Department of Earth and Ocean Sciences

FALL 2017 COURSES

eos.tufts.edu

Course #	Title	Instructor	Block	Day & Time	
EOS 0001	**DYNAMIC EARTH**	Anne Gardulski	E	MWF	10:30AM-11:20AM
	LAB	Benner, Stroup	5+, 6+, or 8+	M, T, or R	1:20PM-4:20PM

Welcome to an exploration of the planet Earth! Our goal this semester will be to learn about the basic principles of geology and about learning itself. To this end we will visit numerous geological localities in the Boston area and will "travel" virtually to interesting geological localities across the continent and around the globe. We will sharpen our powers of observation in canyons and mountains and coastlines, and will develop hypotheses that can explain the origin of the rock and mineral formations we observe. We will test our hypotheses in whatever ways this rather large, bulky Earth allows. In short, we will use basic scientific methods to unravel the history of our dynamic Earth and will try to predict the changes we can expect the Earth's crust to undergo in the future. One might call this geologic problem solving or "Geologic Logic". We will also explore the origin and occurrence of our energy resources (coal, oil, and natural gas) and both metallic and nonmetallic mineral resources. Earthquakes along the San Andreas Fault in California, as well as volcanic eruptions in Yellowstone Park, Crater Lake, and Mt. St. Helens will help us develop an understanding of global geological processes. We hope these explorations challenge you to think in new ways about natural processes, scientific methods, environmental issues, and, in particular, about the relationship of human beings to the Earth's framework of geological time and space.

EOS 1 is designed for students to fulfill the science requirement, is relevant and useful as a related science field, and is a required introductory course for the EOS majors. Labs and field trips will meet 10 times during the semester and attendance is required; there are no lab assignments – we want you to observe and think about and synthesize the applications of the lecture material.

No prerequisite.

EOS 0005	**OCEANOGRAPHY**	Andrew Kemp	D+	TR	10:30AM-11:45AM

The vastness and depths of the world ocean have intrigued and challenged people for millennia. Yet only recently have marine scientists begun to understand the complexities of oceanic systems. The ocean is not only an important resource for humans, but it is a critical link in the earth's atmospheric, climatic, and ecologic structures. This course will emphasize the delicate balance and interrelations of oceanic processes with many of these other global systems.

The oceanography course will begin with a survey of the plate tectonic processes that form the rocks and surface features of the sea floor. A large part of the remainder of the course will deal with the chemical, physical, biological, and geological aspects of the seawater and sediments within this "bowl" of basaltic sea floor. Waves, tides, surface and deep-ocean currents, ocean-atmosphere interactions, organisms and their communities such as reefs, and sediment deposition on the continental shelf, slope, and rise are examples of topics that will be addressed. Also, discussed will be the influence of human activity on coastlines, the problems of pollution, and political boundaries that have been set up for various parts of the ocean.

No prerequisite.

EOS 0011	**MINERALOGY**	*Staff*	D	M 9:30AM-10:20AM TR 10:30AM-11:20AM
EOS 0191-06	LAB (required)	*Staff*	6	T 1:20PM-4:20PM

The science of mineralogy developed over the past 300 years and seeks to understand the relationship between the external physical properties of minerals and the internal atomic structures. It deals with field assemblages of minerals as constantly changing geochemical systems within the earth's crust, and is fundamental to a full understanding of most disciplines in geology. Virtually all rocks, sediments, soils and solid earth and planetary materials are composed of minerals, giving mineralogy numerous applications in archaeology, engineering, oceanography, and astronomy.

The mineralogy course begins with a study of the symmetry of natural crystals and the relationship between crystal forms and the internal atomic symmetry of minerals. As the semester progresses, we will examine a variety of physical and chemical properties which are useful for mineral identification. Students will learn to use the polarizing microscope to identify minerals no larger than a grain of sand, and will learn the theory behind X-ray diffraction and fluorescence, emission spectroscopy, and other sophisticated methods of mineral analysis. By the end of the term, students will have a broad appreciation and understanding of the nature, origin, and occurrence of the most important economic and rock-forming minerals.

The laboratory emphasis is on hand specimen and microscopic identification of minerals and crystals; field recognition of minerals will be one of the major goals of the semester. These field and lab techniques will be directly applicable in EOS 12 (Igneous and Metamorphic Petrology); EOS 42 (Sedimentology/Stratigraphy); and Geology Summer Field Camp. **All students must register for separate 0.5 Credit Lab EOS-0191-06 (Class No. 83718).**

EOS 0038	**HISTORICAL GEOLOGY & PALEONTOLOGY**	Jacob Benner	E+	M 10:30AM-11:45AM W 10:30AM-11:45AM
	LAB	Jacob Benner	7+	W 1:30PM-4:20PM

One of the fascinating aspects of the Earth's history is the rich and varied forms of life that have inhabited our planet for the past 3.5 billion years. Large organisms with hard shells and skeletons that could easily be preserved as fossils first appeared about 543 million years ago. As time passed, these early organisms multiplied and diversified into a great variety of plants and animals, many of which would flourish and then die out in response to environmental stress, and others which continue to inhabit the earth up to the present day. The fossil record provides a means of tracing the evolution and extinction of many groups of organisms, and also supplies information about their ecology and community structures. This course will cover aspects of the taxonomy and description of the major fossil groups, evolutionary trends, and paleoecology, within the context of the geological development of North America and global tectonic changes.

