OEAS - Ocean and Earth Sciences

OEAS 106N Introductory Oceanography (4 Credit Hours)
Introductory course emphasizing the geology, chemistry, physics and biology of the oceans. Laboratory emphasizes practice of basic scientific methods. Knowledge of the metric system, scientific notation, ratio and proportion, and graphing is required. Field trip required.

OEAS 108N Understanding Global Climate Change (4 Credit Hours)
What is the science behind global climate change? How reliable are forecasts of future global warming? This course examines these questions to evaluate the likelihood and potential severity of anthropogenic climate change in the coming centuries. It includes an overview of the physics of the greenhouse effect, an overview of the global carbon cycle and its role as a global thermostat; an examination of predictions and reliability of model forecasts of future climate change; and examination of local impacts of global climate change (e.g., sea level rise in the Tidewater area).

OEAS 110N Earth Science (4 Credit Hours)
This is an introductory course in geological sciences. The course relates the principles of natural science to Earth as a planet, its resources, and its environment. The effects of geologic processes on the environment are stressed. A student receiving credit for OEAS 110N cannot receive credit for OEAS 111N.

OEAS 111N Physical Geology (4 Credit Hours)
This course introduces the student to the study of the materials, structures, and processes of the Earth. Present terrestrial resources are interpreted in terms of the internal and surface processes that formed them. A student receiving credit for OEAS 111N cannot receive credit for OEAS 110N.

OEAS 112N Historical Geology (4 Credit Hours)
The evolution of the continents, ocean basins, mountain chains, and the major life forms throughout Earth's history are studied chronologically and are related to the physical and biological changes that have caused them.
Prerequisites: OEAS 110N or OEAS 111N

OEAS 126N Honors: Introductory Oceanography (4 Credit Hours)
Open only to students in the Honors College. Special honors section of OEAS 106N. In addition to broad coverage of the geology, chemistry, physics and biology of the ocean, students will read scientific papers with current environmental problems. There will be several field trips to nearby ecosystems.

OEAS 130G Research Skills and Information Literacy for the Natural Sciences (3 Credit Hours)
This course is designed to introduce students to a range of research and information literacy skills necessary for natural scientists. The course will introduce students to the wide range of research being undertaken in the natural sciences (e.g., oceanography, geology, physics, biology, and chemistry). The course involves directed reading, exercises in information retrieval, and the synthesis of information from a range of sources into scientific essays and oral presentations.

OEAS 195 Topics (1-4 Credit Hours)
Special topics in physical, geological, chemical or biological oceanography.

OEAS 197 Undergraduate Research Experience in Ocean and Earth Sciences (0 Credit Hours)
Student participation in a supervised, undergraduate research experience for which credit will not apply to the degree. Experience must be related to the student's major, minor or career area of interest.
Prerequisites: permission of the instructor

OEAS 220T Introduction to Meteorology (3 Credit Hours)
This course is an introduction to the basic principles governing both day-to-day weather and the average of weather, or climate. Specific focus will be given to the tools used to measure weather and the ways in which these tools have impacted our understanding of weather in the past and present. Links will be made between the technology-based improvements of our understanding of weather and the impact on the lives of humans throughout recent history. Students will learn about how weather forecasts are made, and how the quality of these forecasts affects our lives.

OEAS 250N Natural Hazards and Disasters (4 Credit Hours)
This course introduces the science behind some of Earth's natural phenomena that can, and often do, result in major loss of life or catastrophic damage to property. It includes an overview, with relevant case studies, of earthquakes, tsunamis, landslides, volcanic eruptions, tropical cyclones (hurricanes), tornadoes, floods, droughts, and space weather. The impact of global climate change and sea level rise on vulnerable populations is examined and current risk assessment and mitigation practices are discussed.

OEAS 295 Special Topics (3 Credit Hours)
An investigation of a selected problem in physical, geological, chemical, or biological oceanography.
Prerequisites: sophomore standing or permission of the instructor

OEAS 302 Environmental Geology (3 Credit Hours)
Geologic resources and processes that limit human activities and pose significant hazards. Does not satisfy OEAS major degree or minor requirements.
Prerequisites: Junior standing and an 8-hour sequence in a General Education science course

OEAS 303 Paleontology (3 Credit Hours)
This course introduces the concepts of paleontology, focusing on the relationship between the evolution of life (particularly invertebrates) and the development of Earth. Field work will also include studies in paleoecology and sedimentary facies. Two field trips are recommended.
Prerequisites: OEAS 111N and OEAS 112N

OEAS 306 Oceanography (3 Credit Hours)
General survey of physical, geological, chemical and biological oceanography. The application of skills from mathematics, geology, physics, biology and chemistry for the solution of oceanographic problems.
Prerequisites: MATH 211 or MATH 205, BIOL 121N or BIOL 136N and BIOL 122N or BIOL 137N, CHEM 121N-CHEM 122N, OEAS 111N, and PHYS 111N or PHYS 231N

OEAS 307 Research Experience in Oceanography (3 Credit Hours)
In this course-based undergraduate research experience, students perform field and laboratory experiments designed to complement topics presented in the Oceanography lecture course, OEAS 306. Students taking OEAS 306 are strongly encouraged to take this laboratory class concurrently with OEAS 306. Ocean and Earth Science majors are required to take this class.
Prerequisites: BIOL 122N or BIOL 137N, BIOL 124N, CHEM 122N, CHEM 124N, and OEAS 111N
Pre- or corequisite: OEAS 306

OEAS 310 Global Earth Systems (4 Credit Hours)
Core course for ocean and earth sciences majors that examines the processes linking the Earth's atmosphere, lithosphere, and hydrosphere into an interactive system.
Prerequisites: BIOL 121N or BIOL 136N, BIOL 122N or BIOL 137N, CHEM 121N, CHEM 122N, and OEAS 111N, all with a grade of C or better

