

# Ocean and Earth Sciences

**Web Site:** <http://www.odu.edu/oeas> (<http://www.odu.edu/oeas/>)

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The Department of Ocean and Earth Sciences offers the following undergraduate majors in Ocean and Earth Science: Oceanography, Environmental Sciences, Geology, Marine Science Technology, Secondary Earth Science Education (6-12), and Middle School Science Education (6-8). A minor in Ocean and Earth Science is also offered.

The department receives considerable support from the Commonwealth and local philanthropic sources, as well as from private industry and area citizens. Establishment of the Virginia Graduate Marine Science Consortium by the General Assembly in 1979 demonstrated the Commonwealth's determination to achieve excellence in marine science. The purpose of the consortium is to advance marine science instruction, research, training, and advisory services and to enhance Virginia's position in seeking funding to carry out these activities. Charter members of the consortium are Old Dominion University, the University of Virginia, Virginia Polytechnic Institute and State University, and the College of William and Mary. The Samuel L. and Fay M. Slover endowment to Old Dominion University in 1986 has significantly accelerated the program of marine studies. In 1991, a Center for Coastal Physical Oceanography (CCPO) was established at Old Dominion University by the Commonwealth of Virginia. The center is a Designated Center for Excellence.

The Department of Ocean and Earth Sciences is housed in two buildings. The Oceanography/Physical Sciences Building contains state-of-the-art teaching laboratories, computer facilities, and research laboratories for biological, chemical and geological oceanography. The Center for Coastal Physical Oceanography is located in the Research I building and houses all of the department's physical oceanography laboratories. The department maintains a 55-foot research vessel, the R/V Fay Slover, primarily for estuarine and coastal studies. In addition to the Slover, the department has a number of small boats suitable for near shore investigations.

## Practicum Experiences

Students in the Ocean and Earth Science majors have the chance to participate in a practicum—a hands-on, course-length experience that closely ties their classroom learning with "real life." Students in Oceanography, Geology, Environmental Science, and Marine Science Technology take OEAS 307, Research Experience in Oceanography. Students in the other majors (Secondary Earth Science Education, and Middle School Science Education) can take OEAS 307 as an upper-division elective. Students may also complete an internship (OEAS 368) with a municipal, state, or federal government agency, a non-governmental organization, or a business. In addition, Honors students may also develop a senior research project in OEAS 487.

## Professional Geologist Certification

Ocean and Earth science graduates who work for several years as geologists and then pass a national standardized test can be certified as a Professional Geologist by the Commonwealth of Virginia or other states. The standardized tests commonly cover the following topics (listed in order of emphasis on the test): Research, Field Methods, and Communications; Structural Geology; Hydrogeology; Sedimentology/Stratigraphy; Petrology; Geomorphology; Engineering Geology; Mineralogy; Geophysics; Paleontology; Geochemistry; Mining Geology; and Petroleum Geology.

## Credit by Examination

Students with prior training or experience may receive credit for three hours of OEAS 111N by passing the DANTES Physical Geology exam. Both tests are administered by the Testing Center. Because OEAS 111N is a four credit course students must also complete a physical geology laboratory course (one credit) in order to use this advanced placement credit. Interested students should contact the chief departmental advisor about this course.

Students may also refer to the Policy on Prior Learning Assessment Credit Options at the Undergraduate Level found in this Catalog.

## Programs

### Bachelor of Science Programs

- Ocean and Earth Science with a Major in Environmental Sciences (BS) (<https://catalog.odu.edu/undergraduate/sciences/ocean-earth-sciences/ocean-earth-science-environmental-sciences-bs/>)
- Ocean and Earth Science with a Major in Geology (BS) (<https://catalog.odu.edu/undergraduate/sciences/ocean-earth-sciences/ocean-earth-science-geology-bs/>)
- Ocean and Earth Science with a Major in Marine Science Technology (BS) (<https://catalog.odu.edu/undergraduate/sciences/ocean-earth-sciences/ocean-earth-science-marine-technology-bs/>)
- Ocean and Earth Science with a Major in Middle School Science Education (6-8) (BS) (<https://catalog.odu.edu/undergraduate/sciences/ocean-earth-sciences/ocean-earth-science-middle-school-education-6-8-bs/>)
- Ocean and Earth Science with a Major in Oceanography (BS) (<https://catalog.odu.edu/undergraduate/sciences/ocean-earth-sciences/ocean-earth-science-oceanography-bs/>)
- Ocean and Earth Science with a Major in Secondary Earth Science Education (6-12) (BS) (<https://catalog.odu.edu/undergraduate/sciences/ocean-earth-sciences/ocean-earth-science-secondary-education-6-12-bs/>)

### Certificate Program

- Spatial Analysis of Coastal Environments Certificate (<https://catalog.odu.edu/undergraduate/sciences/ocean-earth-sciences/spatial-analysis-coastal-environments-certificate/>)

### Minors

- Ocean and Earth Science Minor (<https://catalog.odu.edu/undergraduate/sciences/ocean-earth-sciences/ocean-earth-science-minor/>)

## Courses

### Ocean and Earth Sciences (OEAS)

#### 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, MATH 205 or MATH 211, 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 introductory 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 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 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 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 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 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 Paleoclimatology (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