EARTH & OCEANOGRAPHIC SCIENCE (EOS)

EOS 1020 (a) Archives of Earth: Past and Future
Non-Standard Rotation. Enrollment limit: 16.

An introduction to the evolution of Earth and a glimpse into Earth's future. We will examine pivotal moments in Earth's history, from the formation of Earth's moon, to the rise of oxygen, to colliding continents, and the explosion of life on Earth. What differentiates Earth from other rocky planets? What events have shaped the evolution of Earth? What will future Earth look like? What role are we playing in shaping this future world? These questions are explored through readings, discussions, presentations, and writing.

Previous terms offered: Fall 2022, Fall 2021.

EOS 1070 (a, INS) Sea-Level Rise: Science, Policy, and Society
Non-Standard Rotation. Enrollment limit: 50.

Global sea-level rise is accelerating due to climate change. Such a rise, combined locally with sinking land and/or trapping of coastal sediment, creates dramatic impacts on human lives and property, as well as coastal ecosystems and the services they provide. Explores the scientific basis for sea-level rise and projections of future impacts, options for policy responses over decadal and single-event (disaster) time scales, and narratives about coastal populations. What are trade-offs between armoring and retreat from the coast? Are disasters natural or human-caused? How do race and socioeconomic status influence risk and recovery? Who shapes the narratives on coastal residents and refugees? Who controls the planning process, and how should science be communicated in times of hyper-partisanship?

Previous terms offered: Spring 2021, Fall 2020.

EOS 1105 (a, INS) Introducing Earth
Emily Peterman; Sarah Brisson.
Every Fall. Fall 2023. Enrollment limit: 45.

The Earth is a dynamic system that has been shaped in part by geologic processes such as earthquakes, volcanic activity, and mountain building. During classes and weekly laboratories, students are introduced to Earth and plate tectonics through accessible field experiences along the Maine coast, rock and mineral specimens, images, and models. Students practice making observations, collecting data, and communicating interpretations, and then synthesize the course curriculum and their laboratory findings through a final project.

Previous terms offered: Fall 2022, Fall 2021, Spring 2021, Fall 2020, Fall 2019.

EOS 1505 (a, INS) Oceanography
Collin Roesler; Cathryn Field.
Every Spring. Spring 2024. Enrollment limit: 36.

The fundamentals of geological, physical, chemical, and biological oceanography. Topics include tectonic evolution of the ocean basins; deep-sea sedimentation as a record of ocean history; global ocean circulation, waves, and tides; chemical cycles; ocean ecosystems and productivity; and the ocean's role in climate change. Weekly labs and fieldwork demonstrate these principles in the setting of Casco Bay and the Gulf of Maine. Students complete a field-based research project on coastal oceanography. (Same as: ENVS 1102)

Previous terms offered: Spring 2023, Spring 2022, Spring 2021, Spring 2020.

EOS 2005 (a) Biogeochemistry: An Analysis of Global Change
Cathryn Field; Phil Camill.
Every Fall. Fall 2023. Enrollment limit: 35.

Understanding global change requires knowing how the biosphere, geosphere, oceans, ice, and atmosphere interact. An introduction to earth system science, emphasizing the critical interplay between the physical and living worlds. Key processes include energy flow and material cycles, soil development, primary production and decomposition, microbial ecology and nutrient transformations, and the evolution of life on geochemical cycles in deep time. Terrestrial, wetland, lake, river, estuary, and marine systems are analyzed comparatively. Applied issues are emphasized as case studies, including energy efficiency of food production, acid rain impacts on forests and aquatic systems, forest clearcutting, wetland delineation, eutrophication of coastal estuaries, ocean fertilization, and global carbon sinks. Lectures and three hours of laboratory or fieldwork per week. (Same as: ENVS 2221)

Prerequisites: EOS 1100 - 1999 or BIOL 1102 or BIOL 1109 or CHEM 1092 or CHEM 1102 or CHEM 1109 or ENVS 1102 or ENVS 1104 or ENVS 1515.

Previous terms offered: Fall 2022, Fall 2021, Fall 2020, Fall 2019.

EOS 2010 (a) Isotope Geochemistry
Claire Harrigan.
Non-Standard Rotation. Fall 2023. Enrollment limit: 35.

By analyzing the isotope variability of elements, scientists approach questions related to solid earth, earth surface, and ocean evolution. Radioactive decay and stable isotope mass fractionation are applied to authentic data sets to examine the timing of earth layer differentiation, the age of rock packages, paleotemperatures, the rate of weathering, erosion, and sedimentary basin development, and other applications.