OEAS 315 Minerals and Rocks (4 Credit Hours)
The course introduces the main igneous, sedimentary and metamorphic rocks and their mineral composition. Laboratory exercises include mineral identification by physical and microscopic optical properties, the identification of rocks in hand samples, and basic training with the Brunton compass. Field work includes training in introductary facies analysis, and the analysis of sedimentary rock structures, unconformities, volcanic, plutonic, and metamorphic rock units, clastics and carbonates.
Prerequisites: OEAS 111N, OEAS 112N, CHEM 121N, and CHEM 122N

OEAS 320 Sedimentology and Stratigraphy (4 Credit Hours)
The origin, transport, and deposition of sediments with emphasis on interpretation of sediment sequences, principles and methods of correlation. Laboratory exercises involve field sampling, textural analyses, and sedimentary structures. Field trip required.
Prerequisites: OEAS 110N or OEAS 111N

OEAS 344W Geomorphology (3 Credit Hours)
Geologic processes that shape the earth's surface. Laboratory studies involve interpretation of topographic maps, soil maps, and aerial photographs. Field trip required. This is a writing intensive course.
Prerequisites: OEAS 320 AND either ENGL 211C or ENGL 221C or ENGL 231C with a grade of C or better; or permission of instructor

OEAS 350 Where Rivers Meet the Sea: Ecology and Climate (3 Credit Hours)
This course is designed to introduce students to the highly productive ecosystems of estuaries that result from the interactions of fresh and oceanic waters. The course includes exploration, evaluation, and analysis of the factors that allow construction of realistic conceptual models of an important Earth system.
Prerequisites: ENGL 110C

OEAS 367 Cooperative Education (1-3 Credit Hours)
Available for pass/fail grading only. Student participation for credit based on the academic relevance of the work experience, criteria, and evaluative procedures as formally determined by the department and the Career Management program prior to the semester in which the experience is to take place.
Prerequisites: junior standing and permission of the department

OEAS 368 Internship in Ocean and Earth Sciences (1-3 Credit Hours)
Available for pass/fail grading only. Students gain on the job work experience related to their undergraduate curriculum.
Prerequisites: junior standing, permission of department and a 3.00 grade point average

OEAS 369 Practicum (1-3 Credit Hours)
Field experience in ocean, earth and atmospheric sciences. (qualifies as a CAP experience)
Prerequisites: junior standing, permission of department and must have declared ocean and earth sciences major or minor

OEAS 395 Special Topics (1-4 Credit Hours)
Lectures, field and laboratory studies. An investigation of a selected problem in physical, geological, chemical, or biological oceanography.
Prerequisites: permission of the instructor

OEAS 402/502 Field Experiences in Oceanography for Teachers (3 Credit Hours)
Field and laboratory experiences in oceanography including hands-on experience using equipment and methods suitable for middle and secondary education professionals. Course will provide understanding of oceanic processes using simple field and laboratory experiments. Not available for credit for OES majors and minors.
Prerequisites: background in K-12 Education

OEAS 403W/503 Aquatic Pollution (3 Credit Hours)
This course will present basic ecological principles relevant to water pollution and ecotoxicology. Topics will include runoff, eutrophication, water and sewage treatment, industrial waste, oil pollution, pesticides, and plastics in the sea. Case studies provide focal points for consideration of issues in making decisions and setting policy. This is a writing intensive course. Pre- or
Prerequisites: grade of C or better in ENGL 211C, ENGL 221C, or ENGL 231C
Corequisites: a grade of C or better in OEAS 306

OEAS 405/505 Physical Oceanography (3 Credit Hours)
Physics of the ocean: properties of seawater and their distribution; water mass formation; mass and energy flows; waves; tides; models; estuarine and coastal processes. An elective for science and engineering majors.
Prerequisites: C or better in MATH 211 and either PHYS 232N or two semesters of hydraulics

OEAS 406/506 Matlab (1 Credit Hour)
This course is designed to introduce students to Matlab programming and to develop skills utilizing this program for data analysis
Prerequisites: Junior standing or permission of instructor

OEAS 410/510 Chemical Oceanography (3 Credit Hours)
Chemical composition of the ocean and the chemical, biological, geological and physical processes controlling it.
Prerequisites: CHEM 121N-CHEM 122N and CHEM 123N-CHEM 124N, OEAS 306 or consent of instructor

OEAS 412/512 Global Environmental Change (3 Credit Hours)
An examination of the development of the earth as a habitable planet, from its origin to human impacts on global biogeochemical cycles on land, and in the oceans and atmosphere.
Prerequisites: OEAS 306 and OEAS 310

OEAS 413/513 Environmental Geochemistry (3 Credit Hours)
This course examines geochemical processes at and near the Earth's surface, focusing on the concentration, speciation and reactivity of elements in soils, waters, sediments and the atmosphere. The course examines both the thermodynamic and kinetic controls on these processes, and the role of biology as a mediator (or facilitator) of these processes. Anthropogenic impacts on natural geochemical processes are also examined.
Prerequisites: CHEM 121N-CHEM 122N and CHEM 123N-CHEM 124N, OEAS 111N and OEAS 310

OEAS 415/515 Waves and Tides (3 Credit Hours)
Causes, nature, measurement and analysis of water waves and tides. Mathematical and graphical application to wave and tide problems.
Prerequisites: C or better in MATH 212 and PHYS 232N or permission of the instructor

