

EARTH & ATMOSPHERIC SCIENCES (EAS)

EAS 1101 - Climate and Energy: a 21st Century Earth Science Perspective (3 Credits)

Most people alive today will face unprecedented challenges and opportunities at the intersection of climate change and global energy demand. These two issues are inexorably linked to each other, and to virtually all global health and development grand challenges. Fundamentally, this course asks how we humans, as a species, found our way in to the current bottleneck of climate and energy challenges, and how we, as a society, might find solutions that guarantee future generations can enjoy a stable climate, a secure and nutritious food supply, and access to clean energy. Students learn the fundamental background that they will need to be an informed citizen on these timely and extremely important issues.

Distribution Requirements: (CA-AG, OPHLS-AG, PSC-AG, SCH-AG), (GLC-AS, PHS-AS), (SCT-IL)

Exploratory Studies: (CU-SBY)

Last Four Terms Offered: Fall 2024, Fall 2023, Fall 2022, Fall 2020
Schedule of Classes (<https://classes.cornell.edu/>)

EAS 1108 - Earth in the News (3 Credits)

Provides an introduction to physical geology and earth systems science, especially through the lens of current media. Explores the scientific basis for informed decision-making regarding many timely environmental issues, including climate change; water resources; geologic hazards such as floods, earthquakes, and volcanoes; evolution and the history of life; and energy development. Several field trips are taken in the Ithaca area.

Distribution Requirements: (OPHLS-AG, SCH-AG), (PHS-AS)

Exploratory Studies: (CU-SBY)

Last Four Terms Offered: Summer 2024, Summer 2022, Summer 2021, Summer 2020

Schedule of Classes (<https://classes.cornell.edu/>)

EAS 1180 - How to Build a Habitable Planet (3 Credits)

Crosslisted with ENGRI 1180

Our first human ancestors appeared only six million years ago—4.55 billion years into Earth's history. How did our planet develop the critical ingredients for human life—what are the characteristics that make our Pale Blue Dot suited to host complex life? Should we expect to find life elsewhere on other planets? How has human activity altered the story of the Earth, and what global challenges will Homo sapiens encounter in the coming years to decades? Can we devise and implement solutions to present and future environmental crises? In this course, we will investigate these questions through study of the formation and evolution of our universe, investigate the mechanisms that have led to intelligent life on Earth and quantify the impact of both natural and anthropogenic processes on Earth's changing surface. Students in this course will learn how to analyze and interpret scientific data and apply concepts like mass balance and convection to evaluate Earth as series of complex chemical and physical systems interacting over a breadth of scales.

Distribution Requirements: (OPHLS-AG, PSC-AG, SCH-AG), (PHS-AS)

Last Four Terms Offered: Spring 2025, Spring 2024, Spring 2023, Spring 2022

Learning Outcomes:

- Describe how the elements formed in stars and the evolution of our solar system.
- Characterize Earth's internal structure and how it has changed over time.
- Quantify the relationship between plate tectonics and hazards like earthquakes and volcanoes.
- Discriminate between long-term, short-term, natural and/or anthropogenic drivers of Earth's climate.
- Place the appearance of life and the role of humanity within the context of Earth's geologic history.

Schedule of Classes (<https://classes.cornell.edu/>)

EAS 1190 - Fossil Preparation (1 Credit)

Hands-on experience in the preparation and curation of fossils in laboratories at the Paleontological Research Institution. Students provide own transportation to the Museum of the Earth via public transit or other means. Activities include preparation and study of vertebrate, invertebrate, and plant specimens; sorting of bulk material such as field collections and mastodon dung; and curation of prepared specimens.

Distribution Requirements: (OPHLS-AG)

Last Four Terms Offered: Fall 2022, Fall 2021, Fall 2019, Fall 2018

Schedule of Classes (<https://classes.cornell.edu/>)

EAS 1220 - Natural Hazards (3 Credits)

Crosslisted with ENGRI 1220

Explores the science of natural hazards, their societal impacts, and means of mitigation. The focus is on earthquakes, volcanoes, and tsunamis, but hurricanes, severe weather, climate change, landslides, wildfires, and the threat of extinction from a future impact by an extraterrestrial body are also considered.

Distribution Requirements: (OPHLS-AG, PSC-AG), (PHS-AS), (SCT-IL)

Last Four Terms Offered: Spring 2025, Fall 2024, Spring 2024, Fall 2023

Learning Outcomes:

- Understand the impact of natural hazards on society and its infrastructure.
- Be able to analyze and interpret geological and geophysical datasets in the context of their role in hazard assessment.

Schedule of Classes (<https://classes.cornell.edu/>)

EAS 1310 - Basic Principles of Meteorology (3 Credits)

Simplified treatment of the structure of the atmosphere: heat balance of the Earth; general and secondary circulations; air masses, fronts, and cyclones; and hurricanes, thunderstorms, tornadoes, and atmospheric condensation. The optional 1-credit laboratory for the course is offered as EAS 1330.

Distribution Requirements: (OPHLS-AG, PSC-AG), (PHS-AS), (SCT-IL)

Exploratory Studies: (CU-SBY)

Last Four Terms Offered: Fall 2024, Fall 2023, Fall 2022, Fall 2021

Schedule of Classes (<https://classes.cornell.edu/>)

EAS 1330 - Basic Meteorology Lab (1 Credit)

Required for atmospheric science majors but is optional for other students taking EAS 1310.

Corequisites: EAS 1310.

Distribution Requirements: (OPHLS-AG)

Last Four Terms Offered: Fall 2024, Fall 2023, Fall 2022, Fall 2021

Schedule of Classes (<https://classes.cornell.edu/>)

EAS 1340 - Introductory Weather Analysis and Forecasting (1 Credit)

This course serves as an extension of the EAS 1330 first year major's lab. It provides opportunity for formal weather briefings, explores specific atmospheric storms (synoptic and mesoscale, including the climatology of each storm type), through assigned readings, map analysis, and weather discussions.

Prerequisites: EAS 1310 and EAS 1330.

Distribution Requirements: (OPHLS-AG)

Exploratory Studies: (CU-SBY)

Last Four Terms Offered: Spring 2025, Spring 2024, Spring 2023, Spring 2022

Schedule of Classes (<https://classes.cornell.edu/>)

EAS 1540 - Introductory Oceanography (3 Credits)

Crosslisted with BIOEE 1540

This class relies more on intuitive reasoning rather than complicated mathematical formulas to convey basic concepts about how the ocean works. For this reason, the class is very accessible to non-science majors. The class covers standard material about how the ocean works, but also includes current environmental threats facing the ocean such as global warming, ocean acidification, overfishing and coastal pollution. Students will gain a depth of knowledge about the ocean and global warming to enable them to speak and write confidently about contemporary public issues regarding the health of the ocean, global warming and a sustainable future. This course satisfies the Physical and Biological Sciences (PBS) requirement for students in most colleges. For students in A&S and CALS, this course counts as in-college credit.

Forbidden Overlaps: BIOEE 1540, BIOEE 1560, EAS 1540, EAS 1560

Distribution Requirements: (OPHLS-AG), (PHS-AS), (SCT-IL)

Exploratory Studies: (CU-SBY)

Last Four Terms Offered: Fall 2024, Fall 2023, Fall 2022, Fall 2021

Schedule of Classes (<https://classes.cornell.edu/>)

EAS 1560 - Introductory Oceanography with Laboratory (4 Credits)

Crosslisted with BIOEE 1560

This class relies more on intuitive reasoning rather than complicated mathematical formulas to convey basic concepts about how the ocean works. For this reason, the class is very accessible to non-science majors. The class covers standard material about how the ocean works, but also includes current environmental threats facing the ocean such as global warming, ocean acidification, overfishing and coastal pollution. Students will gain a depth of knowledge about the ocean and global warming to enable them to speak and write confidently about contemporary public issues regarding the health of the ocean, global warming and a sustainable future. This course satisfies the Physical and Biological Sciences (PBS) requirement for students in most colleges and the Introductory Life Sciences/Biological Sciences requirement for students in CALS. For students in A&S and CALS, this course counts as in-college credit. This course is suitable for non-life sciences majors.

Forbidden Overlaps: BIOEE 1540, BIOEE 1560, EAS 1540, EAS 1560

Distribution Requirements: (BIO-AG, OPHLS-AG), (PHS-AS), (SCT-IL)

Exploratory Studies: (CU-SBY)

Last Four Terms Offered: Fall 2024, Fall 2023, Fall 2022, Fall 2021

Schedule of Classes (<https://classes.cornell.edu/>)

EAS 1600 - Environmental Physics (3 Credits)

Fundamentals of radiation, thermodynamics, and mechanics will be introduced and used to understand energy and mass transfers in natural and built environments. Students will describe, identify and use basic principles of physics to discuss and assess renewable energy systems and solve environmental physics problems, using a physics vocabulary and appropriately quantifying results. The course is offered in the spring semester as a flipped class, meeting twice weekly. The course is offered in the fall semester as a web-based, online course and covers the same material.

Prerequisites: mathematics through high school trigonometry.

Forbidden Overlaps: EAS 1600, PHYS 1101, PHYS 1112, PHYS 2207

Distribution Requirements: (CHPH-AG, OPHLS-AG, PSC-AG), (PHS-AS)

Exploratory Studies: (CU-SBY)

Last Four Terms Offered: Spring 2025, Fall 2024, Spring 2024, Fall 2023

Learning Outcomes:

- Describe, identify, and use the basic principles of physics associated with energy and mass budgets and transfers as applied to the Earth's natural and built environment.
- Discuss, assess, and solve environmental physics problems, using a physics vocabulary and appropriately quantifying results.

Schedule of Classes (<https://classes.cornell.edu/>)

EAS 1700 - Evolution of the Earth and Life (3 Credits)

This class covers events and organisms in the history of the Earth and its life, especially those that commonly appear in popular media such as documentaries, books, and science journalism. The class is intended for students of any background interested in an introductory exploration of how the Earth and life came to look the way they do and the science by which we study the geological past. Learn about movements of the continents and implications for climate and life; coevolution of life and the atmosphere; climate change through geologic time; and major patterns of biological evolution, including dinosaur diversification, mass extinctions, and human evolution. The course includes assignments to visit the Museum of the Earth and geological sites around the Cornell campus.

Distribution Requirements: (BIO-AS, PHS-AS), (OPHLS-AG), (SCT-IL)

Exploratory Studies: (CU-ITL, CU-SBY)

Last Four Terms Offered: Spring 2025, Spring 2023, Spring 2022, Spring 2021

Schedule of Classes (<https://classes.cornell.edu/>)

EAS 2021 - Humans and Climate Change (3 Credits)

Crosslisted with COML 2021, ROMS 2021

This course explores the human dimension of climate change, arguably the most significant crisis ever to confront humanity. The focus of this course will be narratives—the stories we tell ourselves as humans about the past, present and future in literature, art, science writing, and philosophy. We will address issues such as deep time; energy transitions; guilt and hope; justice and the future. No prior knowledge of atmospheric science or literary studies required. The course is open to anyone interested in thinking about the wicked problem that is climate change from various perspectives.