Prerequisites: EOS 1100 - 1999 or EOS 2005 (same as ENVS 2221) or CHEM 1102 or CHEM 1109.

Previous terms offered: Spring 2020.

EOS 2020 (a, INS) Earth, Ocean, and Society
Every Spring. Enrollment limit: 35.

Explores the historical, current, and future demands of society on the natural resources of the earth and the ocean. Discusses the formation and extraction of salt, gold, diamonds, rare earth elements, coal, oil, natural gas, and renewable energies (e.g., tidal, geothermal, solar, wind). Examines how policies for these resources are written and revised to reflect changing societal values. Students complete a research project that explores the intersection of natural resources and society. (Same as: ENVS 2250)

Prerequisites: EOS 1100 - 1999 or EOS 2005 (same as ENVS 2221) or ENVS 1102 or ENVS 1104 or ENVS 1515.

Previous terms offered: Spring 2021.

EOS 2030 (a, MCSR) Geographic Information Systems (GIS) Applications in Earth and Oceanographic Science
Non-Standard Rotation. Enrollment limit: 35.

This course is a hands-on introduction to using geospatial datasets within a geographic information system (GIS) with direct applications to investigating questions in earth and oceanographic sciences. Emphasis is placed on using digital maps as a tool to assist with scientific inquiry and successful communication of findings. Technical topics include geospatial data acquisition and database management, coordinate systems and projections, creation and manipulation of raster and vector datasets, data digitization, incorporation of field data into GIS, using LiDAR and other remote sensing applications, and the production of professional quality final maps. As the culmination of this course students will propose and investigate a geospatial question that aligns with their academic/research interests or as a collaborative project with a community organization.

Prerequisites: EOS 1105 or EOS 1305 (same as ENVS 1104) or EOS 1505 (same as ENVS 1102).

Previous terms offered: Fall 2022, Fall 2019.

EOS 2105 (a) Mineral Science
Non-Standard Rotation. Enrollment limit: 16.

Minerals are the earth's building blocks and an important human resource. The study of minerals provides information on processes that occur within the earth's core, mantle, crust, and at its surface. At the surface, minerals interact with the hydrosphere, atmosphere and biosphere, and are essential to understanding environmental issues. Minerals and mineral processes examined using hand-specimens, crystal structures, chemistry, and microscopy.

Prerequisites: EOS 1100 - 1999 or EOS 2005 (same as ENVS 2221).

Previous terms offered: Spring 2023, Spring 2022.

EOS 2110 (a, INS) Volcanoes
Non-Standard Rotation. Enrollment limit: 18.

Volcanoes make the news for their human impact, and they reveal much about the inner workings of Earth. Examination of volcanic eruptions, landforms, products, and hazards. Exploration of tectonic influence and magmatic origins of volcanoes. Investigation into the impact of volcanoes on humans, climate, and Earth history.

Prerequisites: EOS 1100 - 1999 or EOS 2005 (same as ENVS 2221) or ENVS 2221.

Previous terms offered: Spring 2022.

EOS 2130 (a) How to Build a Habitable Planet
Claire Harrigan.
Every Spring. Spring 2024. Enrollment limit: 35.

Early Earth was inhospitable with a molten surface constantly bombarded by meteors. Yet today, humans have land to live on, fresh water, and an oxygen-rich atmosphere. How did we get to this habitable state? A number of conditions must be met across Earth's lithosphere, hydrosphere, and atmosphere to allow life to exist on Earth. This habitable state is due to changes in Earth systems and processes over 4.5 billion years of Earth history. Topics may include planetary formation, the rise of plate tectonics, the evolution of Earth's atmosphere, mass extinctions, and natural hazards and their impact on human communities. Work will include readings from the literature and projects.

EOS 2145 (a, INS) Plate Tectonics
Emily Peterman.
Every Other Spring. Spring 2024. Enrollment limit: 18.

Plate tectonics provides a global framework to understand such varied phenomena as earthquakes, volcanoes, ocean basins, and mountain systems on continents (e.g., the Himalaya, the Andes, the Zagros), beneath the seas (e.g., the Mid-Atlantic Ridge, the East Pacific Rise), and emergent from ice (the Transantarctic Mountains). In-depth analysis of the processes occurring at plate boundaries, the driving forces and dynamics of plate tectonics, the kinematics of plate motion, global plate reconstructions, the predictive power of plate tectonics, and the evolution of the discipline. Weekly labs focus on data analysis, laboratory work, field studies, and synthesis.

