings in sea level that covered so much of the continents with marine sediments? The possible answers, from weathering of rocks during periods of enhanced mountain building to changes in the rate of CO2 release at mid-ocean ridges, all involve plate tectonics. We review the development of the plate tectonic theory, including role Columbia researchers played in making the break-throughs that first confirmed the theory. We will discuss ideas about what might control plate motions on Earth as well as what we know about different kinds of tectonics on other planets. Researchers working on cutting-edge observations and models relating tectonics and climate will be invited to air their views to the class.

Spring 2024: EESC GU4947
Course Number  Section/Call Number  Times/Location  Instructor  Points  Enrollment
EESC 4947  001/12564  T Th 2:40pm - 3:55pm  555 Ext Schermerhorn Hall  W Buck  3.00  8/40

EESC GR9910 SEM IN ATMOSPHERIC SCIENCE. 1.00-3.00 points.
May be repeated for up to 10 points of credit.

Prerequisites: the instructor’s permission.
Prerequisites: the instructors permission. Current research developments in atmospheric sciences including tropical climate variability, stratospheric dynamics, atmospheric chemistry, remote sensing of the Earth’s atmosphere, and global climate modeling.

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 MEASUREMENTS
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 DEVELOPMENT

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