OEAS 416/516 Electronics and Oceanographic Instrumentation (3 Credit Hours)
The course will consist of brief lectures and hands-on laboratory exercises, in which students will learn to build, use, and debug electronic devices relevant to ocean and earth science applications. Topics covered will include circuit theory, power supplies and budgets, transducers and amplifiers, computerized data acquisition, instrument control, signal conditioning and resolution.
Prerequisites: PHYS 232N or 112N, OEAS 306, OEAS 310, STAT 310 or STAT 330

OEAS 418/518 Limnology: Biogeochemistry of Lakes (3 Credit Hours)
Chemical cycling in lakes and reservoirs, and interactions with biological and physical processes; quantitative modeling of lake geochemistry.
Prerequisites: OEAS 306

OEAS 419/519 Spatial Analysis of Coastal Environments (3 Credit Hours)
The course integrates remotely sensed and field techniques for scientific investigation and practical management of coastal environmental systems. Spatial modeling of coastal processes and management tools using geographic information system (GIS).
Prerequisites: GEOG 300, GEOG 402 or GEOG 502, or permission of instructor

OEAS 420/520 Hydrogeology (3 Credit Hours)
Topics covered will include the occurrence and movement of surface and subsurface water, the nature and distribution of permeable rocks and strata, field techniques used in ground-water studies, and the flow of ground-water to wells.
Prerequisites: OEAS 320 or OEAS 344W and MATH 205 or MATH 211; or permission of the instructor

OEAS 425 Marine Geology (3 Credit Hours)
Survey of marine geology and geophysics; plate tectonics and basin formation; seafloor volcanic activity; marine sediments and sediment dynamics; coastal processes; geologic time in the marine record.
Prerequisites: OEAS 306 or OEAS 310 or permission of instructor

OEAS 426/526 Concepts in Oceanography for Teachers (3 Credit Hours)
This web-based course will provide a practical introduction to oceanography for earth science teachers. It is particularly aimed at current science teachers attempting to become certified in earth science education. Topics will include discussions of geological, biological, physica and chemical oceanography. Not available for credit for OEAS majors and minors.
Prerequisites: junior standing or permission of the instructor

OEAS 430/530 Introduction to Geophysics (3 Credit Hours)
Introduction to the physics of the earth, including plate tectonics, volcanism, earthquakes and seismology, gravity, the Earth's magnetic field, geophysical remote sensing, and mantle convection.
Prerequisites: OEAS 111N, MATH 211, and PHYS 111N-PHYS 112N or PHYS 231N-PHYS 232N

OEAS 434/534 Geodynamics (3 Credit Hours)
A qualitative and quantitative description of physical processes in the Earth and environmental sciences. Topics include stress and strain, plate elasticity and flexure, heat flow, fluid mechanics, material rheology, and groundwater flow. Emphasis will be placed on developing an understanding of Earth dynamics using real-world examples, including numerical exercises.
Prerequisites: OEAS 111N, MATH 211, MATH 212, and PHYS 231N
Corequisites: PHYS 232N

OEAS 435 Introduction to Ocean Modeling and Prediction (3 Credit Hours)
Introduction to concepts and theories of numerical ocean circulation models and their applications in physical oceanography, computational fluid dynamics, environmental problems and ocean forecast systems.
Prerequisites: OEAS 405 or OEAS 306; permission of instructor or CEE 330

OEAS 440/540 Biological Oceanography (4 Credit Hours)
Marine organisms and their relationship to physical and chemical processes in the ocean. Laboratory study of local marine organisms, marine ecosystem and sampling techniques. Includes identification, data analysis and field trips.
Prerequisites: OEAS 306 and STAT 130M or STAT 310

OEAS 441 Ocean and Earth Sciences Field Study I (3 Credit Hours)
Interdisciplinary investigation of selected sites in Southeast Virginia that includes field sampling, sample analyses, data interpretation and integration, and group report preparation and presentations. Focuses on development of research questions and site selection, field sampling, sample analyses and interpretation. Oral presentations of results will be made by each student.
Prerequisites: OEAS 306 and OEAS 310; CHEM 123N and CHEM 124N, BIOL 123N or OEAS 303; PHYS 112N or PHYS 232N; MATH 212; STAT 310; all prerequisite courses must be passed with a grade of C or better

OEAS 442W Ocean and Earth Sciences Field Study II (3 Credit Hours)
Interdisciplinary investigation of selected sites in Southeast Virginia that includes field sampling, sample analyses, data interpretation and integration, and group report preparation and presentations. Focuses on site selection and evaluation mapping, sampling, and sample analyses. Oral presentations of results will be made by each student. This is a writing intensive course.
Prerequisites: a grade of C or better in ENGL 211C or ENGL 221C or ENGL 231C; OEAS 441

OEAS 444 Communicating Ocean Science to Informal Audiences (3 Credit Hours)
Communicating Science to Informal Audiences (CoSIA) is designed for students interested in improving their ability to communicate scientific knowledge by presenting information and activities in an informal learning environment. The course combines instruction in inquiry-based science teaching with practical experience presenting to guests of all ages at the Virginia Aquarium. Students will practice communicating knowledge and receive mentoring on how to improve their presentations. CoSIA provides future scientists and educators with a background in current learning theory and applies it through practical experiences to empower them to meet communication challenges they will encounter in their careers.
Prerequisites: OEAS 306 or OEAS 310

OEAS 445 Communicating Ocean Science to Informal Audiences (3 Credit Hours)
This course provides Earth Science Education students with instruction on presenting scientific information to informal audiences (K through adult). Students will develop more in-depth presentations and extended practice presenting their materials on the Virginia Aquarium floor. For Earth Science Education track students, OEAS 444 and OEAS 445 can replace OEAS 441/ OEAS 442W. It is available as an elective for all other students.
Prerequisites: OEAS 444