Enrollment Information: Enrollment limited to: CPEP students.

Last Four Terms Offered: Summer 2024, Spring 2018, Fall 2015, Fall 2014

Schedule of Classes (<https://classes.cornell.edu/>)

EAS 2250 - The Earth System (4 Credits)

Crosslisted with ENGRD 2250

EAS 2250 provides a broad math-, physics-, and chemistry-based introduction to the earth sciences, including geology, paleontology, oceanography, and atmospheric science. Topics covered include formation of the Earth, the chemistry and physics of the Earth's interior, plate tectonics, weathering and erosion, soil development, stream and groundwater flow, volcanism and crustal deformation, the evolution of life, ocean and atmospheric structure, circulation and heat transport, ocean waves and tides, generation of storms, seawater chemistry, mineral and energy resources, and climate change.

Prerequisites: MATH 1110 or MATH 1910.

Distribution Requirements: (OPHLS-AG), (PHS-AS)

Exploratory Studies: (CU-SBY)

Last Four Terms Offered: Spring 2025, Fall 2024, Spring 2024, Fall 2023

Learning Outcomes:

- Describe and use the scientific process; i.e. explain how theories are built upon observations and how both are tested and revised. Be able to give Earth-related examples of this process.
- Explain how fundamental physical, chemical, and biological principles shape the planet Earth, providing concrete examples.
- Explain the place of the Earth in the cosmos: specifically how and when it formed, and how it continues to evolve through processes such as plate tectonics, erosion and sedimentation, etc. Describe the key observations that have led scientists to this present theory of Earth.
- Describe the history of life on Earth and explain how natural selection and evolution has led to the current diversity of organisms on Earth, including man. Explain how life has affected and changed the Earth.
- Be able to participate knowledgeably and intelligently in discussions of public policy related to earth science, particularly with respect to hazards, such as earthquakes and volcanoes, and resources such as water, mineral deposits, hydrocarbons, etc.; and the impact of man's activities on the Earth, particularly including climate change.

Schedule of Classes (<https://classes.cornell.edu/>)

EAS 2400 - Observing the Earth: Remote Sensing and GIS (3 Credits)

Crosslisted with ENGRD 2400

While the environmental challenges and hazards facing society over the next decades are diverse and complex, the next generation of scientists and engineers can look forward to a steadily increasing family of space-based observations that will help us better understand the ongoing changes. This data can enable researchers to highlight potential problems and gain the attention of decision-makers, and to evaluate the efficacy of attempts at mitigation so that we can redirect our efforts into the most useful avenues. Examples of engineering solutions that require evaluation of their outcomes include management and maintenance of coastal infrastructure, flood control or dam-building, and efforts to change land cover/land use. In this course, we will study the key questions facing our planet today, and explore the use of relevant data from current and future satellite missions. We will introduce students to Geographical Information Systems (GIS) and other methods for viewing and manipulating data. We will build from analysis of individual images, including multispectral imagery, and extend to time-series analysis of both optical and microwave data. Students will design and present a capstone project involving satellite data analysis and interpretation.

Distribution Requirements: (DLG-AG, PSC-AG)

Last Four Terms Offered: Spring 2025, Spring 2024

Learning Outcomes:

- Describe how different portions of the electromagnetic spectrum are reflected, absorbed and emitted from the Earth's surface, atmosphere and oceans.
- Calculate key characteristics of the Earth system (e.g., land use, earthquakes, surface temperature, ocean salinity) using data from airplanes or orbiting satellites.
- Analyze large, satellite-based datasets using publicly available, cloud-based GIS tools.
- Assess how engineering choices made during spacecraft design impact the utility of the resulting data (errors, resolution, etc.) for various problems.
- Discuss the history of remote sensing observations and its impact on society.

Schedule of Classes (<https://classes.cornell.edu/>)

EAS 2500 - Meteorological Observations and Instruments (4 Credits)

Covers methods and principles of atmospheric measurements and observations including in situ surface, free-air, and remote systems. Students will gain practical experience in analysis of atmospheric data, and use of state-of-the-art instrumentation.

Prerequisites: EAS 1310.

Distribution Requirements: (DLG-AG, OPHLS-AG, PSC-AG), (PHS-AS, SDS-AS)

Last Four Terms Offered: Spring 2024, Spring 2023, Spring 2022, Spring 2021

Schedule of Classes (<https://classes.cornell.edu/>)

EAS 2680 - Climate and Global Warming (3 Credits)

Familiarizes students from a range of disciplines with the basics and modern issues of climatology, such as what dictates the global and local climate, how to observe and measure it, the greenhouse effect and human-made climate change, natural climate variability and past climates. Also covers the carbon cycle, isotopes, climate models, and what our future climate might look like. Readings focus on deepening mechanistic understanding and recent scientific findings related to climate change.

Prerequisites: basic college math.

Distribution Requirements: (OPHLS-AG, PSC-AG, SCH-AG), (PHS-AS), (SCT-IL)

Exploratory Studies: (CU-SBY)

Last Four Terms Offered: Spring 2025, Spring 2024, Spring 2023, Spring 2022

Schedule of Classes (<https://classes.cornell.edu/>)

EAS 2900 - Introduction to Programming for Meteorology and Climate Science (3 Credits)

Introduction to Python programming and visualization specifically tailored to applications in meteorology and climate science. Topics include: basic Python programming, data manipulation, and instruction in the use of scientific analysis and visualization packages such as numpy, pandas, xarray, cartopy, and metpy.

Prerequisites: EAS 1310 and MATH 1110, or equivalent.

Distribution Requirements: (DLG-AG)

Last Four Terms Offered: Fall 2024, Fall 2023, Fall 2022, Fall 2021

Schedule of Classes (<https://classes.cornell.edu/>)

EAS 3010 - Evolution of the Earth System (4 Credits)

Life activities alter the physical and chemical environment of Earth's surface and are altered by that environment, while physical and chemical processes transform rock, transfer material, and create new rocks that record Earth's environmental history. The interactions over very long times constitute a coevolution of Earth and Life. Course uses modern systems and ancient systems to illustrate principles, methods of reconstructing deep history, and the context of natural change inherent to life and earth.

Prerequisites: EAS 2250 and MATH 1110 or MATH 1910 and one course in chemistry (high school or college).

Distribution Requirements: (OPHLS-AG), (PHS-AS)

Exploratory Studies: (CU-SBY)

Last Four Terms Offered: Fall 2024, Fall 2023, Fall 2022, Fall 2021

Schedule of Classes (<https://classes.cornell.edu/>)

EAS 3030 - Introduction to Biogeochemistry (4 Credits)

Crosslisted with NTRES 3030

Control and function of the Earth's global biogeochemical cycles. Begins with a review of the basic inorganic and organic chemistry of biologically significant elements, and then considers the biogeochemical cycling of carbon, nutrients, and metals that take place in soil, sediments, rivers, and the oceans. Topics include weathering, acid-base chemistry, biological redox processes, nutrient cycling and limitation, trace gas fluxes, bio-active metals, the use of isotopic tracers, controls on atmospheric carbon dioxide, and carbon cycle models. Interactions between global biogeochemical cycles and other components of the Earth system are discussed. Co-enrollment in one lab/discussion section per week is required.

Prerequisites: CHEM 2070 or equivalent, MATH 1120, and a course in biology and/or geology.

Distribution Requirements: (BIO-AS, PHS-AS), (OPHLS-AG, PSC-AG)

Exploratory Studies: (CU-SBY)

Last Four Terms Offered: Fall 2024, Fall 2023, Fall 2022, Fall 2021
Schedule of Classes (<https://classes.cornell.edu/>)

EAS 3050 - Climate Dynamics (3 Credits)

Discusses processes that determine climate and contribute to its change, including atmospheric radiation, ocean circulation, and atmospheric dynamics. Investigates contemporary climate change issues and discusses them in the context of natural variability of the system.

Prerequisites: two semesters of calculus and one semester of physics.

Distribution Requirements: (OPHLS-AG, PSC-AG, SCH-AG), (PHS-AS)

Exploratory Studies: (CU-SBY)

Last Four Terms Offered: Fall 2024, Fall 2023, Fall 2022, Fall 2021
Schedule of Classes (<https://classes.cornell.edu/>)

EAS 3090 - Earth Materials (3 Credits)

Materials of the solid Earth (minerals, rocks) record the formation and evolution of our planet and the solar systems. This course will prepare students to identify minerals, understand their significance as a record of fundamental processes for our planet, and other rocky worlds in the solar system. This course will introduce geochemical concepts that include: element formation in the solar nebula, thermodynamic and kinetic properties that control the formation and chemical diversity of minerals, the mineral and rock record of deep Earth and surface processes. The lectures will be complemented by labs where students will learn to identify minerals using crystallography and polarized microscopy techniques. The labs will also include an introduction to modern analytical methods such as Raman and infrared spectroscopy, scanning electron microscopy, mass spectrometry, with hands-on projects where the students will collect and interpret their own data.

Prerequisites: EAS 2250, CHEM 2070 or equivalent.

Distribution Requirements: (OPHLS-AG, PSC-AG), (PHS-AS)

Last Four Terms Offered: Spring 2025, Spring 2024, Spring 2023, Spring 2022

Schedule of Classes (<https://classes.cornell.edu/>)

EAS 3340 - Microclimatology (3 Credits)

Atmospheric processes at the micro to meso scale. Topics include the surface energy balance, atmosphere-surface exchange of energy and mass, boundary-layer meteorology, flow in complex (and simple) terrain, and deliberate and inadvertent climate modification. A series of exercises will be used to illustrate theoretical concepts using examples from agricultural applications and the renewable energy sector.

Prerequisites: EAS 1310 or EAS 2500 or a course in physics.

Distribution Requirements: (OPHLS-AG, PSC-AG, SCH-AG), (PHS-AS), (SCT-IL)

Last Four Terms Offered: Fall 2023, Fall 2021, Fall 2019, Spring 2014
Schedule of Classes (<https://classes.cornell.edu/>)

EAS 3410 - Atmospheric Thermodynamics and Hydrostatics (3 Credits)

Introduction to the thermodynamics and hydrostatics of the atmosphere and to the methods of description and quantitative analysis used in meteorology. Topics include thermodynamic processes of dry air, water vapor, and moist air and concepts of hydrostatics and stability.

Prerequisites: one year of calculus and one semester of physics.

Distribution Requirements: (OPHLS-AG, PSC-AG), (PHS-AS)

Last Four Terms Offered: Fall 2024, Fall 2023, Fall 2022, Fall 2021
Schedule of Classes (<https://classes.cornell.edu/>)

EAS 3420 - Atmospheric Dynamics (3 Credits)

Introduction to the basic equations and techniques used to understand motion in the atmosphere, with an emphasis on the space and time scales typical of storm systems (the synoptic scale). Derives the governing equations of atmospheric flow from first principles and applies them to middle latitude and tropical meteorology. Topics include balanced flow, atmospheric waves, circulation, and vorticity.