Prerequisites: EOS 1100 - 1999 or EOS 2005 (same as ENVS 2221) or ENVS 1102 or ENVS 1104 or ENVS 1515.

EOS 2155 (a, MCSR) Geomechanics and Numerical Modeling
Non-Standard Rotation. Enrollment limit: 18.

Introduces fundamental physical processes important to the transport of heat, solid mass, and fluids in Earth and on Earth's surface. Emphasizes heat conduction, rock strength and failure, and viscous fluid flow. Provides practice with quantitative expression of physical processes that govern geologic processes. Solutions for problems are derived from first principles, including conservation and flux laws.

Prerequisites: Two of: either EOS 1100 - 1999 or EOS 2005 (same as ENVS 2221) and MATH 1600 or Placement in MATH 1700 (M) or Placement in MATH 1750 (M) or Placement in MATH 1800 (M).

Previous terms offered: Spring 2020.

EOS 2225 (a, INS, MCSR) Structural Geology and Analysis
Claire Harrigan.
Non-Standard Rotation. Fall 2023. Enrollment limit: 18.

Geologic structures provide evidence of the dynamic deformation and evolution of the Earth's crust. Analysis of these structures yields insight into the processes and products of deformation. This course explores: the mechanics of rock deformation, qualitative and quantitative analysis of structural features, techniques of strain analysis, and synthesis of geologic data in a spatial and temporal context. We examine evidence of deformation at scales that range from the plate-tectonic scale to the microscopic scale of individual minerals. Weekly laboratories focus on problem solving through the use of geologic maps, cross-sections, stereographic projections, strain analysis, virtual field trips, and an array of software applications designed for visualizing and interrogating spatial datasets. Students complete a final project involving the techniques of structural geology and analysis.

Prerequisites: EOS 1105 or EOS 1305 (same as ENVS 1104) or EOS 1505 (same as ENVS 1102) or EOS 2005 (same as ENVS 2221).

Previous terms offered: Fall 2022, Fall 2021, Fall 2020.

EOS 2325 (a, INS) Environmental Chemistry
Brandon Tate; Kurt Luthy.
Every Other Spring. Spring 2024. Enrollment limit: 20.

Focuses on two key processes that influence human and wildlife exposure to potentially harmful substances, chemical speciation and transformation. Equilibrium principles as applied to acid-base, complexation, precipitation, and dissolution reactions are used to explore organic and inorganic compound speciation in natural and polluted waters; quantitative approaches are emphasized. Weekly laboratory sections are concerned with the detection and quantification of organic and inorganic compounds in air, water, and soils/sediments. (Same as: CHEM 2050, ENVS 2255)

Prerequisites: CHEM 1092 or CHEM 1102 or CHEM 1109 or CHEM 2000 - 2969 or Placement in CHEM 2000 level or Placement in CHEM 2000/1109.

Previous terms offered: Spring 2022, Spring 2020.

EOS 2330 (a, INS) Quaternary Environments: Reconstructing Landscapes Changed by Climate Shifts in Recent Geologic Past
Non-Standard Rotation. Enrollment limit: 35.

The past 2.6 million years of Earth's history, known as the Quaternary, is uniquely characterized by intense and frequent swings in global climate. The record of both 'Ice Ages' and interglacial warming in Earth's recent geologic past can be studied through many lenses of Earth science. In this course we will explore how sedimentology, geomorphology, and dating methods can be applied to reconstruct past environments associated with Quaternary climate shifts. Specific topics include Quaternary climate records and forcing mechanisms, basic glacial dynamics, isostasy and sea level changes, sediments, landforms, and dating methods. Students will complete a semester long project investigating the Quaternary record of a specific region of the world and will participate in several field trips exploring the Quaternary record of New England. (Same as: ENVS 2266)

Prerequisites: EOS 1100 or higher.

Previous terms offered: Fall 2020, Spring 2020.

EOS 2335 (a, INS) Sedimentary Systems
Every Year. Enrollment limit: 16.

Investigates modern and ancient sedimentary systems, both continental and marine, with emphasis on the dynamics of sediment transport, interpretation of depositional environments from sedimentary structures and facies relationships, stratigraphic techniques for interpreting earth history, and tectonic and sea-level controls on large-scale depositional patterns. There will be one daylong field trip to explore more remote locations.

