EARTH AND PLANETARY SCIENCES (EPS)

**EPS 101a, Climate Change**  Mary-Louise Timmermans and Noah Planavsky
An introductory course that explores the science of global climate change. We analyze processes that regulate the climate on Earth, assess the scientific evidence for global warming, and discuss consequences of climate change. We explore Earth's climate history as it relates to the present climate as well as future climate projections. Uncertainty in the interpretation of climate observations and future projections are examined.  SC  QR

* EPS 105b / APHY 100b / ENAS 100b / EVST 100b / PHYS 100b, Energy, Environment, and Public Policy  Daniel Prober
The technology and use of energy. Impacts on the environment, climate, security, and economy. Application of scientific reasoning and quantitative analysis. Intended for non-science majors with strong backgrounds in math and science.  Q8, SC

**EPS 110a, Dynamic Earth**  David Evans
An introduction to the processes that shape Earth’s environment through the interactions of rocks, soils, the atmosphere, and the hydrosphere. Field trips and practical sessions in the properties of natural materials. Topics include evolution of landscapes; hydrologic and tectonic cycles; extreme geologic events such as earthquakes, floods, volcanism, and landslides; society’s economic dependence on natural materials such as soils, minerals, and fossil fuels; and human influences on the natural environment.  SC

**EPS 111La, Dynamic Earth Laboratory and Field Methods**  David Evans
Practical exercises in the laboratory and in the field to complement G&G 110 or 115. Identification of minerals and rocks; construction of geologic maps and cross sections to determine Earth-system processes and histories. Includes a field trip to the northern Appalachians during the October recess. After or concurrently with G&G 110, or after G&G 115.  SC ½ Course cr

* EPS 125b / E&EB 125b, History of Life  Derek Briggs and Pincelli Hull
Examination of fossil and geologic evidence pertaining to the origin, evolution, and history of life on Earth. Emphasis on major events in the history of life, on what the fossil record reveals about the evolutionary process, on the diversity of ancient and living organisms, and on the evolutionary impact of Earth’s changing environment.  SC

**EPS 126Lb, Laboratory for the History of Life**  Derek Briggs and Pincelli Hull
A survey of the diversification of life using suites of fossils and related modern organisms drawn from critical evolutionary stages. Emphasis on direct observation and description of specimens, the solution of problems posed by the instructor, and the generation and testing of hypotheses by the students. To be taken concurrently with or following G&G 125.  SC ½ Course cr

**EPS 211b / EVST 211b / HIST 416b / HSHM 211b, Global Catastrophe since 1750**  Bill Rankin
A history of the geological, atmospheric, and environmental sciences, with a focus on predictions of global catastrophe. Topics range from headline catastrophes such as global warming, ozone depletion, and nuclear winter to historical debates about the age of the Earth, the nature of fossils, and the management of natural resources. Tensions between science and religion; the role of science in government; environmental economics; the politics of prediction, modeling, and incomplete evidence.  HU

* EPS 220b, Forensic Geoscience  Maureen Long
Approaches and technologies developed for geoscience that have been adapted and applied in criminal, environmental, historical, and archaeological investigations. Methods related to seismology, geophysics, geomorphology, geochemistry, and radiometric dating. Case studies include nuclear treaty verification, detection of unexploded ordnance and clandestine graves, military history, soil and groundwater contamination, archaeological controversies, art and antiquities fraud, and narcotics provenance.  SC

* EPS 270a, Herpetology  Bhart-Anjan Bhullar
An examination of the origin and evolution of amphibians and reptiles with particular emphasis on global diversity, the fossil record, and the evolution of body plans. Discussion of classic and current literature provides a sense of the state of the art. Detailed hands-on study of external and internal anatomy heavily employs the collections of the Yale Peabody Museum. Prerequisites: BIOL 101-104, high-school AP-equivalent preparation, or permission of instructor. E-mail instructor for options if considering alongside EPS 325.  SC

**EPS 274a, Fossil Fuels and World Energy**  Michael Orio
The origins, geologic settings, exploration, exploitation, and extraction of coal, oil, and natural gas as finite Earth resources. The role of fossil fuels in the world’s energy systems; environmental impacts of fossil fuels, including climate change; the transition to low-carbon energy sources. Prerequisites: high school chemistry, mathematics, and Earth science. Recommended preparation: G&G 110 or 205.  SC

**EPS 310a, Isotope Geochemistry**  Alan Rooney
An overview of the fundamental principles of stable and radiogenic isotope geochemistry. Emphasis is placed on applications of such systems to the evolution of the planet and life on Earth. Specific topics include marine geochemistry, geochronology, and biogeochemistry. Prerequisites: CHEM 115, MATH 120, and PHYS 171 or equivalents, or with permission of instructor.  Q8, SC

**EPS 312a, Structural Geology**  Mark Brandon
An introduction to the origin and structure of the lithosphere and continental and oceanic crust. Topics include what controls the solid versus fluid behavior of rocks during deformation, and what controls the character and motion of tectonic plates. Laboratory exercises and field trips.  Q8, SC
EPS 319a, Introduction to the Physics and Chemistry of Earth Materials  Shun-ichiro Karato
Basic principles that control the physical and chemical properties of Earth materials. Thermodynamics, equation of state, phase transformations, elastic properties and phase diagrams. After CHEM 161, 165, or 167 (or CHEM 115), MATH 120, and PHYS 181, or equivalents.  QR, SC

EPS 322b, Physics of Weather and Climate  Juan Lora
The climatic system; survey of atmospheric behavior and climatic change; meteorological measurements and analysis; formulation of physical principles governing weather and climate with selected applications to small- and large-scale phenomena. After PHYS 181 and MATH 120 or equivalents.  QR, SC