Prerequisites: familiarity with multivariate calculus (e.g. MATH 2220, or MATH 2930 or equivalent) or one semester of university physics.

Distribution Requirements: (OPHLS-AG, PSC-AG), (PHS-AS)

Last Four Terms Offered: Spring 2025, Spring 2024, Spring 2023, Spring 2022

Schedule of Classes (<https://classes.cornell.edu/>)

EAS 3421 - Atmospheric Dynamics Discussion: Quantitative Visualization (2 Credits)

Students will develop familiarity with concepts in atmospheric dynamics through quantitative visualizations of atmospheric data. Through the semester, they will progress from interactive activities and discussions based around computational 'notebooks' to developing their own pedagogical visualization of an atmospheric concept, phenomenon, or event.

Prerequisites: familiarity with multivariate calculus or MATH 2930, one semester of university physics.

Distribution Requirements: (OPHLS-AG)

Last Four Terms Offered: Spring 2021, Spring 2020
Schedule of Classes (<https://classes.cornell.edu/>)

EAS 3450 - Environmental Geophysics (3 Credits)

Fundamentals of subsurface imaging by geophysical methods as used in oil exploration and environmental investigations. Covers seismic reflection, refraction, gravity, magnetics, resistivity, and ground-penetrating radar (GPR) techniques.

Prerequisites: MATH 1920 and PHYS 2208 or PHYS 2213, or equivalent.

Distribution Requirements: (OPHLS-AG, PSC-AG), (PHS-AS)

Exploratory Studies: (CU-CEL, CU-SBY)

Last Four Terms Offered: Fall 2024, Fall 2022, Fall 2021, Fall 2020
Schedule of Classes (<https://classes.cornell.edu/>)

EAS 3520 - Synoptic Meteorology I (3 Credits)

Study of weather map analysis and forecasting techniques by applying the principles of fluid and heat flow. Strengthens previously introduced meteorological concepts that are applied to forecasting midlatitude synoptic scale weather systems, such as cyclones, anticyclones, jet streams, fronts, and waves.

Prerequisites: EAS 3410. Corequisite: EAS 3420.

Distribution Requirements: (DLG-AG, OPHLS-AG, PSC-AG), (PHS-AS)

Last Four Terms Offered: Spring 2025, Spring 2024, Spring 2023, Spring 2022

Schedule of Classes (<https://classes.cornell.edu/>)

EAS 3530 - Physical Oceanography (3 Credits)

Covers thermohaline and wind-driven circulation and surface-ocean boundary-layer dynamics. Mathematical expressions for describing conservation of momentum, mass, and heat in a fluid are used to explain the ocean's responses to wind and buoyancy forcing.

Prerequisites: BIOEE 1540/EAS 1540 or BIOEE 1560/EAS 1560 or equivalent, MATH 1120 or MATH 1920, and PHYS 1112 or PHYS 2207, or permission of instructor.

Distribution Requirements: (OPHLS-AG, PSC-AG), (PHS-AS)

Last Four Terms Offered: Spring 2025, Spring 2023, Spring 2021, Spring 2019

Schedule of Classes (<https://classes.cornell.edu/>)

EAS 3540 - Ocean Satellite Remote Sensing (3 Credits)

The goal of the course is to teach participants the basic skills needed to work independently to acquire, analyze and visualize data sets derived from a variety of satellite sensors that provide global estimates of phytoplankton abundance, sea surface temperature ocean wind speeds, and geostrophic currents. An important feature of the course is to develop good Python programming skills that are needed to effectively analyze and visualize satellite data to answer important oceanographic questions. Background lectures will cover the fundamentals of bio-optics, phytoplankton pigment algorithms and, to a lesser extent, the underlying physical principals leading to the measurement of sea surface temperature, ocean wind speed and geostrophic currents. The 3-credit class is taught in an intensive format for 9 weeks with 150 minutes of lecture time and 4hr and 50min of computer lab time each week.

Prerequisites: one course in marine science or permission of instructor.

Distribution Requirements: (DLG-AG, OPHLS-AG, PSC-AG), (PHS-AS)

Last Four Terms Offered: Spring 2024, Spring 2022, Spring 2020, Spring 2018

Schedule of Classes (<https://classes.cornell.edu/>)

EAS 3555 - Marine Microbes and Disease in a Changing Ocean (3 Credits)

Crosslisted with BIOMI 3500

Marine microorganisms fuel globally significant elemental cycles through their activities. They also drive diseases in multicellular life through pathogenesis, modulation of host-associated microbiomes, and through induction of stressors (e.g. toxins, hypoxia). The purpose of this course is to provide junior- and senior-level students a background in biological oceanography, marine microbial ecology, biogeochemistry, and disease pathogenesis in marine habitats. The emphasis of the course is on understanding how biology affects and is affected by the oceans, and how organisms interact to produce ocean biological phenomena. The course is divided into 4 modules: 1) Marine microbial diversity and ocean structure; 2) Ocean biogeochemistry; 3) Marine disease pathogenesis; and 4) Pollution and climate change. This course will equip students with foundations for further undergraduate courses in ocean sciences and environmental dynamics, and for graduate studies in biological oceanography and marine biology.

Prerequisites: BIOEE 1610, BIOEE 1780.

Distribution Requirements: (BIO-AS), (BSC-AG, OPHLS-AG)

Exploratory Studies: (CU-SBY)

Last Four Terms Offered: Fall 2024, Fall 2023, Spring 2023, Spring 2022

Learning Outcomes:

- Describe the taxonomic and functional diversity of marine microorganisms in both natural and human influenced habitats of the ocean.
- Examine the contributions of each group of marine organisms, from viruses through metazoa, to overall ecosystem function and elemental cycling.
- Access the current threats to marine ecosystems on local and global scales through pollution and climate change.
- Describe how microorganisms cause disease and how diseases influence marine ecosystems.

Schedule of Classes (<https://classes.cornell.edu/>)

EAS 3880 - Global Geophysics (3 Credits)

Covers global tectonics and the deep structure of the solid Earth as revealed by investigations of earthquakes, earthquake waves, the Earth's gravitational and magnetic fields, and heat flow. Students are highly encouraged to have either the math/phys prerequisites OR an introductory geologic sciences course before taking this class.

Prerequisites: MATH 1120 or MATH 1920, and PHYS 2208 or PHYS 2213.

Last Four Terms Offered: Spring 2025, Spring 2024, Spring 2023, Spring 2022

Schedule of Classes (<https://classes.cornell.edu/>)

EAS 4010 - Fundamentals of Energy and Mineral Resources (3 Credits)

The sustainable development of humanity requires natural resources for the basics of life and for increasing global standards of living. Minerals and energy are critical for human existence now and for future generations, and so new resources must be discovered, developed efficiently, and kept in the circular economy through reuse and recycling. Discovery means fully understanding the Earth, including the geological processes that concentrate resources in the subsurface and the surficial conditions that may challenge resource extraction. Realistic estimates needed for future consumption include changing global demand and new technologies. Finally, we need to be aware of the social and political dimensions of mineral and energy resource management that regulate and control aspects of resource-related social development.

Prerequisites: Recommended prerequisite: previous course in geology.

Distribution Requirements: (OPHLS-AG), (PHS-AS)

Exploratory Studies: (CU-SBY)

Last Four Terms Offered: Fall 2024, Fall 2023, Fall 2021, Spring 2021
Schedule of Classes (<https://classes.cornell.edu/>)

EAS 4040 - Geodynamics (3 Credits)

Quantitative study of the deformation, heat transport, and melting processes that have shaped the evolution of the solid Earth. Familiar physical and chemical principles and concepts are applied to the study of plate tectonics, fluid dynamics, mantle convection, melting, and mountain building.

Prerequisites: calculus, calculus-based physics, and at least one course in Earth Sciences, or permission of instructor.

Distribution Requirements: (OPHLS-AG), (PHS-AS)

Last Four Terms Offered: Spring 2025, Spring 2023, Fall 2020, Fall 2018
Schedule of Classes (<https://classes.cornell.edu/>)

EAS 4050 - Active Tectonics and Structural Geology (3 Credits)

Develops the ideas and methods necessary to understand how the Earth deforms—from individual earthquakes to the construction of mountain ranges. Discusses the driving forces of deformation, and how these forces interact with different geologic materials to cause deformation.

Prerequisites: Recommended prerequisite: linear algebra equivalent to MATH 2940.

Distribution Requirements: (OPHLS-AG), (PHS-AS, SDS-AS)

Exploratory Studies: (CU-SBY)

Last Four Terms Offered: Spring 2022, Fall 2017, Fall 2015, Fall 2013
Schedule of Classes (<https://classes.cornell.edu/>)

EAS 4060 - Geodesy (3 Credits)

Explores the methods and applications of geodesy by focusing heavily on Global Satellite Navigation Network (GNSS) data and Interferometric Synthetic Aperture Radar data (InSAR). The course covers some of the key principles of geodesy, including how to describe and measure the shape of the Earth, how to find, select and process data of a range of types, and applications to problems relating to ground displacement (e.g., volcanoes, earthquakes, extraction of groundwater) and surface processes/characteristics (e.g., soil moisture, vegetation).

Prerequisites: calculus, calculus-based physics, introductory programming class, and at least one course in Earth Sciences, or permission of instructor.

Last Four Terms Offered: Fall 2024

Schedule of Classes (<https://classes.cornell.edu/>)

EAS 4150 - GPS: Theory and Design (4 Credits)

Crosslisted with MAE 4150, ECE 4150

Analysis of GPS operating principles and engineering practice with a culminating design exercise. GPS satellite orbital dynamics, navigation data modeling, position/navigation/timing solution algorithm, receiver and antenna characteristics, analysis of error and accuracy, differential GPS.

Prerequisites: 3000-level engineering course with advanced math content (e.g., ECE 3030 or MAE 3260).

Last Four Terms Offered: Spring 2025, Spring 2023, Spring 2020, Spring 2018

Learning Outcomes:

- Students will be able to develop an understanding of orbital mechanics with non-Keplerian perturbations and reference frames adequate to calculate GPS satellite positions in absolute and local coordinates.
- Students will be able to use the GPS observables, their physical models, and the multi-variable version of Newton's nonlinear equation-solving method to calculate a navigation solution and a velocity solution.
- Students will be able to gain an understanding of the sources of ranging errors and how they map to navigation errors.
- Students will be able to collect raw GPS data in a laboratory environment, to analyze its properties, including its noise properties, and to use it to derive useful position, navigation, timing, and velocity information.
- Students will be able to implement an advanced analysis or design solution to a GPS problem, test it experimentally, and effectively communicate the results in a final report.