Prerequisites: EOS 1100 - 1999 or EOS 2005 (same as ENVS 2221) or ENVS 1102 or ENVS 1104 or ENVS 1515.

Previous terms offered: Spring 2021, Spring 2020.

EOS 2340 (a, INS) Human Land Use Change
Non-Standard Rotation. Enrollment limit: 35.

Human activity since the Industrial Revolution has changed the physical world faster than during almost any period in earth history. Examines such changes to the earth surface and their impacts on earth systems, with attention to topics such as agriculture, deforestation, urbanization, climate change, mining, and river damming. Investigates how land use change has altered natural processes using various analytical techniques and sources, including historical archives and satellite or other spatial data. Introduces computer programming techniques to carry out these analyses. Draws inspiration from efforts to dismantle historic inequities, restore environmental function, and promote a just world, focusing on solutions. Students complete a culminating research project of academic and/or community interest.

Prerequisites: EOS 1105 or EOS 1305 (same as ENVS 1104) or EOS 2005 (same as ENVS 2221).

Previous terms offered: Spring 2023.

EOS 2345 (a) Geomorphology: Form and Process at the Earth's Surface
Jabari Jones.
Every Other Fall. Fall 2023. Enrollment limit: 35.

Earth's surface is marked by the interactions of the atmosphere, water and ice, biota, tectonics, and underlying rock and soil. Even familiar landscapes beget questions on how they formed, how they might change, and how they relate to patterns at both larger and smaller scales. Examines Earth's landscapes and the processes that shape them, with particular emphasis on rivers, hillslopes, and tectonic and climatic forcing. (Same as: ENVS 2270)

Prerequisites: EOS 1105 or EOS 2005 (same as ENVS 2221).

Previous terms offered: Fall 2022, Fall 2020, Fall 2019.

EOS 2365 (a) Coastal Processes and Environments
Every Year. Enrollment limit: 15.

Coasts are among the most densely populated and dynamic components of the earth system, with forms that reflect the interplay among sediment delivery, reshaping by waves and coastal currents, changes in land subsidence and/or sea levels, and human interventions. Understanding these processes and how they may change is a first step toward reducing risk and developing resilient coastal communities. Examines coastal environments (e.g., deltas, barrier islands, beaches, salt marshes), the processes that shape them, and underlying controls. Considers impacts of climate change and sea-level rise on coastal erosion and flooding, and trade-offs involved in human responses to such problems.

Prerequisites: EOS 1105 or EOS 1305 (same as ENVS 1104) or EOS 1505 (same as ENVS 1102) or EOS 2005 (same as ENVS 2221).

Previous terms offered: Fall 2020.

EOS 2375 (a, INS) Data Science Approaches for Hydrology
Non-Standard Rotation. Enrollment limit: 18.

The politics of land and water have shaped the history of the United States since its founding. Today, addressing urgent threats posed by floods, droughts, depleted groundwater resources, and water pollution is central to creating a sustainable, just society. Builds a foundation in hydrology, the study of water. Considers how human activities impact water systems and, in turn, how water systems impact human lives and livelihoods. Analyzes urgent hydrological problems using publicly available big data, such as remote sensing/GIS data, direct monitoring datasets, and student data generated in weekly labs, developing transferrable data science and programming skills. Students complete an original big data research project.

Prerequisites: EOS 2005 (same as ENVS 2221).

Previous terms offered: Spring 2023.

EOS 2385 (c, DPI, MCSR) Environmental Justice and Earth Surface Processes
Jabari Jones.
Every Other Year. Spring 2024. Enrollment limit: 18.

The environmental justice movement has a rich history, but earth scientists often lack the analytical framework needed to address issues of environmental injustice. This course takes a data-driven approach to questions of environmental justice, with a focus on the interplay of Earth surface processes and societal inequity. Topics may include flood hazards, shoreline management and access, water quality, storage of toxic substances, and global climate risk. Includes discussion of contemporary and foundational environmental justice literature, lab exercises using geographic and statistical techniques, and a final project on questions of interest.

EOS 2515 (a) Paleoceanography
Michele LaVigne.
Non-Standard Rotation. Spring 2024. Enrollment limit: 18.

The ocean plays a key role in regulating Earth's climate and serves as an archive of past climate conditions. The study of paleoceanography provides a baseline of natural oceanographic variability against which human-induced climate change must be assessed. Examination of the oceans' physical, biological, and biogeochemical responses to external and internal pressures of Earth's climate with focus on examples from the Cenozoic Era (past 65.5 million years). Labs, projects, and class activities emphasize paleoceanographic reconstructions using deep-sea sediments, corals, and bivalves from the Gulf of Maine. Includes a laboratory and fulfills the oceans requirement for the EOS major.

