# Department of Earth and Ocean Sciences

## SPRING 2020 COURSES

eos.tufts.edu

| Course # | Title | Instructor | Block | Day & Time |
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| **EOS 2** | **ENVIRONMENTAL GEOLOGY W/LAB** | Jack Ridge | C or<br>E | TWF 9:30AM-10:20AM or<br>MWF 10:30AM-11:20AM |
| | **LAB** | Jack Ridge and STAFF | 5+, 6+, 7+, or 8+ | M, T, W, R 1:20PM-4:20PM |

Environmental geology is an introduction to geologic environments and the processes that shape and modify Earth's surface. Of particular interest are the roles of water, ice, wind, and gravity and their effects in different surface environments and climates. These modern surficial processes strongly influence humans and their ability to live and interact with their surroundings. They also provide us with much of the evidence for interpreting ancient geologic environments, allowing us to understand how the earth has evolved over time and to predict the changes we can expect it to undergo in the future.

Specific topics covered in environmental geology include an overview of earth materials, groundwater, and processes of the hydrologic cycle. Also considered from a geological and human perspective are weathering and erosion, landslides, river, glacial, and ocean systems, and environments ranging from arid to periglacial (cold climate). The past climatic and sea level history of Earth's recent ice ages is discussed in relation to modern climate change.

Prerequisite: none.

4 credits

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| **EOS 15** | **MASS EXTINCTIONS: THE PAST, PRESENT, AND FUTURE OF BIODIVERSITY** | Noel Heim | D+ | TR 10:30AM-11:45AM |

Extinction is the inevitable fate of all species. However, the pace of extinction over geological time has not been steady. Earth's history is punctuated by intervals of rapid species loss, so-called mass extinctions. Since animals first evolved nearly 600 million years ago, there have been five major mass extinctions. In this course, we will explore the historical development of mass extinctions as a concept; compare and contrast the roles of volcanism, meteorite impacts, global warming, ice ages, and the evolution of novel species in causing mass extinctions; analyze the effects of mass extinctions of biodiversity and ecosystem structure; and attempt to answer the question "Are we in the midst of the 6th mass extinction?".

This is a seminar course in which very few lectures will be given by the instructor. The bulk of your learning will take place through reading and discussing scientific papers. Discussions will be student-led and every student will be required to be a discussion leader at least once. In addition to comparing and contrasting the causes and consequences of the major mass extinction, you will learn how to read a technical scientific article, become familiar with paleobiological data, and learn the methods used to study ancient biodiversity and events in Earth's history.

Prerequisite: EOS 0001 or EOS 0002 or BIO 0014.

3 credits

| EOS 22 | STRUCTURAL GEOLOGY | Anne Gardulski | G+ | MW 1:30PM-2:45PM |
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| | RECITATION | Anne Gardulski | GF | F 1:30PM-2:20PM |

Deformation of the earth's crust occurs on all scales, from microscopic crystal lattice dislocations to huge structures such as the San Andreas Fault that are hundreds of kilometers long. This course will address different aspects of structural analysis, with the ultimate goal of understanding structures in hand samples and outcrops as well as the regional and tectonic significance of structurally deformed rocks.

The structure course is organized into three major sections and will begin with methods of evaluating the strain or deformation in rocks. Quantification of stretching or compression of geologic structures will be undertaken through geometrical construction, as well as measurement and calculation. The array of structures that can occur in rocks, including folds, faults, joints, and cleavage, will be discussed in the second section of the course. Structural information from folds, for example, can be gleaned from many characteristics, such as the fold orientation and relative thickness of limbs and hinges. The last section will be concerned with dynamic analysis of structures, the orientations and magnitudes of stresses that produced deformation. Finally, the tectonic context of structures will complete the semester.

Problem sets and projects will emphasize experimentation and practical techniques for structural study and interpretation.

Prerequisite: Recommended EOS 1 or 2.

4 credits

| EOS 52 | PALEOCLIMATE | Andrew Kemp | C | TWF 9:30AM-10:20AM |
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A key component of almost all disciplines within the Earth and Ocean Sciences is the evolution of climate through geological time on scales of billions of years to decades and from the birth of Earth to the present day and into the future. Understanding the important phases and events in paleoclimate provides context for research in related fields and is a critical part of the discussion surrounding modern climate changes. By the end of this course you will be familiar with the major climate shifts that took place during the last ~4bn years, understand the evidence on which current thinking is based, and be able to explain the mechanism(s) that drove paleoclimatic change. We will begin by developing some basic understanding of how Earth's climate system works before moving onto discussion of widely used proxies. We will then embark on a 4bn year journey beginning with the wrongly perceived "hell" of the Hadean and ending with Quaternary glaciations, the Holocene, the Hockey Stick and a glimpse into the near future.

Two lectures per week.

Prerequisite: EOS 2 or EOS 51.

3 credits

| EOS 133 | FIELD METHODS IN HYDROGEOLOGY | Grant Garven | 8+ | R 1:20PM-4:20PM |
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| | RECITATION | Grant Garven | F+R | R 12:00PM-1:15PM |

Field aspects of geohydrology, groundwater mapping and sampling, aquifer testing, well drilling, monitoring, and instrumentation of boreholes. The course will blend lecture with basic field methods to understand how monitoring and production wells are planned and drilled, and what types of geologic, geophysical, and geochemical data can be gathered for subsurface flow systems. A network of boreholes on the Tufts campus will be used as field sites to characterize subsurface parameters in the unsaturated and saturated zones, and study regional flow in an urban watershed. Field trips, with quantitative analysis of geohydrologic data.

Prerequisite: EOS 1 or 2 and Physics 1 or 11 or equivalent. Note: Engineers register for CEE 114, cross-listed.

4 credits

| EOS 288 | GROUNDWATER MODELING | Grant Garven | G+ | MW 1:30PM-2:45PM |
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Numerical analysis of groundwater flow, with applications. Topics include: numerical formulation of the governing equations using finite difference, finite element, integrated finite difference, particle tracking, boundary element, and discrete element techniques; matrix and iterative solutions; algorithms for 1-D, 2-D, and 3-D flow; stability and accuracy; applications using popular USGS software in the public domain. Students will be expected to apply existing Fortran programs for 1-D, 2-D, and 3-D solutions as part of computational laboratory modeling assignments.

Prerequisite: Graduate standing.

5 credits