Prerequisite: EOS 1 and 2 recommended (or consent)

EOS 51/151	**GLOBAL CLIMATE CHANGE**	Andrew Kemp	B	TRF	8:30AM-9:20AM

An introduction to the workings of Earth's climate system to better understand the causes of present and future climate change. Emphasis will be placed on processes that control Earth's modern climate, such as global energy budgets and the behavior of greenhouse gases. Important features of global and regional climate systems such as El Nino South Oscillation will be studied. Having completed the course, students will have a deepened understanding of how and why climate changed in the recent past and the science behind forecasts of future global climate change. Course material will be delivered through lectures and problem-based classroom exercises. Students are expected to have some background knowledge of Earth and Ocean Science. May be taken by graduate students as EOS 151.

Prerequisites: EOS 1, 2 or 5.

EOS 0131 (CEE 113)	**GROUNDWATER**	Grant Garven	E	MWF	10:30AM-11:20AM

This course covers groundwater hydrology (also known as hydrogeology), the discipline that deals with the occurrence, migration, and development of all subsurface water. It is about the geological environments that control the occurrence of groundwater, and the physical laws that govern and describe the flow of groundwater. It will also address the influence of humans on the natural groundwater environment, and conversely the influence of natural groundwater regimes on water resources development, agriculture, industry, economic sustainability, and engineering infrastructures. Geologists and engineers traditionally use the term *"groundwater"* to refer to subsurface water that occurs beneath the water table, within soils, sediments, and rock formations that are fully saturated. This classical definition will be retained for this course and the focus of most lectures, but we will also develop a more comprehensive understanding of subsurface water, from the shallowest water found well above the water table in the unsaturated zone of soils to the deepest water found in brine-saturated aquifers in the Earth's crust. Groundwater hydrology is interdisciplinary in nature, bridging fields of geology, physics, chemistry, hydrology, and applied mathematics. This course will introduce students to the physical properties of groundwater, the physical laws and theory that govern its movement, the properties of geologic media that control rates of flow and storage, and methods for modeling subsurface flow patterns. Later in the course, the lectures focus on more practical topics, such as methods for groundwater exploration, water-well drilling technology, the hydraulics of pumping wells, aquifer mechanics, and groundwater resource evaluation. Near the end of the course, we examine the role of groundwater in watershed hydrology, geotechnical problems, and geologic processes.

The class will include 1 field trip to study hydrogeology in the field and to see how production wells and piezometers are drilled and completed. EOS 131 is a prerequisite for EOS 132 *Groundwater Chemistry & Quality*, which will be taught in the following spring semester.

Recommendations: EOS 1 or 2 (formerly GEO 1 or GEO 2), and MATH 32 (formerly MATH 11).

EOS 287 (CEE 287)	**SUBSURFACE FLUID DYNAMICS**	Grant Garven	C	TWF	9:30AM-10:20AM

This course will address advanced theory in groundwater hydrology. The early part of the course will cover the hydrodynamics of groundwater flow and Darcy's Law in porous sediments and fractured rocks. Fluid potential, flow nets and hodographs, vorticity of inhomogeneous fluids, and the physics of fluids in the unsaturated soil zone will also be covered. Topics related to contemporary applications include two-phase flow in petroleum reservoirs and carbon sequestration, flow in deforming media, geochemical transport in reactive formations, and fluid flow with heat transport in geothermal and nuclear waste repository systems.

Recommendations: MATH 51 (formerly MATH 38) and ES 8, or equivalents.

PROJECTED FUTURE COURSE OFFERINGS*

Fall 2017
EOS 1 - The Dynamic Earth
EOS 5 - Oceanography
EOS 11 - Mineralogy
EOS 38 - Historical Geology & Paleontology
EOS 51/151 - Global Climate Change
EOS 131 - Groundwater
EOS 287 - Subsurface Fluid Dynamics

Spring 2018
EOS 2 - Environmental Geology
EOS 12 - Igneous & Metamorphic Petrology
EOS 22 - Structural Geology
EOS 52/152 - Paleoclimate
EOS 104 - Geological Applications of GIS
EOS 133 – Field Methods in Hydrogeology
EOS 288 - Groundwater Modeling

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*Please consult a faculty member regarding course selection