Schedule of Classes (<https://classes.cornell.edu/>)

EAS 4190 - Geofluids (3 Credits)

This course focuses on relationships between fluids and geologic processes. A strong focus will be on feedbacks between fluid conditions and elastic and permanent deformation within rocks and sediments. Considerable attention is given to the science of safe and successful drilling operations. Topics of discussion include applications to earthquakes, volcanoes, seafloor vents, and well drilling. Graduate students and advanced undergraduates are welcome to enroll, particularly those who have taken hydrogeology and/or structural geology / mechanics. The course will involve quantitative problem solving, reading fundamental papers, analytical solutions, simple matlab or python scripting, and a final report where students will apply the skills and understanding developed in the course to a problem related to their research or field of interest.

Distribution Requirements: (OPHLS-AG), (PHS-AS)

Last Four Terms Offered: Fall 2023, Fall 2021

Schedule of Classes (<https://classes.cornell.edu/>)

EAS 4350 - Statistical Methods in Meteorology and Climatology (3 Credits)

Statistical methods used in climatology, operational weather forecasting, and selected meteorological research applications. Statistical characteristics of meteorological data, including probability distributions, correlation structures and their implications for statistical inference. Also covers operational forecasts derived from multiple regression models, including the MOS system; and forecast evaluation techniques.

Prerequisites: one introductory course each in statistics (e.g., AEM 2100) and calculus.

Distribution Requirements: (DLS-AG, OPHLS-AG, PSC-AG), (SDS-AS)

Last Four Terms Offered: Fall 2022, Fall 2020, Fall 2018, Fall 2016

Schedule of Classes (<https://classes.cornell.edu/>)

EAS 4370 - Field Geophysics (3 Credits)

Fundamentals of subsurface imaging by geophysical methods as used in resource exploration and environmental investigations. Covers seismic, gravity, magnetics, resistivity, geodetic and ground-penetrating radar (GPR) techniques. Field exercises will allow students to collect such data near campus that is of local or regional societal relevance, analyze it, and communicate the results.

Prerequisites: MATH 1920, PHYS 2208, PHYS 2213, or equivalent.

Course Fee: Course Fee, \$50. Lab fee.

Distribution Requirements: (OPHLS-AG), (PHS-AS, SDS-AS)

Exploratory Studies: (CU-CEL, CU-SBY)

Last Four Terms Offered: Spring 2025, Spring 2023, Spring 2022, Spring 2019

Schedule of Classes (<https://classes.cornell.edu/>)

EAS 4441 - Controversies in Global Climate Change Science and Policy (1.5 Credits)

Climate change is one of the most important and yet most difficult international problems to address. This course will introduce students to the interface between global climate change science and policy, with a focus on how science factors into the United Nations Framework Convention on Climate Change (UNFCCC) and how negotiations take place leading up to and at the annual Conference of the Parties (COP). Students will critically analyze contemporary climate change science and global environmental policy-making; develop and addresses pertinent research questions; engage with experts in the field and help them with policy-relevant research; and develop experience with communications and social media. The course will meet once a week and will involve lectures, discussions, and debates on important topics.

Exploratory Studies: (CU-SBY)

Last Four Terms Offered: Fall 2022, Fall 2021, Fall 2020

Learning Outcomes:

- Understand climate change science, impacts, mitigation, and adaptation and the technical, scientific, economic and political challenges and opportunities that solving climate change represents.
- Explain the global climate change negotiations process, and articulate different viewpoints and north/south perspectives on the politically charged topics associated with climate change.
- Evaluate future developments in light of the complex political and ethical issues behind climate negotiations.
- Communicate effectively through writing, speech and visual information.
- Learn to integrate quantitative and qualitative sources of information about climate change.

Schedule of Classes (<https://classes.cornell.edu/>)

EAS 4443 - Global Climate Change Science and Policy (3 Credits)

Crosslisted with GDEV 4443, ENVS 4443

This Engaged Cornell course will introduce students to climate change science and policy, with a focus on how science factors into the United Nations Framework Convention on Climate Change (UNFCCC) and how negotiations take place at the annual Conference of the Parties (COP). The course will enable Cornell students to participate in global, engaged learning at the most significant annual meeting of the U.N. on climate change; and make a vital contribution to their academic studies and decisions about future work in international environmental affairs. Students will critically analyze contemporary climate change science and global environmental policy-making; develop and address pertinent research questions; engage with experts in the field and help them with policy-relevant research; and develop experience with communications and social media. The course will involve lectures, discussions, readings, and group projects. Teams of students will work with partner organizations representing developing countries, non-governmental organizations, and international organizations to help them prepare for the COP. This innovative, cross-disciplinary course will provide a career-changing opportunity to students to engage in the global policy-making process to address a difficult environmental problem.

Distribution Requirements: (CA-AG), (GLC-AS)

Exploratory Studies: (CU-CEL, CU-ITL, CU-SBY)

Last Four Terms Offered: Fall 2022, Fall 2021, Fall 2020, Fall 2019

Learning Outcomes:

- Students will develop substantive knowledge to: describe the basics of climate change science and the technical, scientific, economic and political challenges and opportunities that solving climate change represents; understand the diverse perspectives from a cultural, political, scientific and economic view of the problem and solutions of climate change to develop intercultural competence; explain the global climate change negotiations process, and articulate different viewpoints and north/south perspectives on the politically charged topics associated with climate change; evaluate future developments in light of the complex political and ethical issues behind climate negotiations.
- Students will gain skills to: improve personal reflection; develop partnerships; work on projects.
- Students will also develop technical skills to: communicate about climate change to/with different audiences; develop intercultural competence by working with diverse peers and partners; develop professional skills working and communicating with international partners.

Schedule of Classes (<https://classes.cornell.edu/>)

EAS 4447 - Interacting with Global Climate Policy (1 Credit)

This course allows the students to attend the negotiations taking place at the annual Conference of the Parties (COP) for United Nations Framework Convention on Climate Change (UNFCCC) as part of Cornell's delegation. The course will enable Cornell students to participate in global, engaged learning at the most significant annual meeting of the U.N. on climate change; and make a vital contribution to their academic studies and decisions about future work in international environmental affairs. Teams of students will work with partner organizations representing developing countries, non-governmental organizations, and international organizations to help them prepare for the COP.

Corequisites: EAS 4443.

Course Fee: Course Fee, \$3000. Fee amount approximate.

Exploratory Studies: (CU-CEL, CU-ITL)

Last Four Terms Offered: Fall 2022, Fall 2021

Learning Outcomes:

- Describe the basics of climate change science and the technical, scientific, economic, and political challenges and opportunities that solving climate change represents. Understand the diverse perspectives from a cultural, political, scientific, and economic view of the problem and solutions of climate change to develop intercultural competence.
- Explain the global climate change negotiations process, and articulate different viewpoints and north/south perspectives on the politically charged topics associated with climate change.
- Evaluate future developments in light of the complex political and ethical issues behind climate negotiations.
- Gain skills in personal reflection, partnership development and project work.
- Develop intercultural competence by working with diverse peers and partners.
- Develop professional skills working and communicating with international partners.

Schedule of Classes (<https://classes.cornell.edu/>)

EAS 4470 - Physical Meteorology (3 Credits)

Primarily a survey of natural phenomena of the atmosphere, with emphasis on their underlying physical principles. Topics include an introduction to atmospheric radiation processes, atmospheric optics and electricity, microphysical cloud processes, and principles of radar probing of the atmosphere.

Prerequisites: one year each of calculus and physics.

Distribution Requirements: (OPHLS-AG), (PHS-AS)

Last Four Terms Offered: Fall 2023, Fall 2021, Fall 2019, Fall 2017

Schedule of Classes (<https://classes.cornell.edu/>)

EAS 4510 - Synoptic Meteorology II (3 Credits)

Structure and dynamics of large-scale midlatitude weather systems, such as cyclones, anticyclones, and waves, with consideration of processes that contribute to temperature changes and precipitation. Lab sessions involve real-time weather forecasting and the application of a numerical model of the atmosphere to the study of selected large-scale midlatitude weather events.

Prerequisites: EAS 3410 and EAS 3420 or equivalent.

Distribution Requirements: (OPHLS-AG), (PHS-AS)

Last Four Terms Offered: Fall 2024, Fall 2023, Fall 2022, Fall 2021

Schedule of Classes (<https://classes.cornell.edu/>)

EAS 4550 - Geochemistry (3 Credits)

Chemistry applied to understanding the Earth and the Solar System including its formation and evolution, and processes occurring on the Earth's surface and in its interior. The course covers thermodynamics and kinetics of geochemical processes, aquatic and environmental chemistry, geochronology, trace element and isotope geochemistry, paleoclimatology, and the carbon cycle and organic geochemistry.

Prerequisites: CHEM 2070 or CHEM 2090 or equivalent.

Distribution Requirements: (OPHLS-AG), (PHS-AS)

Last Four Terms Offered: Fall 2024, Fall 2022, Spring 2021, Fall 2019

Schedule of Classes (<https://classes.cornell.edu/>)

EAS 4561 - Isotope Geochemistry (3 Credits)

Fundamentals of radiogenic, cosmogenic, and stable isotope geochemistry and application to a variety of Earth system problems including evolution of the crust and mantle, earth surface processes, climate, biosphere, global water, and elemental cycling. We will explore recent advances in the development of isotope tracers and instrument capabilities, evaluate model frameworks, and learn how to interpret isotope signatures in a variety of modern and paleo contexts.

Distribution Requirements: (OPHLS-AG), (PHS-AS)

Last Four Terms Offered: Spring 2025, Spring 2023, Spring 2017, Spring 2015

Schedule of Classes (<https://classes.cornell.edu/>)

EAS 4570 - Atmospheric Air Pollution (3 Credits)

Examines sources, effects, transport, measurement, and controls of air pollution. Discusses the basic principles in each area with an emphasis on their local, regional, and global impacts.

Prerequisites: EAS 3410 or thermodynamics course, and one semester of chemistry, or permission of instructor.

Distribution Requirements: (OPHLS-AG), (PHS-AS)

Exploratory Studies: (CU-SBY)

Last Four Terms Offered: Spring 2023, Spring 2022, Fall 2020, Fall 2018

Schedule of Classes (<https://classes.cornell.edu/>)

EAS 4580 - Volcanology (3 Credits)

Volcanic rocks constitute a significant component of the surface of all the terrestrial planets. Volcanoes are the main location of mass and energy exchange between the external and internal parts of our planet, making volcanic processes key not only for the physical and chemical evolution of the planet, but also to the evolution of climate and life. This course incorporates the physics and chemistry of magmatic processes related to volcanic activity in several modules followed by exercises done in class and complemented by weekly assignments.

Distribution Requirements: (OPHLS-AG), (PHS-AS)

Last Four Terms Offered: Fall 2024, Fall 2021, Spring 2020, Spring 2019

Learning Outcomes:

- Identify, describe and interpret the different volcanic deposits in the geologic record.
- Interpret the physical mechanisms by which magmas are produced, transport through the mantle and crust, and erupt at the surface.
- Understand the role of volcanism in planetary evolution.
- Evaluate the hazards and risks to human populations and the environment associated with volcanic processes.