OEAS 451W/551 Data Collection and Analysis in Oceanography (4 Credit Hours)
This course introduces students to the basic numerical tools used to obtain and analyze information in the ocean and earth sciences. The students will use various oceanographic instruments to obtain data at different locations of the Chesapeake Bay. Data obtained with those instruments will be processed and analyzed using data analysis techniques discussed in class. The data will then be used to answer a particular question related to the temporal and spatial variability in a natural system. This is a writing intensive class.
Prerequisites: STAT 310 and MATH 211 or MATH 205
Pre- or corequisite: OEAS 306

OEAS 452 Microbial Ecology of the Oceans (3 Credit Hours)
Marine microbes thrive in all oceanic habitats including what would be considered extreme environmental conditions. This course studies the role that these microbes play in biogeochemical cycling and food web dynamics in the oceans (the microbial loop). Throughout the course, students will learn about different microbial functional groups and the processes they mediate in marine systems, which include virtually all geochemical reactions occurring in the oceans. Students will learn through lectures, readings written by experts in the field, and class discussions.
Prerequisites: OEAS 306 or OEAS 310 or permission of the instructor

OEAS 453W/553 Marine Molecular Ecology (4 Credit Hours)
This course will explore the ecology of marine organisms using molecular techniques and data. Molecular ecology covers a wide variety of sub-disciplines, including genetics, physiology, ecology, and evolution. The course will explore basic theory in population genetics, ecology, and evolution and cover nucleic acid techniques and their applications. This is a writing intensive course.
Prerequisites: BIOL 291 or BIOL 292 or BIOL 293 or BIOL 294 or BIOL 331 or OEAS 306

OEAS 466W/566 Introduction to Mitigation and Adaptation Studies (3 Credit Hours)
Students will be introduced to the science underpinning mitigation of human-induced changes in the Earth system, including but not limited to climate change and sea level rise, and adaptation to the impacts of these changes. The course will cover the environmental hazards and the opportunities and limitations for conservation, mitigation and adaptation. This is a writing intensive course. Cross listed with BIOL 466W and IDS 466W.
Prerequisites: BIOL 291 or permission of instructor

OEAS 467/567 Sustainability Leadership (3 Credit Hours)
In this class, students will discover what makes a leader for sustainability. They will consider a range of global and local crises from a leadership point of view in the context of sustainability science, which addresses the development of communities in a rapidly changing social, economic, and environmental system-of-systems environment. The course will be based on taking a problem-motivated and solution-focused approach to the challenges considered. The course includes a service learning project focusing on a leadership experience in solving a real-world environmental problem.
Prerequisites: BIOL 466W or OEAS 466W or IDS 466W

OEAS 468W Research Methods in Math and Sciences (3 Credit Hours)
Emphasizes the tools and techniques used to solve scientific problems. Topics include use and design of experiments, use of statistics to interpret experimental results, mathematical modeling of scientific phenomena, and oral and written presentation of results. Students will perform four independent inquiries, combining skills from mathematics and science to solve research problems. This is a writing intensive course.
Prerequisites: A grade of C or better in ENGL 211C or ENGL 221C or ENGL 231C and OEAS 306 or OEAS 310 and STEM 201

OEAS 470/570 Proxy Reconstruction of Late Cenozoic Climate: Calibrations and Applications (3 Credit Hours)
This course will examine recent developments in paleo-proxy calibration and their application in reconstructing Late Cenozoic climate history. Students will read several papers covering the theoretical basis and empirical evidence supporting some of the most common proxies used in paleoclimatology/ paleoceanography each week. Each week will begin with a lecture on the topic, followed by an in-depth discussion. Students will be required to present one of the weekly topics and lead the class discussion.
Prerequisites: CHEM 121N, CHEM 122N, CHEM 123N and CHEM 124N

OEAS 487 Honors Research in Ocean and Earth Sciences (1-3 Credit Hours)
Supervised study in a field of individual interest. Research results are reported in a public oral presentation and a thesis.
Prerequisites: senior standing and admission to the Academic Honors Program

OEAS 490 Paleoceanography (3 Credit Hours)
This course will provide an overview of how marine sediments are used to reconstruct Earth's climate history over the past 600 million years. Students will discuss the factors that control modern climate and explore how these variables led to cycles of Greenhouse and Icehouse worlds in the past. Finally, students will discuss how past and modern climate records can be used to predict future climate change.
Prerequisites: general chemistry, OEAS 111N and OEAS 112N

OEAS 495/595 Special Topics (1-4 Credit Hours)
Lectures, field and laboratory studies. An investigation of a selected problem in physical, geological, chemical, or biological oceanography.
Prerequisites: junior standing and permission of the instructor

OEAS 497 Special Problems and Research (1-3 Credit Hours)
Independent reading and study on a topic to be selected with the direction of an instructor.
Prerequisites: junior standing

OEAS 502 Field Experiences in Oceanography for Teachers (3 Credit Hours)
Field and laboratory experiences in oceanography including hands-on experience using equipment and methods suitable for middle and secondary education professionals. Course will provide understanding of oceanic processes using simple field and laboratory experiments. Not available for credit for OES majors and minors.
Prerequisites: background in K-12 Education

OEAS 503 Aquatic Pollution (3 Credit Hours)
This course will present basic ecological principles relevant to water pollution and ecotoxicology. Topics will include runoff, eutrophication, water and sewage treatment, industrial waste, oil pollution, pesticides, and plastics in the sea. Case studies provide focal points for consideration of issues in making decisions and setting policy. This is a writing intensive course.