EOS 2525 (a) Marine Biogeochemistry
Every Spring. Enrollment limit: 15.

Oceanic cycles of carbon, oxygen, and nutrients play a key role in linking global climate change, marine primary productivity, and ocean acidification. Fundamental concepts of marine biogeochemistry used to assess potential consequences of future climate scenarios on chemical cycling in the ocean. Past climate transitions evaluated as potential analogs for future change using select case studies of published paleoceanographic proxy records derived from corals, ice cores, and deep-sea sediments. Weekly laboratory sections and student research projects focus on creating and interpreting new geochemical paleoclimate records from marine archives and predicting future impacts of climate change and ocean acidification on marine calcifiers. (Same as: ENVS 2251)

Prerequisites: Two of: EOS 1100 - 1999 or either ENVS 1102 or ENVS 1104 or ENVS 1515 and EOS 2005 (same as ENVS 2221).

Previous terms offered: Spring 2022, Spring 2021, Spring 2020.

EOS 2530 (a) Poles Apart: Exploration of Earth's High Latitudes
Every Other Year. Enrollment limit: 35.

The Arctic and Antarctic polar regions are largely dominated by ice, yet they are vastly different in terms of geography. The Arctic is an ocean largely surrounded by continents, while the Antarctic is a continent surrounded by ocean. Antarctica is dominated by ice caps, glaciers and ice shelves, surrounded by a seasonal band of sea ice. The Arctic Ocean is mostly covered year-round by sea ice with ice caps and glaciers found mainly in Greenland. These differences lead to profoundly contrasting impacts on global climate and ocean circulation. Tectonic evolution, ice dynamics, ocean circulation, and biology of these regions are compared and contrasted through lectures and readings and discussions of journal articles. Readings from twentieth century journals of polar exploration are used to provide students with first hand accounts of scientific discoveries and a "sense of place", that deep emotional connection people have toward a place. Fulfills the within-department elective in EOS. (Same as: ENVS 2287)

Prerequisites: EOS 1105 or EOS 1305 (same as ENVS 1104) or EOS 1505 (same as ENVS 1102) or EOS 2005 (same as ENVS 2221).

Previous terms offered: Fall 2021, Fall 2019.

EOS 2540 (a, INS) Equatorial Oceanography
Every Year. Enrollment limit: 35.

The equatorial ocean is a region with virtually no seasonal variability, and yet undergoes the strongest interannual to decadal climate variations of any oceanographic province. This key region constitutes one of the most important yet highly variable natural sources of carbon dioxide (CO2) to the atmosphere. Explores how circulation, upwelling, biological activity, biogeochemistry, and CO2 flux in this key region vary in response to rapid changes in climate. Particular emphasis on past, present, and future dynamics of the El Niño Southern Oscillation. In-class discussions are focused on the primary scientific literature.

Prerequisites: EOS 1105 - 1515 or EOS 2005 (same as ENVS 2221).

Previous terms offered: Spring 2022, Spring 2021.

EOS 2550 (a, INS, MCSR) Satellite Remote Sensing of the Ocean
Every Other Fall. Enrollment limit: 35.

In the 1980s, NASA's satellite program turned some of its space-viewing sensors towards the earth to better understand its processes. Since that time, NASA's Earth Observatory mission has yielded a fleet of satellites bearing an array of sensors that provide a global view of the earth each day. Global-scale ocean properties, including bathymetry, temperature, salinity, wave height, currents, primary productivity, sea ice distribution, and sea level, are revealed through satellite-detection of ultraviolet, visible, infrared and microwave energy emanating from the ocean. These satellite data records currently exceed thirty years in length and therefore can be used to interpret climate-scale ocean responses from space. A semester-long research project, targeted on a student-selected oceanic region, focuses on building both quantitative skills through data analysis and writing skills through iterative writing assignments that focus on communicating data interpretation and synthesis. (Same as: ENVS 2222)

Prerequisites: Two of: either EOS 1105 - 2969 or EOS 3000 or higher and either MATH 1300 - 2969 or MATH 3000 or higher or Placement in MATH 1600 (M) or Placement in MATH 1700 (M) or Placement in MATH 1750 (M) or Placement in MATH 1800 (M) or Placement in MATH 2020 or 2206 (M) or Placement in 2000, 2020, 2206 (M).