EPS 355a, Vertebrate Palaeontology  Jacques Gauthier
Phylogeny and evolution of the major clades of vertebrates from Cambrian to Recent, as inferred mainly from the fossilized remains of the musculoskeletal system (cranial, axial, and appendicular skeletons). Special attention given to the evolution of vertebrate feeding, locomotor, and sensory systems. Prerequisite: E&E 225, or with permission of instructor.  SC  ½ Course cr

EPS 333a, Physical Oceanography  Alexey Fedorov
An introduction to ocean dynamics and physical processes controlling large-scale ocean circulation, the Gulf Stream, wind-driven waves, tsunamis, tides, coastal upwelling, and other phenomena. Modern observational, theoretical, and numerical techniques used to study the ocean. The ocean's role in climate and global climate change. After PHYS 181 and MATH 120 or equivalents, or with permission of instructor.  QR, SC

EPS 342a / PHYS 342a, Introduction to Earth and Environmental Physics  John Wettlaufer
A broad introduction to the processes that affect the past, present, and future features of the Earth. Examples include climate and climate change and anthropogenic activities underlying them, planetary history, and their relation to our understanding of Earth’s present dynamics and thermodynamics. Prerequisite: PHYS 170, 171, or 180, 181, or 200, 201, or 260, 261, or permission of instructor. Recommended preparation: familiarity with basic calculus and differential equations.  QR, SC

* EPS 345a, Paleoecology  Pinellì Hull
How organisms have interacted with one another and the environment has changed dramatically through the history of life. The species and ecosystems we see today, with their myriad interactions and influences, are in many ways very unusual in a historical context. What's more, the evolution of ecosystems has profoundly shaped and driven the evolution of species and the earth system over billions of years. For students of (macro)evolution, geobiology, paleontology, and earth system science, a foundation in paleoecology is essential for understanding the dynamics and drivers of these interrelated systems. To this end, this course is designed to provide students with i) a basic literacy in core concepts of paleoecology, ii) deeper insights into a few major topics, and iii) basic analytical methods with which to ask and answer novel questions of the fossil record. Prerequisite: EPS 125, BIOL 104, or permission of instructor.  SC

EPS 350a, Rock Formation in Mountain Belts  Jay Ague
The fundamental principles governing the formation of metamorphic and igneous rocks during mountain building. Topics include processes of heat and mass transfer in orogenic belts, generation of igneous rocks in continental and subduction settings, ultrahigh pressure and ultrahigh temperature metamorphism, spatial and temporal patterns of petrologic processes throughout geologic time, and pressure-temperature-time paths of metamorphic and igneous rocks. Prerequisites: PHYS 181 or permission of instructor.  SC

* EPS 362b / ARGC 362b / EVST 362b, Observing Earth from Space  Xuhui Lee
A practical introduction to satellite image analysis of Earth’s surface. Topics include the spectrum of electromagnetic radiation, satellite-borne radiometers, data transmission and storage, computer image analysis, the merging of satellite imagery with GIS and applications to weather and climate, oceanography, surficial geology, ecology and epidemiology, forestry, agriculture, archaeology, and watershed management. Prerequisites: college-level physics or chemistry, two courses in geology and natural science of the environment or equivalents, and computer literacy.  QR, SC

EPS 421b, Geophysical Fluid Dynamics  Mary-Louise Timmermans
A survey of fluid dynamics, with applications to oceans and atmospheres. Mathematical models illustrate the fundamental dynamical principles of geophysical fluid phenomena such as large-scale flows, waves, boundary layers, and flow stability. Concepts are investigated through laboratory experiments in a rotating water tank. Prerequisites: differential equations and introductory fluid mechanics.  QR, SC

EPS 428a / AMTH 428a / E&E 428a / PHYS 428a, Science of Complex Systems  Jun Korenaga
Introduction to the quantitative analysis of systems with many degrees of freedom. Fundamental components in the science of complex systems, including how to simulate complex systems, how to analyze model behaviors, and how to validate models using observations. Topics include cellular automata, bifurcation theory, deterministic chaos, self-organized criticality, renormalization, and inverse theory. Prerequisite: PHYS 301, MATH 247, or equivalent.  QR, SC

EPS 456a, Introduction to Seismology  Maureen Long
Earthquakes and seismic waves, P and S waves, surface waves and free oscillations. Remote sensing of Earth’s deep interior and faulting mechanisms. Prerequisites: MATH 120, 222, and PHYS 181, or equivalents.  QR, SC

* EPS 487a or b, Individual Study in Earth and Planetary Sciences  Staff
Individual study for qualified undergraduates under faculty supervision. To register for this course, each student must submit a written plan of study, approved by the adviser, to the director of undergraduate studies. May be taken more than once for credit.  ½ Course cr
* EPS 488a and EPS 489b, Research in Earth and Planetary Sciences  Staff
Individual study for qualified juniors and seniors under faculty supervision. To register for this course, each student must submit a written plan of study, approved by the adviser, to the director of undergraduate studies.

* EPS 490a and EPS 491b, Research and Senior Thesis  Staff
Two terms of independent library, laboratory, field, or modeling-based research under faculty supervision. To register for this course, each student must submit a written plan of study, approved by a faculty adviser, to the director of undergraduate studies by the start of the senior year. The plan requires approval of the full EPS faculty.

* EPS 492a or b, The Senior Essay  Staff
One term of independent library, laboratory, field, or modeling-based research under faculty supervision. To register for this course, each student must submit a written plan of study, approved by a faculty adviser, to the director of undergraduate studies at the beginning of the term in which the essay is to be written.