Schedule of Classes (<https://classes.cornell.edu/>)

EAS 4590 - Earthquake Physics (3 Credits)

Last Four Terms Offered: Fall 2024

Schedule of Classes (<https://classes.cornell.edu/>)

EAS 4700 - Advanced Weather Forecasting and Analysis (2 Credits)

Applied course focusing on weather forecasting and analysis techniques for various regions around the world. Lectures emphasize the application of student's knowledge of atmospheric dynamics, thermodynamics, and computer-data analysis to forecast the development and movement of multiscale weather systems. Students participate in weekly forecast discussions; write daily forecasts that include a synoptic discussion, quantitative precipitation forecasts, and severe weather outlook for the forecast region; and lead class discussion on assigned readings.

Prerequisites: EAS 3520, EAS 4510.

Distribution Requirements: (DLG-AG, OPHLS-AG, PSC-AG), (PHS-AS)

Last Four Terms Offered: Spring 2025, Spring 2024, Fall 2023, Spring 2023

Schedule of Classes (<https://classes.cornell.edu/>)

EAS 4710 - Introduction to Groundwater (3 Credits)

Crosslisted with BEE 4710

Fresh water has become a limited resource in many parts of the world. In arid and semi-arid regions, groundwater levels are declining at unsustainable levels. In several industrial areas, groundwater is contaminated and unsuitable as potable water. This course will address the sustainability and pollution of groundwater by first understanding the theory of saturated and unsaturated flow and contaminant transport under ideal conditions. Subsequently, we learn to simplify groundwater systems in complex subsurface environments to obtain practical solutions. At the end of the course, the learned material will be put in a broader context as they are affected by natural or human actions. Throughout the course, guest speakers will discuss topics of current interest related to water. This elective course is intended for seniors interested in subsurface water and solute transport applications to sustainable groundwater use and prevention of pollution. Well-prepared EAS, CEE and BEE juniors are welcome, too.

Exploratory Studies: (CU-SBY)

Last Four Terms Offered: Spring 2025, Spring 2024, Spring 2023, Spring 2022

Schedule of Classes (<https://classes.cornell.edu/>)

EAS 4720 - Fundamentals of Glaciology (3 Credits)

This course is a physics-based introduction to glacier and ice sheet dynamics, with applications in understanding the response of modern terrestrial ice sheets to a changing climate. Topics covered include ice-sheet mass balance, the material properties and rheology of ice and snow, temperature and heat transport, the basic equations of ice-sheet and ice-shelf flow, basal processes, ice-sheet hydrology, fracture and calving, and ice-atmosphere and ice-ocean interactions. The course also overviews methods of observing ice sheet processes and change, including geophysical methods and satellite and airborne remote sensing.

Prerequisites: MATH 1920, PHYS 1112, and CS1110/CS1112 or EAS2900

Enrollment Information: Recommended prerequisite: multivariable calculus (MATH 1920 or equivalent), undergraduate mechanics (PHYS 1112 or equivalent), programming proficiency in Python (CS1110/1112 or EAS2900 plus one additional course with a significant programming component or equivalent experience recommended)

Distribution Requirements: (BIO-AS, PHS-AS)

Schedule of Classes (<https://classes.cornell.edu/>)

EAS 4740 - Quantitative Data Analysis for the Geosciences (3 Credits)

Geoscientists cannot perform controlled experiments, and they study processes that occur over time and distance scales that cannot fit into a laboratory, leading to unusual data analysis problems. This course first covers basic statistical methods for handling and treating noisy data of this sort, then parameter estimation from incomplete and noisy measurements, then basics of time series analysis. Examples include spatial, temporal, sequential and directional problems derived from climate science, seismology, sedimentology, structural geology, geochemistry and related fields.

Prerequisites: two semesters of calculus, and coursework in earth and atmospheric sciences at 3000-level or above. Recommended prerequisite: linear algebra.

Distribution Requirements: (DLS-AG, OPHLS-AG), (PHS-AS, SDS-AS)

Last Four Terms Offered: Spring 2022, Spring 2019, Spring 2018, Spring 2017

Schedule of Classes (<https://classes.cornell.edu/>)

EAS 4790 - Paleobiology (4 Credits)

Crosslisted with BIOEE 4790

Surveys the major groups of invertebrate organisms and their evolutionary histories, and the theoretical and practical principles of paleontology, from biostratigraphy to macroevolution. Intended to fill out the biological backgrounds of Earth and atmospheric science students concerning the nature and significance of the fossil record for their respective studies, and the paleontological backgrounds of biology students interested in ecology and evolution.

Prerequisites: BIOEE 1780 or BIOSM 1780, EAS 3010, or permission of instructor.

Distribution Requirements: (BIO-AS), (OPHLS-AG)

Last Four Terms Offered: Spring 2024, Spring 2023, Spring 2022, Spring 2021

Schedule of Classes (<https://classes.cornell.edu/>)

EAS 4800 - Atmospheric Chemistry: From Air Pollution to Global Change (3 Credits)

Crosslisted with BEE 4800

This course investigates the science of atmospheric chemistry as its relation to air pollution and global change. Students examine the chemistry and physics that determines atmospheric composition on local to global scales including the effects of biogeochemistry and atmospheric photochemistry.

Prerequisites: CHEM 2070 or CHEM 2090, MATH 1920, and PHYS 1112 or equivalent, or permission of instructor.

Distribution Requirements: (OPHLS-AG), (PHS-AS)

Exploratory Studies: (CU-SBY)

Last Four Terms Offered: Fall 2024, Fall 2022, Fall 2021, Fall 2020

Schedule of Classes (<https://classes.cornell.edu/>)

EAS 4820 - Seismology (3 Credits)

This course presents an overview of observations and methods in seismology. Topics include techniques necessary for understanding elastic wave propagation in layered media and what these waves teach us about Earth's composition and structure. This course introduces concepts in earthquake and reflection seismology and seismic hazard.

Prerequisites: one year of calculus, one year of physics. Recommended prerequisite: structural geology.

Distribution Requirements: (OPHLS-AG), (PHS-AS)

Last Four Terms Offered: Spring 2024, Fall 2018, Fall 2016, Fall 2014

Schedule of Classes (<https://classes.cornell.edu/>)

EAS 4840 - Inverse Methods in the Natural Sciences (3 Credits)

An exploration of solution methods for inverse problems with examples taken from geophysics and related fields, with particular attention to making inferences from inaccurate, incomplete, or inconsistent physical data. Applications include medical and seismic tomography, earthquake location, image processing, and radio/radar imaging. Linear algebra (including condition numbers) and probability and statistics (including error analysis, Bayes theorem, Gibbs distribution, and Markov chains) are reviewed. Methods covered include nonlinear least-squares, maximum likelihood methods, and local and global optimization methods, including simulated annealing and genetic algorithms.

Prerequisites: MATH 2940.

Distribution Requirements: (OPHLS-AG), (SDS-AS)

Last Four Terms Offered: Fall 2024, Fall 2022, Fall 2020, Fall 2018
Schedule of Classes (<https://classes.cornell.edu/>)

EAS 4860 - Tropical Meteorology and Climate (3 Credits)

This course will examine the atmospheric processes responsible for inducing variations in tropical weather and climate on daily to interannual timescales. Computer lab visualization and numerical modeling exercises will deepen student understanding of tropical meteorology, develop programming proficiency, and enhance scientific writing skills.

Prerequisites: EAS 3050, EAS 3410, EAS 3420, EAS 4470, or permission of instructor.

Corequisites: EAS 3420.

Distribution Requirements: (DLG-AG, OPHLS-AG, PSC-AG), (PHS-AS)

Last Four Terms Offered: Spring 2023, Spring 2020, Spring 2019, Spring 2017

Learning Outcomes:

- Develop and apply numerical data analysis and visualization routines.

Schedule of Classes (<https://classes.cornell.edu/>)

EAS 4870 - Introduction to Radar Remote Sensing (3 Credits)

Crosslisted with ECE 4870

Fundamentals of radar, antennas, and remote sensing. Exposes students to the principles underlying the analysis and design of antennas used for communication and for radar-related applications. Students also encounter both a mathematical and a practical description of how radars function, how their performance can be optimized for different applications, and how signals acquired by them can be processed. The objective is to familiarize students with a wide variety of radars rather than turn them into practicing radar engineers. Each topic is developed from basic principles so students with a wide variety of backgrounds are able to take the course. Emphasizes radar applications in geophysics, meteorology and atmospheric sciences, and astronomy and space sciences. Gives special attention to radar remote sensing of the Earth from spacecraft.

Prerequisites: PHYS 2208 or PHYS 2213 or equivalent, or permission of instructor.

Distribution Requirements: (OPHLS-AG), (PHS-AS)

Last Four Terms Offered: Spring 2024, Spring 2022, Spring 2019, Spring 2016

Learning Outcomes:

- Appreciate the historical, scientific, and sociological impact of radar systems.
- Understand the reciprocity theorem and its profound consequences.
- Learn to evaluate antenna performance using analysis and numerical methods, including computer algebra.
- Be able to design antennas, radar systems, and remote sensing experiments for specific tasks.
- Learn to design waveforms and process signals produced by radars and other instruments.

Schedule of Classes (<https://classes.cornell.edu/>)

EAS 4910 - Undergraduate Research (1-4 Credits)

Introduction to the techniques and philosophy of research in the earth sciences and an opportunity for undergraduates to participate in current faculty research projects. Topics chosen in consultation with, and guided by, a faculty member. A short written report is required, and outstanding projects are prepared for publication.

Exploratory Studies: (CU-UG)

Last Four Terms Offered: Fall 2024, Fall 2023, Fall 2022, Fall 2021

Schedule of Classes (<https://classes.cornell.edu/>)

EAS 4920 - Undergraduate Research (1-4 Credits)

Introduction to the techniques and philosophy of research in the earth sciences and an opportunity for undergraduates to participate in current faculty research projects. Topics chosen in consultation with, and guided by, a faculty member. A short written report is required, and outstanding projects are prepared for publication.

Exploratory Studies: (CU-UG)

Last Four Terms Offered: Spring 2025, Spring 2024, Spring 2023, Spring 2022

Schedule of Classes (<https://classes.cornell.edu/>)

EAS 4940 - Special Topics in Earth and Atmospheric Sciences (1-8 Credits)

The department teaches trial courses under this number. Offerings vary by semester and are advertised by the department before the beginning of the semester.

Last Four Terms Offered: Fall 2024, Spring 2024, Spring 2023, Fall 2022
Schedule of Classes (<https://classes.cornell.edu/>)

EAS 4960 - Internship Experience (1-2 Credits)

Students with internship opportunities may be able to receive credit through this course.