Previous terms offered: Fall 2022.

EOS 2565 (a, INS, MCSR) Coastal Oceanography
Collin Roesler.
Every Other Year. Fall 2023. Enrollment limit: 15.

Coastal oceans lie between the shore and the continental shelves. While they represent less than 10 percent of the global ocean, they are responsible for more than half of the global ocean productivity and are the oceanic regime most experienced by humans. They are also the connection between terrestrial environment and the open ocean, and thus quite sensitive to anthropogenic activities. Interdisciplinary exploration of the coastal ocean includes geologic morphology, tides and coastal currents, river impacts, and coastal ecosystems, with examples taken from global coastal oceans. Weekly labs focus on developing skills in field observation, experimentation, and data analysis in the context of the Gulf of Maine. Fulfills the 2000-level ocean core requirement for the EOS major.

Prerequisites: Two of: EOS 1100 - 1999 and EOS 2005 (same as ENVS 2221).

Previous terms offered: Fall 2021, Fall 2019.

EOS 2585 (a, INS, MCSR) Ocean and Climate
Every Other Year. Enrollment limit: 18.

The ocean covers more than 70 percent of Earth's surface. It has a vast capacity to modulate variations in global heat and carbon dioxide, thereby regulating climate and ultimately life on Earth. Beginning with an investigation of paleo-climate records preserved in deep-sea sediment cores and in Antarctic and Greenland glacial ice cores, the patterns of natural climate variations are explored with the goal of understanding historic climate change observations. Predictions of polar glacial and sea ice, sea level, ocean temperatures, and ocean acidity investigated through readings and discussions of scientific literature. Weekly laboratory sessions devoted to field trips, laboratory experiments, and computer-based data analysis and modeling to provide hands-on experiences for understanding the time and space scales of processes governing oceans, climate, and ecosystems. Laboratory exercises form the basis for student research projects. Mathematics 1700 is recommended. (Same as: ENVS 2282)

Prerequisites: Two of: either EOS 1505 (same as ENVS 1102) or EOS 2005 (same as ENVS 2221) and MATH 1600 or Placement in MATH 1700 (M) or Placement in MATH 1750 (M) or Placement in MATH 1800 (M) or Placement in MATH 2020 or 2206 (M) or Placement in 2000, 2020, 2206 (M).

Previous terms offered: Fall 2022, Fall 2020.

EOS 2625 (a) Ocean Acidification
Jaret Reblin; Michele LaVigne; Holly Parker.
Non-Standard Rotation. Fall 2023. Enrollment limit: 15.

Recent trends of carbon dioxide emissions are causing acidification of the ocean at a rate unprecedented in the geologic record. The associated changes in ocean chemistry present myriad potential difficulties for marine ecosystems and the shellfish industries that rely upon them. Considers the causes, consequences, and policy implications of ocean acidification, including the highly variable and extreme coastal carbonate chemistry conditions of the Gulf of Maine. Laboratory component includes student research projects in collaboration with community partners and the Bowdoin Coastal Studies Semester to study questions related to climate, carbon, and biogeochemical cycling in local ecosystems. Taught at the Schiller Coastal Studies Center with transportation provided from the main campus and included in the time block indicated. Not open to students who have credit for EOS 2525.

Prerequisites: BIOL 1102 or BIOL 1109 - 2969 or Placement in BIOL 2000 level or CHEM 1102 or CHEM 1109 or Placement in CHEM 2000 level or EOS 1105 or EOS 1305 (same as ENVS 1104) or EOS 1505 (same as ENVS 1102) or EOS 2005 (same as ENVS 2221) or PHYS 1140 - 2969.

EOS 2680 (a, INS, MCSR) Ocean Carbon Climate Change Solutions
Non-Standard Rotation. Enrollment limit: 35.

As the largest decadal-to-millennial timescale carbon store on Earth, the ocean has outstanding potential for sequestering carbon dioxide from the atmosphere. And, as a significant fraction of the global population lives near the ocean, ocean carbon solutions have the potential to reach huge markets and directly touch the lives of billions. This course explores the ocean's possible contribution to the reversal of climate change via a multiple-perspective, critical assessment of natural and geoengineering solutions for increasing ocean carbon uptake or reducing emissions. Course work will focus on analysis of open-ended problems based on current research papers, the use of real-world, open-source quantitative tools for mapping and scaling up ocean climate solutions, and sharing results via in-class presentations.