OEAS 505 Physical Oceanography (3 Credit Hours)
Physics of the ocean: properties of seawater and their distribution; water mass formation; mass and energy flows; waves; tides; models; estuarine and coastal processes. An elective for science and engineering majors.
Prerequisites: C or better in MATH 211 and either PHYS 232N or two semesters of hydraulics

OEAS 506 Matlab (1 Credit Hour)
This course is designed to introduce students to Matlab programming and to develop skills utilizing this program for data analysis.
Prerequisites: Junior standing or permission of instructor

OEAS 510 Chemical Oceanography (3 Credit Hours)
Chemical composition of the ocean and the chemical, biological, geological and physical processes controlling it.

OEAS 512 Global Environmental Change (3 Credit Hours)
An examination of the development of the earth as a habitable planet, from its origin to human impacts on global biogeochemical cycles on land, and in the oceans and atmosphere.

OEAS 513 Environmental Geochemistry (3 Credit Hours)
This course examines geochemical processes at and near the Earth's surface, focusing on the concentration, speciation and reactivity of elements in soils, waters, sediments and the atmosphere. The course examines both the thermodynamic and kinetic controls on these processes, and the role of biology as a mediator (or facilitator) of these processes. Anthropogenic impacts on natural geochemical processes are also examined.

OEAS 515 Waves and Tides (3 Credit Hours)
Causes, nature, measurement and analysis of water waves and tides. Mathematical and graphical application to wave and tide problems.
Prerequisites: C or better in MATH 212 and PHYS 232N or permission of the instructor

OEAS 516 Electronics and Oceanographic Instrumentation (3 Credit Hours)
The course will consist of brief lectures and hands-on laboratory exercises, in which students will learn to build, use, and debug electronic devices relevant to ocean and earth science applications. Topics covered will include circuit theory, power supplies and budgets, transducers and amplifiers, computerized data acquisition, instrument control, signal conditioning and resolution.

OEAS 518 Limnology: Biogeochemistry of Lakes (3 Credit Hours)
Chemical cycling in lakes and reservoirs, and interactions with biological and physical processes; quantitative modeling of lake geochemistry.

OEAS 519 Spatial Analysis of Coastal Environments (3 Credit Hours)
The course integrates remotely sensed and field techniques for scientific investigation and practical management of coastal environmental systems. Spatial modeling of coastal processes and management tools using geographic information system (GIS).
Prerequisites: GEOG 300, GEOG 402 or GEOG 502, or permission of instructor

OEAS 520 Hydrogeology (3 Credit Hours)
Topics covered will include the occurrence and movement of surface and subsurface water, the nature and distribution of permeable rocks and strata, field techniques used in ground-water studies, and the flow of ground-water to wells.

OEAS 526 Concepts in Oceanography for Teachers (3 Credit Hours)
This web-based course will provide a practical introduction to oceanography for earth science teachers. It is particularly aimed at current science teachers attempting to become certified in earth science education. Topics will include discussions of geological, biological, physical and chemical oceanography. Not available for credit for OES majors and minors.

OEAS 530 Introduction to Geophysics (3 Credit Hours)
Introduction to the physics of the earth, including plate tectonics, volcanism, earthquakes and seismology, gravity, the earth's magnetic field, geophysical remote sensing, and mantle convection.

OEAS 534 Geodynamics (3 Credit Hours)
A qualitative and quantitative description of physical processes in the Earth and environmental sciences. Topics include stress and strain, plate elasticity and flexure, heat flow, fluid mechanics, material rheology, and groundwater flow. Emphasis will be placed on developing an understanding of Earth dynamics using real-world examples, including numerical exercises.
Prerequisites: MATH 211, MATH 212, PHYS 231N, and PHYS 232N or equivalents

OEAS 540 Biological Oceanography (4 Credit Hours)
Marine organisms and their relationship to physical and chemical processes in the ocean. Laboratory study of local marine organisms, marine ecosystem and sampling techniques. Includes identification, data analysis and field trips.

OEAS 551 Data Collection and Analysis in Oceanography (4 Credit Hours)
This course introduces students to the basic oceanographic instruments used to obtain and analyze information by investigating different locations in the Chesapeake Bay. Data obtained with these instruments will be processed and analyzed using the data analysis techniques discussed in class. The data will then be used to answer a particular question related to the temporal and spatial variability in a natural system.
Prerequisites: College level statistics (at least one semester)

OEAS 553 Marine Molecular Ecology (4 Credit Hours)
This course will explore the ecology of marine organisms using molecular techniques and data. Molecular ecology covers a wide variety of sub-disciplines, including genetics, physiology, ecology, and evolution. The course will explore basic theory in population genetics, ecology, and evolution and cover nucleic acid techniques and their applications.

OEAS 566 Introduction to Mitigation and Adaptation (3 Credit Hours)
Students will be introduced to the science underpinning mitigation of human-induced changes in the Earth system, including but not limited to climate change and sea level rise, and adaptation to the impacts of these changes. The course will cover the environmental hazards and the opportunities and limitations for conservation, mitigation and adaptation. Cross listed with BIOL 566.

OEAS 567 Sustainability Leadership (3 Credit Hours)
In this class, students will discover what makes a leader for sustainability. They will consider a range of global and local crises from a leadership point of view in the context of sustainability science, which addresses the development of communities in a rapidly changing social, economic, and environmental system-of-systems environment. The course will be based on taking a problem-motivated and solution-focused approach to the challenges considered. The course includes a service learning project focusing on a leadership experience in solving a real-world environmental problem.
Prerequisites: BIOL 566 or OEAS 566

OEAS 570 Proxy Reconstruction of Late Cenozoic Climate: Calibrations and Applications (3 Credit Hours)
This course will examine recent developments in paleo-proxy calibration and their application in reconstructing Late Cenozoic climate history. Students will read several papers covering the theoretical basis and empirical evidence supporting some of the most common proxies used in paleoclimatology/ paleoceanography each week. Each week will begin with a lecture on the topic, followed by an in-depth discussion. Students will be required to present two of the weekly topics and lead the class discussion.