Last Four Terms Offered: Spring 2025, Fall 2024, Spring 2024, Fall 2023
Schedule of Classes (<https://classes.cornell.edu/>)

EAS 4970 - Individual Study in Atmospheric Science (1-6 Credits)

Topics are arranged at the beginning of the semester for individual study or for group discussions.

Last Four Terms Offered: Spring 2025, Fall 2024, Spring 2024, Fall 2023
Schedule of Classes (<https://classes.cornell.edu/>)

EAS 4980 - Teaching Experience in Earth and Atmospheric Sciences (1-4 Credits)

The student assists in teaching an EAS course appropriate to his or her previous training. The student meets with a discussion or laboratory section, prepares course materials, grades assignments, and regularly discusses course objectives and teaching techniques with the faculty member in charge of the course.

Last Four Terms Offered: Spring 2025, Fall 2024, Spring 2024, Fall 2023
Schedule of Classes (<https://classes.cornell.edu/>)

EAS 4990 - Undergraduate Research in Atmospheric Science (1-4 Credits)

Independent research on current problems in atmospheric science.

Exploratory Studies: (CU-UG)

Last Four Terms Offered: Spring 2024, Fall 2023, Spring 2023, Fall 2022
Schedule of Classes (<https://classes.cornell.edu/>)

EAS 5000 - Master Engineering Design Project (2-12 Credits)

Project with significant engineering content that is required for the M.Eng. program.

Last Four Terms Offered: Spring 2025, Fall 2024, Spring 2024, Fall 2023
Schedule of Classes (<https://classes.cornell.edu/>)

EAS 5010 - Fundamentals of Energy and Mineral Resources (3 Credits)

The sustainable development of humanity requires natural resources for the basics of life and for increasing global standards of living. Minerals and energy are critical for human existence now and for future generations, and so new resources must be discovered, developed efficiently, and kept in the circular economy through reuse and recycling. Discovery means fully understanding the Earth, including the geological processes that concentrate resources in the subsurface and the surficial conditions that may challenge resource extraction. Realistic estimates needed for future consumption include changing global demand and new technologies. Finally, we need to be aware of the social and political dimensions of mineral and energy resource management that regulate and control aspects of resource-related social development.

Prerequisites: Recommended prerequisite: previous course in geology.

Exploratory Studies: (CU-SBY)

Last Four Terms Offered: Fall 2023, Fall 2021, Spring 2021, Fall 2019
Schedule of Classes (<https://classes.cornell.edu/>)

EAS 5011 - Evolution of the Earth System (4 Credits)

Life activities alter the physical and chemical environment of Earth's surface and are altered by that environment, while physical and chemical processes transform rock, transfer material, and create new rocks that record Earth's environmental history. The interactions over very long times constitute a coevolution of Earth and Life. Course uses modern systems and ancient systems to illustrate principles, methods of reconstructing deep history, and the context of natural change inherent to life and earth.

Prerequisites: EAS 2250, MATH 1110 or MATH 1910, one course in chemistry (high school or college).

Enrollment Information: Enrollment limited to: graduate students.

Exploratory Studies: (CU-SBY)

Last Four Terms Offered: Fall 2022, Fall 2021, Fall 2020, Fall 2019
Schedule of Classes (<https://classes.cornell.edu/>)

EAS 5041 - Geodynamics (3 Credits)

Quantitative study of the deformation, heat transport, and melting processes that have shaped the evolution of the solid Earth. Familiar physical and chemical principles and concepts are applied to the study of plate tectonics, fluid dynamics, mantle convection, melting, and mountain building.

Prerequisites: calculus, calculus-based physics, and at least one course in Earth Sciences, or permission of instructor.

Last Four Terms Offered: Spring 2025, Spring 2023, Fall 2020, Fall 2018
Schedule of Classes (<https://classes.cornell.edu/>)

EAS 5051 - Climate Dynamics (3 Credits)

Discusses processes that determine climate and contribute to its change, including atmospheric radiation, ocean circulation, and atmospheric dynamics. Investigates contemporary climate change issues and discusses them in the context of natural variability of the system.

Prerequisites: two semesters of calculus and one semester of physics.

Exploratory Studies: (CU-SBY)

Last Four Terms Offered: Fall 2024, Fall 2023, Fall 2022, Fall 2021
Schedule of Classes (<https://classes.cornell.edu/>)

EAS 5060 - EAS Workshops on How to Succeed (1 Credit)

Last Four Terms Offered: Spring 2025, Fall 2024, Spring 2024, Fall 2023
Schedule of Classes (<https://classes.cornell.edu/>)

EAS 5090 - Earth Materials (3 Credits)

Materials of the solid Earth (minerals, rocks) record the formation and evolution of our planet and the solar systems. This course will prepare students to identify minerals, understand their significance as a record of fundamental processes for our planet, and other rocky worlds in the solar system. This course will introduce geochemical concepts that include: element formation in the solar nebula, thermodynamic and kinetic properties that control the formation and chemical diversity of minerals, the mineral and rock record of deep Earth and surface processes. The lectures will be complemented by labs where students will learn to identify minerals using crystallography and polarized microscopy techniques. The labs will also include an introduction to modern analytical methods such as Raman and infrared spectroscopy, scanning electron microscopy, mass spectrometry, with hands-on projects where the students will collect and interpret their own data.

Prerequisites: EAS 2250, CHEM 2070 or equivalent.

Last Four Terms Offered: Spring 2025, Spring 2024, Spring 2023, Spring 2022
Schedule of Classes (<https://classes.cornell.edu/>)

EAS 5340 - Microclimatology (3 Credits)

Atmospheric processes at the micro to meso scale. Topics include the surface energy balance, atmosphere-surface exchange of energy and mass, boundary-layer meteorology, flow in complex (and simple) terrain, and deliberate and inadvertent climate modification. A series of exercises will be used to illustrate theoretical concepts using examples from agricultural applications and the renewable energy sector.

Prerequisites: EAS 1310 or EAS 2500 or a course in physics.

Last Four Terms Offered: Fall 2023, Fall 2021

Schedule of Classes (<https://classes.cornell.edu/>)

EAS 5350 - Statistical Methods in Meteorology and Climatology (3 Credits)

Statistical methods used in climatology, operational weather forecasting, and selected meteorological research applications. Statistical characteristics of meteorological data, including probability distributions, correlation structures and their implications for statistical inference. Also covers operational forecasts derived from multiple regression models, including the MOS system; and forecast evaluation techniques.

Prerequisites: one introductory course each in statistics (e.g. AEM 2100) and calculus.

Last Four Terms Offered: Fall 2022, Fall 2020, Fall 2018, Fall 2016

Schedule of Classes (<https://classes.cornell.edu/>)

EAS 5420 - Atmospheric Dynamics (3 Credits)

Introduction to the basic equations and techniques used to understand motion in the atmosphere, with an emphasis on the space and time scales typical of storm systems (the synoptic scale). Derives the governing equations of atmospheric flow from first principles and applies them to mid-latitude meteorology. Topics include balanced flow, atmospheric waves, vorticity, and baroclinic instability. Students taking this course at the graduate level (EAS 5420) will have to complete additional questions on the biweekly problem sets and on the prelim and final exams.

Prerequisites: familiarity with multivariate calculus is expected, (e.g. MATH 1910, MATH 2220, or equivalent), and one semester of university physics.

Last Four Terms Offered: Spring 2025, Spring 2024, Spring 2023, Spring 2022

Learning Outcomes:

- Fluently use concepts of advection, balance, buoyancy, vorticity, and others to describe atmospheric phenomena.
- Demonstrate and derive equations describing atmospheric flows from physical conservation principals (momentum, mass, entropy) and scale analysis.
- Apply and interpret these equations in relevant atmospheric conditions.

Schedule of Classes (<https://classes.cornell.edu/>)

EAS 5443 - Global Climate Change Science and Policy (3-4 Credits)

Crosslisted with GDEV 5443

This Engaged Cornell course will introduce students to climate change science and policy, with a focus on how science factors into the United Nations Framework Convention on Climate Change (UNFCCC) and how negotiations take place at the annual Conference of the Parties (COP). The course will enable Cornell students to participate in global, engaged learning at the most significant annual meeting of the U.N. on climate change; and make a vital contribution to their academic studies and decisions about future work in international environmental affairs. Students will critically analyze contemporary climate change science and global environmental policy-making; develop and address pertinent research questions; engage with experts in the field and help them with policy-relevant research; and develop experience with communications and social media. The course will involve lectures, discussions, readings, and group projects. Teams of students will work with partner organizations representing developing countries, non-governmental organizations, and international organizations to help them prepare for the COP. This innovative, cross-disciplinary course will provide a career-changing opportunity to students to engage in the global policy-making process to address a difficult environmental problem.

Exploratory Studies: (CU-CEL, CU-ITL, CU-SBY)

Last Four Terms Offered: Fall 2022, Fall 2021, Fall 2020, Fall 2019

Learning Outcomes:

- Students will develop substantive knowledge to: describe the basics of climate change science and the technical, scientific, economic and political challenges and opportunities that solving climate change represents; understand the diverse perspectives from a cultural, political, scientific and economic view of the problem and solutions of climate change to develop intercultural competence; explain the global climate change negotiations process, and articulate different viewpoints and north/south perspectives on the politically charged topics associated with climate change; evaluate future developments in light of the complex political and ethical issues behind climate negotiations.
- Students will gain skills to: improve personal reflection; develop partnerships; work on projects.
- Students will also develop technical skills to: communicate about climate change to/different audiences; develop intercultural competence by working with diverse peers and partners; develop professional skills working and communicating with international partners.

Schedule of Classes (<https://classes.cornell.edu/>)

EAS 5447 - Interacting with Global Climate Policy (1 Credit)

This course allows the students to attend the negotiations taking place at the annual Conference of the Parties (COP) for United Nations Framework Convention on Climate Change (UNFCCC) as part of Cornell's delegation. The course will enable Cornell students to participate in global, engaged learning at the most significant annual meeting of the U.N. on climate change; and make a vital contribution to their academic studies and decisions about future work in international environmental affairs. Teams of students will work with partner organizations representing developing countries, non-governmental organizations, and international organizations to help them prepare for the COP.

Corequisites: EAS 5443.

Course Fee: Course Fee, \$3000. Fee amount approximate.

Last Four Terms Offered: Fall 2022, Fall 2021

Learning Outcomes:

- Students will be able to describe the basics of climate change science and the technical, scientific, economic, and political challenges and opportunities that solving climate change represents. Understand the diverse perspectives from a cultural, political, scientific, and economic view of the problem and solutions of climate change to develop intercultural competence.
- Students will be able to explain the global climate change negotiations process, and articulate different viewpoints and north/south perspectives on the politically charged topics associated with climate change.
- Students will be able to evaluate future developments in light of the complex political and ethical issues behind climate negotiations.
- Students will gain skills in personal reflection, partnership development and project work.
- Students will be able to develop intercultural competence by working with diverse peers and partners.
- Students will develop professional skills working and communicating with international partners.