Prerequisites: Three of: EOS 1100 - 1999 and EOS 2005 (same as ENVS 2221) and MATH 1600 or Placement in MATH 1700 (M) or Placement in MATH 1750 (M) or Placement in MATH 1800 (M).

Previous terms offered: Fall 2020, Spring 2020.

EOS 2685 (a, INS, MCSR) Fluent in Fluids: Finding Patterns from Teacups to Oceans
Non-Standard Rotation. Enrollment limit: 18.

The subtle balances of forces in fluids impact everyday life at a range of scales spanning Earth's climate to the flow of blood. Fluids are also surprising and sublime because their flows can result in unexpected organization out of chaos, and very small features can steer currents that are many orders of magnitude larger. This introductory fluids course explores a new way of looking at fluids by searching for and quantifying patterns in flows. Labs will test how shifts in key parameters change the overall flow. In class, a primarily conceptual formulation of fluid dynamics and simplified mathematical models of fluids will be used to explain the movement of fluids at large and small scales. Along each step of the way, real-world examples drawn from as diverse contexts as the kitchen sink and cutting-edge oceanographic research will be used to illustrate the nature of fluids and their impact.

Prerequisites: Three of: EOS 1100 - 1999 and EOS 2005 (same as ENVS 2221) and MATH 1600 or Placement in MATH 1700 (M) or Placement in MATH 1750 (M) or Placement in MATH 1800 (M).

Previous terms offered: Spring 2020.

EOS 2810 (a, INS, MCSR) Atmospheric and Ocean Dynamics
Mark Battle.
Every Other Fall. Fall 2023. Enrollment limit: 35.

A mathematically rigorous analysis of the motions of the atmosphere and oceans on a variety of spatial and temporal scales. Covers fluid dynamics in inertial and rotating reference frames, as well as global and local energy balance, applied to the coupled ocean-atmosphere system. (Same as: PHYS 2810, ENVS 2253)

Prerequisites: PHYS 1140.

Previous terms offered: Fall 2020.

EOS 3020 (a) Earth Climate History
Phil Camill.
Every Spring. Spring 2024. Enrollment limit: 16.

The modern world is experiencing rapid climate warming and some parts extreme drought, which will have dramatic impacts on ecosystems and human societies. How do contemporary warming and aridity compare to past changes in climate over the last billion years? Are modern changes human-caused or part of the natural variability in the climate system? What effects did past changes have on global ecosystems and human societies? Students use environmental records from rocks, soils, ocean cores, ice cores, lake cores, fossil plants, and tree rings to assemble proxies of past changes in climate, atmospheric CO2, and disturbance to examine several issues: long-term carbon cycling and climate, major extinction events, the rise of C4 photosynthesis and the evolution of grazing mammals, orbital forcing and glacial cycles, glacial refugia and post-glacial species migrations, climate change and the rise and collapse of human civilizations, climate/overkill hypothesis of Pleistocene megafauna, climate variability, drought cycles, climate change impacts on disturbances (fire and hurricanes), and determining natural variability versus human-caused climate change. (Same as: ENVS 3902)

Prerequisites: EOS 2005 (same as ENVS 2221).

Previous terms offered: Spring 2023, Spring 2022, Spring 2021, Spring 2020.

EOS 3050 (a) The Physics of Climate
Non-Standard Rotation. Enrollment limit: 35.

A rigorous treatment of the earth's climate, based on physical principles. Topics include climate feedbacks, sensitivity to perturbations, and the connections between climate and radiative transfer, atmospheric composition, and large-scale circulation of the oceans and atmospheres. Anthropogenic climate change also studied. (Same as: PHYS 3810, ENVS 3957)

Prerequisites: PHYS 2150 or PHYS 2810 (same as ENVS 2253 and EOS 2810) or PHYS 3000.

Previous terms offered: Spring 2021.

EOS 3070 (a) Geoscience for the Common Good
Michele LaVigne.
Non-Standard Rotation. Spring 2024. Enrollment limit: 16.

Human society is inextricably linked with the geosciences. From critical minerals and water resources to earthquake and climate hazards, every sphere of the Earth System plays a role in the health, economy, and security of our global community. Explores how geoscientists can apply skills and expertise to benefit society through public engagement. Students draw from local community partner conversations, media, geoscience legislation, and prior EOS course knowledge to identify connections between societal issues and Earth System Science. Students research societally relevant topics spanning multiple spheres of the Earth System and practice non-partisan communication and science policy engagement through improvisational scenarios. Students synthesize geoscience literature or data for non-scientific audiences in a portfolio of public-facing communication products such as expert witness testimonies, Op-Eds, policymaker meetings and memos, and broader impacts statements for grants.