OEAS 595 Special Topics (1-4 Credit Hours)
Lectures, field and laboratory studies. An investigation of a selected problem in physical, geological, chemical, or biological oceanography.
Prerequisites: permission of the instructor

OEAS 603 Geobiology (3 Credit Hours)
Geobiology and the associated field of biosedimentology reflect the interdisciplinary approach to environmental problems, questions related to Earth history, and the exploration of extraterrestrial worlds. The course elaborates our understanding of geobiology and biosedimentology by conducting a study on benthic cyanobacteria and their influences on sedimentary processes in marine environments. Study area is Fisherman's Island, located close to Norfolk, VA. The course includes aspects of astrobiology (the "sister of geobiology"), and discusses the evolution of life on Earth.

OEAS 604 Introduction to Physical Oceanography (3 Credit Hours)
Introduction to descriptive and dynamical physical oceanography. Properties of sea water; distribution of temperature, salinity and density; water, salt, and heat budgets; techniques for describing the ocean; circulation and water masses of the world's oceans and coastal waters.

OEAS 605 Introduction to Ocean Modeling and Prediction (3 Credit Hours)
Instructor approval required. Introduction to concepts and theories of numerical ocean models and their applications in physical oceanography, computational fluid dynamics, environmental problems and ocean forecast systems.
Prerequisites: OEAS 505 or OEAS 604

OEAS 606 Experimental Procedures in Physical Oceanography (3 Credit Hours)
Provides basic knowledge for conducting field experiments in physical oceanography. Fundamentals of experimental design and sampling theory. Standard methods of data reduction, analysis, and reporting.

OEAS 607 Introduction to Python for Data Analysis (1 Credit Hour)
The goal of this class is to introduce students to the Python programming language, and to equip them with basic coding, data management and version control skills that will allow them to get more research done in less time and with less pain (computationally-speaking).

OEAS 610 Advanced Chemical Oceanography (3 Credit Hours)
Chemical properties of seawater; chemical composition of the ocean including major and trace elements, dissolved gases, micronutrient elements, and organic compounds; processes controlling this composition.

OEAS 611 Chemical Oceanography Laboratory (3 Credit Hours)
Basic analytical chemistry of seawater; field work in chemical oceanography.

OEAS 613 Geochemistry of Marine Sediments (3 Credit Hours)
An introduction to the geochemistry of marine sediments, with an emphasis on nutrient (C,N,P,S) and trace element cycling in marine sediments.
Prerequisites: OEAS 610 and OEAS 612

OEAS 614 Estuarine and Coastal Biogeochemical Cycles (3 Credit Hours)
Chemical dynamics within water and sediments of estuaries, salt marshes, and the continental shelf; river-sea, air-sea, and sediment-water interactions; modeling techniques.
Prerequisites: OEAS 610

OEAS 620 Advanced Geological Sciences (3 Credit Hours)
Survey of marine and terrestrial geology and geophysics; plate tectonics and basin formation; marine sediments and sediment dynamics; marine depositional environments and depositional systems; marine stratigraphy dynamics and the formation of marine basins.

OEAS 622 Wetland & Coastal Hydrogeology (3 Credit Hours)
Techniques used to calculate components of water budgets and groundwater fluxes in coastal systems, including wetlands, tidal rivers, estuaries, and shelf waters. Hydrologic criteria used to delineate wetlands. Many lab exercises will require field work in local wetlands and coastal systems.

OEAS 625 Marine Sedimentary Environments (3 Credit Hours)
Attributes of marine sediments; main sedimentary facies zones in marine and coastal environments (deep sea, shelf, tidal flats, lagoons, barrier islands); modern depositional systems versus ancient depositional systems; reefs (brachiopoda, corals, sponges, foraminifers, etc); traces and trace fossils.
Prerequisites: OEAS 620

OEAS 630 Dynamical Oceanography I (3 Credit Hours)
Dynamics of rotating, stratified fluids, geostrophic adjustment, potential vorticity, Ekman layers, gravity waves, and large scale ocean circulation.
Prerequisites: OEAS 604

OEAS 640 Advanced Biological Oceanography (4 Credit Hours)
Marine organisms and their interactions with the physical and chemical environments of the sea; primary production, population ecology, nutrition, reproduction, and marine biogeography; related laboratory exercises.

OEAS 651 Introduction to Physics of Estuaries (3 Credit Hours)
This course considers the physical oceanography of estuaries. In particular, it explores how circulation and mixing in estuaries are influenced by atmospheric forcing, tidal forcing, coastal influences and bathymetric variability. Topics to be treated include classification of estuaries, typical steady dynamical balances, transport of salt and other quantities, mixing, and time-space scales of variability.
Prerequisites: OEAS 604

OEAS 658 Participatory and Agent-Based Modeling, Simulation, and Visualization (3 Credit Hours)
Many societal challenges are “wicked problems,” i.e., social or cultural problems that are difficult or impossible to solve. The class will introduce the students to the theory of wicked problems, engage them in transdisciplinary approaches to address such problems using collaborative strategies such as participatory modeling combined with conceptual and agent-based models. Scenario-based simulations and visualizations will be used to explore possible futures and to create foresight related to wicked problems.
Prerequisites: OEAS 566/BIOL 566 or permission of the instructors

OEAS 667 Cooperative Education (1-3 Credit Hours)
Available for pass/fail grading only. May be repeated for credit. Student participation for credit based on the academic relevance of the work experience, criteria, and evaluative procedures as formally determined by the department and Career Development Services prior to the semester in which the work experience is to take place.
Prerequisites: approval by the department and Career Development Services in accordance with the policy for granting credit for Cooperative Education programs

OEAS 669 Internship in Oceanography (1-3 Credit Hours)
1-3 credits.
Prerequisites: permission of the department

OEAS 695 Special Topics in Oceanography (1-3 Credit Hours)
An advanced investigation in a selected problem in physical, geological, chemical, or biological oceanography under the direction of the faculty of the Department of Ocean, Earth and Atmospheric Sciences.