Schedule of Classes (<https://classes.cornell.edu/>)

EAS 5450 - Environmental Geophysics (3 Credits)

Fundamentals of subsurface imaging by geophysical methods as used in oil exploration and environmental investigations. Covers seismic reflection, refraction, gravity, magnetics, resistivity, and ground-penetrating radar (GPR) techniques.

Prerequisites: MATH 1920 and PHYS 2208 or PHYS 2213, or equivalent.

Exploratory Studies: (CU-CEL, CU-SBY)

Last Four Terms Offered: Fall 2024, Fall 2022, Fall 2021

Schedule of Classes (<https://classes.cornell.edu/>)

EAS 5555 - Numerical Techniques for Weather and Climate Modeling (2 Credits)

This class will present an introductory overview of the common methodological approaches used today for numerical weather prediction and global climate modeling. Technical skills and in-depth understanding of the approaches will be emphasized through short weekly reading assignments and programming activities. An historical perspective on weather and climate modeling will be covered as well in the scope of this course because it helps put state-of-the-art numerical modeling in an appropriate context. Final projects will include running a weather or climate model on the National Center for Atmospheric Research's Cheyenne supercomputer, or other supercomputing facilities if students have access to other resources they would like to use. Cloud computing based solutions to numerical weather and climate modeling will also be covered.

Prerequisites: MATH 1920 and PHYS 2208.

Exploratory Studies: (CU-CEL)

Last Four Terms Offered: Spring 2024, Spring 2021, Spring 2019

Learning Outcomes:

- Students will be able to understand the theory, derivation, and application of numerical techniques used today for climate and weather modeling.
- Students will be able to explain how parameterization schemes are used and characterize their limitations.
- Students will be able to configure and run climate and weather simulations independently.
- Students will be able to modify underlying code to change model behavior.

Schedule of Classes (<https://classes.cornell.edu/>)

EAS 5620 - Marine Ecosystem Sustainability (3 Credits)

Prerequisites: BIOEE 1610.

Exploratory Studies: (CU-SBY)

Last Four Terms Offered: Fall 2022, Fall 2021, Fall 2018, Fall 2016

Schedule of Classes (<https://classes.cornell.edu/>)

EAS 5720 - Fundamentals of Glaciology (3 Credits)

Schedule of Classes (<https://classes.cornell.edu/>)

EAS 5740 - Quantitative Data Analysis for the Geosciences (3 Credits)

Geoscientists cannot perform controlled experiments, and they study processes that occur over time and distance scales that cannot fit into a laboratory, leading to unusual data analysis problems. This course first covers basic statistical methods for handling and treating noisy data of this sort, then parameter estimation from incomplete and noisy measurements, then basics of time series analysis. Examples include spatial, temporal, sequential and directional problems derived from climate science, seismology, sedimentology, structural geology, geochemistry and related fields.

Prerequisites: two semesters of calculus, and coursework in earth and atmospheric sciences at 3000-level or above. Recommended prerequisite: linear algebra.

Last Four Terms Offered: Spring 2022, Spring 2019, Spring 2018, Spring 2017

Schedule of Classes (<https://classes.cornell.edu/>)

EAS 5750 - Planetary Atmospheres (3 Credits)

Crosslisted with ASTRO 6575

This course will provide an overview of fundamental physical processes that govern the structure and behavior of atmospheres in the solar system and beyond. Topics covered will include the basic principles of atmospheric statics, radiative transfer, dynamics, cloud physics, and chemistry to understand the diverse range of observable atmospheres. These topics will be explored through review of relevant physical processes and research in solar system and exoplanetary science. This course is geared toward graduate students with a solid background in relevant math and physics coursework.

Prerequisites: PHYS 2214 or PHYS 2218, MATH 2930 or equivalent.

Last Four Terms Offered: Spring 2024, Fall 2016, Fall 2014, Spring 2013
Schedule of Classes (<https://classes.cornell.edu/>)

EAS 5770 - Planetary Surface Processes (3 Credits)

Crosslisted with ASTRO 6577

This course explores remote sensing techniques for studying solar system surfaces and the geomorphic processes shaping them. Topics include impact cratering, volcanism, tectonism, and erosion, with an emphasis on terrestrial field sites as planetary analogs. Students will also learn about surface morphology, planetary weathering, and fundamental field and remote sensing methods. An optional 1-credit field trip is available (see ASTRO 6580).

Last Four Terms Offered: Spring 2024, Spring 2022, Spring 2020, Spring 2017

Schedule of Classes (<https://classes.cornell.edu/>)

EAS 5780 - Planet Formation and Evolution (3 Credits)

Crosslisted with ASTRO 6578

Last Four Terms Offered: Spring 2021, Fall 2017, Spring 2016, Spring 2014

Schedule of Classes (<https://classes.cornell.edu/>)

EAS 5810 - Introduction to Plasma Physics (4 Credits)

Crosslisted with ECE 5810, AEP 6060

Topics include plasma state; motion of charged particles in fields; drift-orbit theory; coulomb scattering, collisions; ambipolar diffusion; elementary transport theory; two-fluid and hydromagnetic equations; plasma oscillations and waves, CMA diagram; hydromagnetic stability; and elementary applications to space physics, plasma technology, and controlled fusion.

Enrollment Information: Enrollment limited to: graduate students and exceptional seniors. Recommended prerequisite: ECE 3030 or equivalent.

Last Four Terms Offered: Fall 2023, Fall 2022, Fall 2021, Fall 2020
Schedule of Classes (<https://classes.cornell.edu/>)

EAS 5840 - Inverse Methods in the Natural Sciences (3 Credits)

An exploration of solution methods for inverse problems with examples taken from geophysics and related fields, with particular attention to making inferences from inaccurate, incomplete, or inconsistent physical data. Applications include medical and seismic tomography, earthquake location, image processing, and radio/radar imaging. Linear algebra (including condition numbers) and probability and statistics (including error analysis, Bayes theorem, Gibbs distribution, and Markov chains) are reviewed. Methods covered include nonlinear least-squares, maximum likelihood methods, and local and global optimization methods, including simulated annealing and genetic algorithms.

Prerequisites: MATH 2940.

Last Four Terms Offered: Fall 2024, Fall 2022, Fall 2020, Fall 2018
Schedule of Classes (<https://classes.cornell.edu/>)

EAS 5850 - Global Geophysics (3 Credits)

Covers global tectonics and the deep structure of the solid Earth as revealed by investigations of earthquakes, earthquake waves, the Earth's gravitational and magnetic fields, and heat flow. Students are highly encouraged to have either the math/phys prerequisites OR an introductory geologic sciences course before taking this class.

Prerequisites: MATH 1120 or MATH 1920, and PHYS 2208 or PHYS 2213.

Last Four Terms Offered: Spring 2025, Spring 2024, Spring 2023, Spring 2022

Schedule of Classes (<https://classes.cornell.edu/>)

EAS 5870 - Introduction to Radar Remote Sensing (3 Credits)

Fundamentals of radar, antennas, and remote sensing. Exposes students to the principles underlying the analysis and design of antennas used for communication and for radar-related applications. Students also encounter both a mathematical and a practical description of how radars function, how their performance can be optimized for different applications, and how signals acquired by them can be processed. The objective is to familiarize students with a wide variety of radars rather than turn them into practicing radar engineers. Each topic is developed from basic principles so students with a wide variety of backgrounds are able to take the course. Emphasizes radar applications in geophysics, meteorology and atmospheric sciences, and astronomy and space sciences. Gives special attention to radar remote sensing of the Earth from spacecraft.

Prerequisites: PHYS 2208 or PHYS 2213 or equivalent, or permission of instructor.

Last Four Terms Offered: Spring 2024, Spring 2022

Learning Outcomes:

- Appreciate the historical, scientific, and sociological impact of radar systems.
- Understand the reciprocity theorem and its profound consequences.
- Learn to evaluate antenna performance using analysis and numerical methods, including computer algebra.
- Be able to design antennas, radar systems, and remote sensing experiments for specific tasks.
- Learn to design waveforms and process signals produced by radars and other instruments.

Schedule of Classes (<https://classes.cornell.edu/>)

EAS 6190 - Geofluids (3 Credits)

This course focuses on relationships between fluids and geologic processes. A strong focus will be on feedbacks between fluid conditions and elastic and permanent deformation within rocks and sediments. Considerable attention is given to the science of safe and successful drilling operations. Topics of discussion include applications to earthquakes, volcanoes, seafloor vents, and well drilling. Graduate students and advanced undergraduates are welcome to enroll, particularly those who have taken hydrogeology and/or structural geology / mechanics. The course will involve quantitative problem solving, reading fundamental papers, analytical solutions, simple matlab or python scripting, and a final report where students will apply the skills and understanding developed in the course to a problem related to their research or field of interest.

Last Four Terms Offered: Fall 2023, Fall 2021

Schedule of Classes (<https://classes.cornell.edu/>)

EAS 6370 - Field Geophysics (3 Credits)

Fundamentals of subsurface imaging by geophysical methods as used in resource exploration and environmental investigations. Covers seismic, gravity, magnetics, resistivity, geodetic and ground-penetrating radar (GPR) techniques. Field exercises will allow students to collect such data near campus that is of local or regional societal relevance, analyze it, and communicate the results.

Prerequisites: MATH 1920, PHYS 2208, PHYS 2213, or equivalent.

Course Fee: Materials Fee, \$50. Lab materials.

Exploratory Studies: (CU-CEL, CU-SBY)

Last Four Terms Offered: Spring 2025, Spring 2023, Spring 2022

Schedule of Classes (<https://classes.cornell.edu/>)

EAS 6520 - Advanced Atmospheric Dynamics (3 Credits)

Advanced topics in atmospheric dynamics such as quasigeostrophic theory and diagnosis, atmospheric waves, wave instability, mesoscale processes, general circulation of the atmosphere, and the middle atmosphere.

Prerequisites: EAS 3410 and EAS 3420 or equivalent.

Last Four Terms Offered: Fall 2023, Fall 2021, Spring 2018, Spring 2017

Schedule of Classes (<https://classes.cornell.edu/>)

EAS 6540 - Ocean Satellite Remote Sensing (3 Credits)

The goal of the course is to teach participants the basic skills needed to work independently to acquire, analyze and visualize data sets derived from a variety of satellite sensors that provide global estimates of phytoplankton abundance, sea surface temperature ocean wind speeds, and geostrophic currents. An important feature of the course is to develop good Python programming skills that are needed to effectively analyze and visualize satellite data to answer important oceanographic questions. Background lectures will cover the fundamentals of bio-optics, phytoplankton pigment algorithms and, to a lesser extent, the underlying physical principals leading to the measurement of sea surface temperature, ocean wind speed and geostrophic currents. The 3-credit class is taught in an intensive format for 9 weeks with 150 minutes of lecture time and 4hr and 50min of computer lab time each week.

Prerequisites: one course in marine science or permission of instructor.