EOS 3085 (a, INS, MCSR) Quantitative Approaches to Research in Earth and Oceanographic Science
Claire Harrigan; Sarah Brisson.
Every Spring. Spring 2024. Enrollment limit: 24.

Quantitative approaches are suitable for addressing many Earth and oceanographic science research questions. Computational tools, such as R, allow scientists to draw meaning from large and/or complex datasets. Projects leveraging these tools may focus on topics like environmental monitoring, petrologic analysis of Maine rocks, and harnessing existing public datasets. Emphasis on student-driven research questions, data collection and quantitative analysis of those data, group work, and communication skills. Includes a weekly laboratory and fulfills the 3000-level capstone research course requirement for the EOS major.

EOS 3115 (a) Research in Mineral Science
Non-Standard Rotation. Enrollment limit: 15.

Minerals are the earth's building blocks and an important human resource. The study of minerals provides information on processes that occur within the earth's core, mantle, crust, and at its surface. At the surface, minerals interact with the hydrosphere, atmosphere and biosphere, and are essential to understanding environmental issues. Minerals and mineral processes examined using hand-specimens, crystal structures, chemistry, and microscopy. Class projects emphasize mineral-based research.

Prerequisites: EOS 2005 (same as ENVS 2221).

Previous terms offered: Spring 2020.

EOS 3140 (a) Tectonics and Climate
Non-Standard Rotation. Enrollment limit: 16.

Exploration of the complex interactions between tectonics and climate. Discussion of current research is emphasized by reading primary literature, through class discussions and presentations, and by writing scientific essays. The emphasis on current research means topics may vary, but include: the rise of continents, the evolution of plate tectonics on Earth over the last 4.5 billion years, ancient mountain belts, supercontinents, the record of earth system processes preserved in the geologic record, predictions of how the modern earth system will be recorded in the future rock record, the topographic growth of mountain belts, and Cenozoic climate change.

Prerequisites: EOS 1105 or EOS 2005 (same as ENVS 2221).

Previous terms offered: Spring 2021.

EOS 3165 (a) Research in Earth and Oceanographic Science: Topics in Petrotectonics
Every Spring. Enrollment limit: 15.

Rocks preserve a record of their geologic history through their chemistry, mineralogy, and texture. Many of these attributes are linked to the tectonic setting in which the rock formed, which have (co)varied with changes in Earth's atmosphere, biosphere, hydrosphere, and lithosphere. We will examine the distribution, composition, structure, and mineralogy of rocks and their relationships to tectonic environments. The petrotectonic evolution of Earth and resultant geologic archive will be explored using hand specimens, microscopy, chemical analysis, thermodynamic modeling, and field study. We will also discuss natural hazards, natural resources, and their intersections with society and the environment. Laboratory activities and projects emphasize developing research and communication skills in the geosciences, culminating in an independent research project. Includes a weekly laboratory and fulfills the 3000-level capstone research course requirement for the EOS major.

Prerequisites: Three of: either EOS 2115 or EOS 2125 or EOS 2145 or EOS 2155 or EOS 2165 or EOS 2225 and either EOS 2335 or EOS 2345 (same as ENVS 2270) or EOS 2365 and either EOS 2525 (same as ENVS 2251) or EOS 2565 or EOS 2585 (same as ENVS 2282) or EOS 2685.

Previous terms offered: Spring 2023, Spring 2022, Spring 2021.

EOS 3515 (a) Research in Oceanography: Topics in Paleoceanography
Non-Standard Rotation. Enrollment limit: 18.

The ocean plays a key role in regulating Earth's climate and serves as an archive of past climate conditions. The study of paleoceanography provides a baseline of natural oceanographic variability against which human-induced climate change must be assessed. Examination of the oceans' physical, biological, and biogeochemical responses to external and internal pressures of Earth's climate with focus on the Cenozoic Era (past 65.5 million years). Weekly labs and projects emphasize paleoceanographic reconstructions using deep-sea sediments, corals, and ice cores. Includes a laboratory and fulfills the 3000-level research experience course requirement for the EOS major.

Prerequisites: EOS 2005 (same as ENVS 2221).

Previous terms offered: Fall 2021, Fall 2020.