OEAS 696 Selected Topics (1-3 Credit Hours)
An advanced investigation in a selected problem in physical, geological, chemical, or biological oceanography under the direction of the faculty of the Department of Ocean, Earth and Atmospheric Sciences.
Prerequisites: permission of the instructor

OEAS 698 Research (1-9 Credit Hours)
Any semester; hours to be arranged; variable credit. 1-9 credits per semester. M.S.-level research.

OEAS 699 Thesis (1-9 Credit Hours)
Any semester; hours to be arranged; variable credit. 1-9 credits per semester. M.S.-level work primarily devoted to the writing of the thesis.

OEAS 701 Scientific Computing for Environmental Sciences (3 Credit Hours)
This course is designed for incoming graduate students in environmental science disciplines (e.g. oceanography, geography, ecology, geology, biology, etc.) to introduce modern computing software, programming tools and best practices that are broadly applicable to carrying out research in the environmental sciences. Material covered will include an introduction to Unix, programming using commonly used open-source languages (Python and R), version control and data backup, and data visualization tools for environmental data and making maps. Students will also be introduced to high performance computing and tools for analyzing 'big data' on remote clusters. This course is not discipline specific and is designed to be accessible to any students who want to work with environmental data.

OEAS 704 Time Series in Oceanography (3 Credit Hours)
A study of the basic techniques used to model and analyze time series of oceanographic data. These include temporal spatial and frequency/wave number domain techniques.
Prerequisites: calculus

OEAS 705 Advanced Environmental Data Science (3 Credit Hours)
This is an advanced computational analysis course designed to introduce students to data management and analysis methods commonly used in data science applications. The data analysis portion of the course will be primarily based on machine learning methods. The course will also give an overview of a selection of scientific databases which host freely available oceanographic data and output from numerical model simulations. This course is not discipline specific and will be useful for any students who want to work with data efficiently and gain experience in data management, proper techniques in developing analytical pipelines and applying machine learning to their research.
Prerequisites: Permission of instructor

OEAS 708 Simulation Techniques for Ocean Circulation (3 Credit Hours)
Emphasis is on the construction of working ocean models, both vorticity-stream function and primitive equation models analyzed, mostly finite difference techniques, implicit and explicit schemes, staggered grids, discussion of ocean general circulation models.
Prerequisites: OEAS 730, and knowledge of a computer program language (FORTRAN preferred)

OEAS 711 Regional Oceanography (3 Credit Hours)
The regional oceanography of the major ocean basins, marginal seas, and coastal oceans. Seasonal and interannual variability. Heat and salt cycles.
Prerequisites: OEAS 604

OEAS 730 Dynamical Oceanography II (3 Credit Hours)
Dynamics of rotating stratified fluids. Inertial waves, equatorial dynamics, coastal dynamics, dynamic instability.

OEAS 733 Marine Microbiology (3 Credit Hours)
The course covers the distribution, abundance, and biogeochemical activities of microorganisms in the oceans, with emphasis on prokaryotic microbes and viruses. Symbioses with higher organisms, and applied aspects of marine microbiology, including biofouling and corrosion, invasive species, and marine biotechnology are also addressed.

OEAS 735 Paleoclimatology (3 Credit Hours)
This course focuses on the causes (forcings) of climate change; natural response time of the climate system; interactions and feedbacks; and the geologic record in climate change.

OEAS 741 Fisheries Population Dynamics (4 Credit Hours)
An introduction to the major questions in the management of marine fisheries: abundance, estimation, distribution, recruitment and optimum yield. Topics are presented within the context of fisheries management, marine productivity and population ecology, all of which shape the direction of the primary literature.

OEAS 755 Mathematical Modeling of Marine Ecosystems (3 Credit Hours)
This course is focused on the theory and techniques of mathematical model development for marine ecosystems. The course is designed to provide an understanding of how to parameterize interaction among components of marine food webs and interaction of food web components with physical environments.

OEAS 764 Coastal Sedimentology (3 Credit Hours)
Sedimentary processes in different coastal zones will be described: carbonate, evaporitic, and clastic depositional systems. We will conduct a small research project along the coast of Virginia. Field trip required.

OEAS 765 Marine Biogeochemistry (3 Credit Hours)
This class will focus on biologically mediated elemental cycling in aquatic systems. Assimilatory and dissimilatory biological processes involving auto- and heterotrophic organisms frequently mediate elemental cycling of these elements. Inorganic compounds and dissolved and particulate organic material will be discussed in terms of their biological reactivity and turnover times in aquatic systems and their contribution to elemental cycling on a variety of temporal and spatial scales. Also included is the issue of how community structure and function alter biogeochemical cycles.

OEAS 770 Aquatic Photosynthesis (4 Credit Hours)
This course examines the physics, chemistry, biology and ecology of photosynthesis by aquatic organisms. Topics include light harvesting, energy transfer, carbon metabolism and biosynthesis and their ecological consequences.

OEAS 772 Aquatic Optics (4 Credit Hours)
The course covers the physics of light transmission through the aquatic medium as affected by scattering and absorption, the optical properties of seawater, suspended particles of living cells, underwater vision and ocean color.

OEAS 791 Seminar (1 Credit Hour)
Techniques for presenting scientific data at professional meetings and seminars. Practical experience and feedback from discussions with visiting speakers.