Last Four Terms Offered: Spring 2024, Spring 2022, Spring 2020, Spring 2018

Schedule of Classes (<https://classes.cornell.edu/>)

EAS 6550 - Geochemistry (3 Credits)

Chemistry applied to understanding the Earth and the Solar System including its formation and evolution, and processes occurring on the Earth's surface and in its interior. The course covers thermodynamics and kinetics of geochemical processes, aquatic and environmental chemistry, geochronology, trace element and isotope geochemistry, paleoclimatology, and the carbon cycle and organic geochemistry.

Prerequisites: CHEM 2070 or CHEM 2090 or equivalent.

Last Four Terms Offered: Fall 2024, Fall 2022

Schedule of Classes (<https://classes.cornell.edu/>)

EAS 6560 - Isotope Geochemistry (3 Credits)

Fundamentals of radiogenic, cosmogenic, and stable isotope geochemistry and application to a variety of Earth system problems including evolution of the crust and mantle, earth surface processes, climate, biosphere, global water, and elemental cycling. We will explore recent advances in the development of isotope tracers and instrument capabilities, evaluate model frameworks, and learn how to interpret isotope signatures in a variety of modern and paleo contexts.

Last Four Terms Offered: Spring 2023, Spring 2017, Spring 2015, Spring 2013

Schedule of Classes (<https://classes.cornell.edu/>)

EAS 6580 - Volcanology (3 Credits)

Volcanic rocks constitute a significant component of the surface of all the terrestrial planets. Volcanoes are the main location of mass and energy exchange between the external and internal parts of our planet, making volcanic processes key not only for the physical and chemical evolution of the planet, but also to the evolution of climate and life. This course incorporates the physics and chemistry of magmatic processes related to volcanic activity in several modules followed by exercises done in class and complemented by weekly assignments.

Last Four Terms Offered: Fall 2024, Fall 2021

Learning Outcomes:

- Identify, describe and interpret the different volcanic deposits in the geologic record.
- Interpret the physical mechanisms by which magmas are produced, transport through the mantle and crust, and erupt at the surface.
- Understand the role of volcanism in planetary evolution.
- Evaluate the hazards and risks to human populations and the environment associated with volcanic processes.

Schedule of Classes (<https://classes.cornell.edu/>)

EAS 6590 - Earthquake Physics (3 Credits)

Last Four Terms Offered: Fall 2024

Schedule of Classes (<https://classes.cornell.edu/>)

EAS 6710 - Introduction to Groundwater (3 Credits)

Crosslisted with BEE 6710

Fresh water has become a limited resource in many parts of the world. In arid and semi-arid regions, groundwater levels are declining at unsustainable levels. In several industrial areas, groundwater is contaminated and unsuitable as potable water. This course will address the sustainability and pollution of groundwater by first understanding the theory of saturated and unsaturated flow and contaminant transport under ideal conditions. Subsequently, we learn to simplify groundwater systems in complex subsurface environments to obtain practical solutions. At the end of the course, the learned material will be put in a broader context as they are affected by natural or human actions. Throughout the course, guest speakers will discuss topics of current interest related to water. This elective course is intended for graduate students interested in subsurface water and solute transport applications to sustainable groundwater use and prevention of pollution.

Exploratory Studies: (CU-SBY)

Last Four Terms Offered: Spring 2025, Spring 2024, Spring 2023, Spring 2022

Schedule of Classes (<https://classes.cornell.edu/>)

EAS 6755 - Finite Element Method: Theory and Applications in Mechanics and Multiphysics (3 Credits)

Crosslisted with CEE 6755, MAE 6755

This class is an intermediate-level course on the linear Finite Element Method (FEM) for graduate engineering students. The students will learn to: set up the strong formulation of mechanical, hydraulic, thermal, and coupled problems, write the variational formulation, discretize the weak form in space and time, choose a resolution algorithm, write an input file for a FEM software, and interpret numerical results. Applications will focus on climate change and energy. First, one-dimensional problems will be solved for one dependent variable, e.g., elongation, fluid flow, heat transfer. Second, hydro-mechanical equations for two-phase porous media will be introduced and applied to consolidation problems. Next, 2D space discretization and numerical integration will be explained and applied through simulation and analysis of problems of plane elasticity and seepage. The course will conclude with the modeling unsaturated porous media with applications to geological storage, evapotranspiration, and subsidence.

Last Four Terms Offered: Spring 2025

Learning Outcomes:

- Approximate the solution of partial differential equations by using a variational method.
- Design Finite Element models for time-dependent hydro-mechanical problems.
- Analyze Finite Element results, numerical errors, and convergence issues.

Schedule of Classes (<https://classes.cornell.edu/>)

EAS 6800 - Atmospheric Chemistry: From Air Pollution to Global Change (3 Credits)

Crosslisted with BEE 6800

This course investigates the science of atmospheric chemistry as its relation to air pollution and global change. Students examine the chemistry and physics that determines atmospheric composition on local to global scales including the effects of biogeochemistry and atmospheric photochemistry.

Prerequisites: CHEM 2070 or CHEM 2090, MATH 1920, and PHYS 1112 or equivalent or permission of instructor.

Exploratory Studies: (CU-SBY)

Last Four Terms Offered: Fall 2024, Fall 2022, Fall 2021

Schedule of Classes (<https://classes.cornell.edu/>)

EAS 6820 - Seismology (3 Credits)

This course presents an overview of observations and methods in seismology. Topics include techniques necessary for understanding elastic wave propagation in layered media and what these waves teach us about Earth's composition and structure. This course introduces concepts in earthquake and reflection seismology and seismic hazard.

Prerequisites: one year of calculus, one year of physics. Recommended prerequisite: structural geology.

Last Four Terms Offered: Spring 2024, Spring 2021, Fall 2018, Fall 2016

Schedule of Classes (<https://classes.cornell.edu/>)

EAS 6920 - Special Topics in Earth and Atmospheric Sciences (1-6 Credits)

Study of topics in earth and atmospheric science that are more specialized or different from other courses. Special topics depend on staff and student interests.

Last Four Terms Offered: Spring 2025, Fall 2024, Spring 2024, Fall 2023

Schedule of Classes (<https://classes.cornell.edu/>)

EAS 7010 - Thesis Research (1-15 Credits)

Thesis research for geological sciences graduate students.

Last Four Terms Offered: Fall 2024, Fall 2023, Fall 2022, Fall 2021

Schedule of Classes (<https://classes.cornell.edu/>)

EAS 7020 - Thesis Research (1-15 Credits)

Thesis research for geological sciences graduate students.

Last Four Terms Offered: Spring 2025, Spring 2024, Spring 2023, Spring 2022

Schedule of Classes (<https://classes.cornell.edu/>)

EAS 7110 - Upper Atmospheric and Space Physics (1-3 Credits)

Reading class for upper atmospheric physics.

Last Four Terms Offered: Spring 2025, Spring 2024, Fall 2023, Spring 2023

Schedule of Classes (<https://classes.cornell.edu/>)

EAS 7310 - Advanced Topics in Geodetic Monitoring and Modeling (1-3 Credits)

Advanced work on original investigations in geodetic monitoring and modeling. Topics change from semester to semester. Contact the instructor for more information.

Last Four Terms Offered: Fall 2023, Fall 2022, Fall 2021, Fall 2020

Schedule of Classes (<https://classes.cornell.edu/>)

EAS 7570 - Current Research in Petrology and Geochemistry (1-3 Credits)

Advanced work on original investigations in petrology and geochemistry. Topics change from semester to semester. Contact the instructor for more information.

Last Four Terms Offered: Fall 2023, Fall 2022, Fall 2021, Fall 2020

Schedule of Classes (<https://classes.cornell.edu/>)

EAS 7620 - Advanced Topics in Paleobiology (1-3 Credits)

Advanced work on original investigations in paleobiology. Topics change from semester to semester. Contact the instructor for more information.

Last Four Terms Offered: Spring 2024, Fall 2023, Spring 2023, Fall 2022

Schedule of Classes (<https://classes.cornell.edu/>)

EAS 7650 - Topics in Paleoecology (1 Credit)

Advanced work on original investigations in paleoecology. Topics change from semester to semester. Contact the instructor for more information.

Last Four Terms Offered: Spring 2025, Spring 2024, Fall 2023, Spring 2023

Schedule of Classes (<https://classes.cornell.edu/>)

EAS 7710 - Advanced Topics in Sedimentology and Stratigraphy (1-3 Credits)

Advanced readings on specific themes in sedimentology, stratigraphy, and sedimentary basins. Topics change from semester to semester and will be chosen in consultation between student and instructor.

Last Four Terms Offered: Fall 2023, Spring 2023, Fall 2022, Spring 2022

Schedule of Classes (<https://classes.cornell.edu/>)

EAS 7800 - Earthquake Record Reading (1 Credit)

Analysis and interpretation of real-time geophysical data focusing on interesting and significant events that happen during the semester, emphasizing seismogram interpretation of large earthquakes.

Last Four Terms Offered: Fall 2024, Fall 2023, Fall 2022, Fall 2021

Schedule of Classes (<https://classes.cornell.edu/>)

EAS 7810 - Advanced Topics in Seismic Imaging (1-4 Credits)

Exploration of advanced techniques for imaging the earth via readings and/or computer exercises.

Last Four Terms Offered: Fall 2023, Fall 2022, Fall 2021, Fall 2020

Schedule of Classes (<https://classes.cornell.edu/>)

EAS 7910 - Atmospheric Science Seminar (1 Credit)

Last Four Terms Offered: Spring 2025, Fall 2024

Schedule of Classes (<https://classes.cornell.edu/>)

EAS 7930 - Earth Science Seminar (1 Credit)

Seminar course for graduate students in geological sciences with topics in tectonics, seismology, petrology, and similar disciplines. Emphasis on mountain belts, but other topics entertained.

Exploratory Studies: (LAAREA, SAAREA)

Last Four Terms Offered: Spring 2025, Fall 2024, Spring 2024, Fall 2023

Schedule of Classes (<https://classes.cornell.edu/>)

EAS 8500 - Master's Level Thesis Research in Atmospheric Science (1-15 Credits)

Thesis research for atmospheric science master's students.

Last Four Terms Offered: Spring 2025, Fall 2024, Spring 2024, Fall 2023

Schedule of Classes (<https://classes.cornell.edu/>)

EAS 9500 - Graduate-Level Dissertation Research in Atmospheric Science (1-15 Credits)

Dissertation research for atmospheric science Ph.D. students only before A exam has been passed.

Last Four Terms Offered: Spring 2025, Fall 2024, Spring 2024, Fall 2023

Schedule of Classes (<https://classes.cornell.edu/>)

EAS 9510 - Doctoral-Level Dissertation Research in Atmospheric Science (1-15 Credits)

Dissertation research for atmospheric science Ph.D. students after A exam has been passed.

Last Four Terms Offered: Spring 2025, Fall 2024, Spring 2024, Fall 2023

Schedule of Classes (<https://classes.cornell.edu/>)