OEAS 795 Advanced Topics in Oceanography (1-4 Credit Hours)
An advanced investigation of a selected problem in physical, geological, chemical, or biological oceanography under the direction of the faculty of the Department of Ocean, Earth and Atmospheric Sciences.

OEAS 801 Scientific Computing for Environmental Sciences (3 Credit Hours)
This course is designed for incoming graduate students in environmental science disciplines (e.g. oceanography, geography, ecology, geology, biology, etc.) to introduce modern computing software, programming tools and best practices that are broadly applicable to carrying out research in the environmental sciences. Material covered will include an introduction to Unix, programming using commonly used open-source languages (Python and R), version control and data backup, and data visualization tools for environmental data and making maps. Students will also be introduced to high performance computing and tools for analyzing 'big data' on remote clusters. This course is not discipline specific and is designed to be accessible to any students who want to work with environmental data.

OEAS 804 Time Series in Oceanography (3 Credit Hours)
A study of the basic techniques used to model and analyze time series of oceanographic data. These include temporal spatial and frequency/wave number domain techniques.
Prerequisites: calculus

OEAS 805 Advanced Environmental Data Science (3 Credit Hours)
This is an advanced computational analysis course designed to introduce students to data management and analysis methods commonly used in data science applications. The data analysis portion of the course will be primarily based on machine learning methods. The course will also give an overview of a selection of scientific databases which host freely available oceanographic data and output from numerical model simulations. This course is not discipline specific and will be useful for any students who want to work with data efficiently and gain experience in data management, proper techniques in developing analytical pipelines and applying machine learning to their research.
Prerequisites: Permission of instructor

OEAS 808 Simulation Techniques for Ocean Circulation (3 Credit Hours)
Emphasis is on the construction of working ocean models, both vorticity-stream function and primitive equation models analyzed, mostly finite difference techniques, implicit and explicit schemes, staggered grids, discussion of ocean general circulation models.
Prerequisites: OEAS 730, and knowledge of a computer program language (FORTRAN preferred)

OEAS 811 Regional Oceanography (3 Credit Hours)
The regional oceanography of the major ocean basins, marginal seas, and coastal oceans. Seasonal and interannual variability. Heat and salt cycles.
Prerequisites: OEAS 604

OEAS 830 Dynamical Oceanography II (3 Credit Hours)
Dynamics of rotating stratified fluids. Inertial waves, equatorial dynamics, coastal dynamics, dynamic instability.

OEAS 833 Marine Microbiology (3 Credit Hours)
The course covers the distribution, abundance, and biogeochemical activities of microorganisms in the oceans, with emphasis on prokaryotic microbes and viruses. Symbioses with higher organisms, and applied aspects of marine microbiology, including biofouling and corrosion, invasive species, and marine biotechnology are also addressed.

OEAS 840 Plankton Dynamics (3 Credit Hours)
This course emphasizes the ecology of heterotrophic plankton from bacteria to protists, from metazoan invertebrate plankton to fish larvae. Students will explore the role of plankton groups and species in the context of pelagic ecosystems. Planktonic processes are not only relevant for the ocean ecosystem but also for fisheries, aquaculture, environmental and human health, and global climate. The course consists of lectures, discussion groups on selected reading material, and laboratory demonstrations.

OEAS 841 Fisheries Population Dynamics (4 Credit Hours)
An introduction to the major questions in the management of marine fisheries: abundance, estimation, distribution, recruitment and optimum yield. Topics are presented within the context of fisheries management, marine productivity and population ecology, all of which shape the direction of the primary literature.

OEAS 855 Mathematical Modeling of Marine Ecosystems (3 Credit Hours)
This course is focused on the theory and techniques of mathematical model development for marine ecosystems. The course is designed to provide an understanding of how to parameterize interaction among components of marine food webs and interaction of food web components with physical environments.

OEAS 864 Coastal Sedimentology (3 Credit Hours)
Sedimentary processes in different coastal zones will be described: carbonate, evaporitic, and clastic depositional systems. We will conduct a small research project along the coast of Virginia. Field trip required.

OEAS 865 Marine Biogeochemistry (3 Credit Hours)
This class will focus on biologically mediated elemental cycling in aquatic systems. Assimilatory and dissimilatory biological processes involving auto- and heterotrophic organisms frequently mediate elemental cycling of these elements. Inorganic compounds and dissolved and particulate organic material will be discussed in terms of their biological reactivity and turnover times in aquatic systems and their contribution to elemental cycling on a variety of temporal and spatial scales. Also included is the issue of how community structure and function alter biogeochemical cycles.

OEAS 870 Aquatic Photosynthesis (4 Credit Hours)
This course examines the physics, chemistry, biology and ecology of photosynthesis by aquatic organisms. Topics include light harvesting, energy transfer, carbon metabolism and biosynthesis and their ecological consequences.

OEAS 872 Aquatic Optics (4 Credit Hours)
The course covers the physics of light transmission through the aquatic medium as affected by scattering and absorption, the optical properties of seawater, suspended particles of living cells, underwater vision and ocean color.

OEAS 891 Seminar (1 Credit Hour)
Techniques for presenting scientific data at professional meetings and seminars. Practical experience and feedback from discussions with visiting speakers.

OEAS 895 Advanced Topics in Oceanography (1-4 Credit Hours)
An advanced investigation of a selected problem in physical, geological, chemical, or biological oceanography under the direction of the faculty of the Department of Ocean and Earth Sciences.

OEAS 898 Doctoral Research (1-9 Credit Hours)
Any semester; hours to be arranged; variable credit, 1-9 credits per semester. Ph.D.-level research.

OEAS 899 Dissertation (1-9 Credit Hours)
Any semester; hours to be arranged; variable credit, 1-9 credits per semester.Ph.D.-level work primarily devoted to the writing of the dissertation.