

# DEPARTMENT OF ENVIRONMENTAL SCIENCES

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The department of environmental sciences (DES) offers graduate degrees in geology, biology, and environmental sciences at the master's level and in biology and environmental sciences at the doctoral level. Students entering the M.S. or Ph.D. programs are expected to have an adequate background in the natural sciences and mathematics, but may be admitted on a provisional basis if they lack such a background. Complete program details are available at the department website.

## Mission Statement

The Mission of the Department of Environmental Sciences is to conduct research to create today's environmental solutions, teach to train tomorrow's environmental leaders, and serve to promote global environmental awareness.

## General Description

The Toledo region offers potential students an ideal natural laboratory for studies in ecology, geology, and environmental sciences because it is located where unique natural habitats and landforms occur in proximity to high human population and natural resource use. Toledo is in northwestern Ohio, on the western shore of Lake Erie at the mouth of the Maumee River. The greater metropolitan area is characterized by glacial terrains, and agricultural, urban, and natural ecosystems. Local rivers, Lake Erie's productive fisheries and wetlands, the remarkable diversity of the Oak Openings savannas and woodlands, and wetland remnants of the Great Black Swamp, make the Toledo region a dynamic location for the study of environmental sciences as well as an enjoyable place to live and work.

The Department's strengths in education and research are in the areas of: Earth surface processes; aquatic, landscape, microbial, plant, soil, systems, and vertebrate ecology; and bioremediation and phytoremediation. Research in other areas of both ecology and geology is also conducted. Much of this research occurs in the Toledo region, and often in other parts of the US and the world.

## Degrees Offered

- MS in Geology (<https://catalog.utoledo.edu/graduate/natural-sciences-mathematics/departments/environmental-sciences/ms-geology/>)
- MS Environmental Science (<https://catalog.utoledo.edu/graduate/natural-sciences-mathematics/departments/environmental-sciences/ms-environmental-science/>)
- PhD in Environmental Science (<https://catalog.utoledo.edu/graduate/natural-sciences-mathematics/departments/environmental-sciences/phd-environmental-science/>)
- PhD in Biology (Ecology Track) (<https://catalog.utoledo.edu/graduate/natural-sciences-mathematics/departments/environmental-sciences/phd-biology-ecology-track/>)

- MS in Biology (Ecology Track) (<https://catalog.utoledo.edu/graduate/natural-sciences-mathematics/departments/environmental-sciences/ms-biology-ecology-track/>)
- MS in Biology (Ecology and Organismal Biology Concentration) (<https://catalog.utoledo.edu/graduate/natural-sciences-mathematics/departments/environmental-sciences/ms-biology-ecology-track/>)
- PhD in Biology (Ecology Concentration) (<https://catalog.utoledo.edu/graduate/natural-sciences-mathematics/departments/environmental-sciences/phd-biology-ecology-track/>)

### EEES 5100 Advanced Glacial and Quaternary Geology

[3 credit hours]

To provide broad geologic understanding of cyclical events including glaciation, sea level, and ice sheet paleogeography during the Quaternary Period. Also, to provide detailed geologic understanding of what a glacier is and how it shapes the landscape. Specific topics will include mass balance, ice flow, hydrology, erosion, deposition, resultant landforms, glacial lake environments, and development of the regional glacial landscape. A field trip is mandatory.

**Term Offered:** Spring

### EEES 5150 Organic Evolution

[3 credit hours]

The modern theory of evolution is presented within a general framework of biological and geological evidence focusing on the fossil record, early biomolecules, protein synthesis, genetics, phylogeny and vertebrate evolution.

**Term Offered:** Spring, Summer

### EEES 5160 Advanced Environmental Data Management

[3 credit hours]

A course in data management for environmental science graduate students covering the basics of data management practices and the use of Excel and R for data preparation, evaluation, analysis, visualization, and interpretation.

**Term Offered:** Fall

### EEES 5200 Advanced Quaternary Geology

[3 credit hours]

To provide understanding of such cyclical events as climate change, sea level fluctuations, vegetation change and ice sheet paleogeography during the Quaternary Period and to explore future changes for planet Earth.

**Term Offered:** Spring

### EEES 5220 Environmental Geochemistry

[3 credit hours]

Chemical reactions of environmental concern. Water and soil chemistry related to contaminant fate and mobility. Computer software used.

**Term Offered:** Spring

### EEES 5240 Soil Science

[3 credit hours]

Basic principles of soil formation of physics, chemistry and biology with emphasis on their influence on fluid and chemical migration and preservation of soil quality from geological, agricultural and environmental perspectives.

**Term Offered:** Spring

**EEES 5250 Soil Ecology**

[3 credit hours]

Underlying concepts and theory of modern soil ecology will be reviewed including the biogeochemical cycles and ecological functions of soil, and the effects of human activities. (Spring, alternate years, odd)

**Prerequisites:** (BIOL 3050 with a minimum grade of D- and EEES 4240 with a minimum grade of D-) or (BIOL 3050 with a minimum grade of D- and EEES 5240 with a minimum grade of D-)

**Term Offered:** Fall

**EEES 5260 Soil Ecology Laboratory**

[1 credit hour]

Laboratory exercises designed to complement the material covered in the lecture.

**Term Offered:** Fall

**EEES 5350 Ecology and Conservation of Reptiles and Amphibians**

[3 credit hours]

Ecology, diversity, evolution, and conservation of amphibians and reptiles. Lectures will discuss natural history, trait diversity, evolutionary context, and ecological implications of amphibians and reptiles. Hands-on activities will include taxonomy and identification of local species, survey and field methods, and discussions of scientific literature. Throughout this course, the biology of amphibians and reptiles will be emphasized in the context of conservation.

**Term Offered:** Spring

**EEES 5410 Hydrogeology**

[3 credit hours]

Fundamentals of groundwater/earth interactions are introduced concentrating on physical aspects of groundwater flow with applications to the field of water resources and contaminant investigations. This course is designed as the fundamental course in groundwater for students who plan to use hydrogeology in their careers, e.g., environmental geologists, civil and environmental engineers, environmental specialists and scientists, and petroleum geologists.

**Prerequisites:** MATH 1750 with a minimum grade of D- or MATH 1850 with a minimum grade of D- or MATH 1830 with a minimum grade of D- or MATH 1920 with a minimum grade of D-

**Term Offered:** Spring

**EEES 5450 Hazardous Waste Management**

[3 credit hours]

Environmental regulations concerning hazardous waste, characteristics of hazardous waste and disposal technologies, toxicology, characteristics of organic chemicals and heavy metals, biodegradation, soil science, groundwater contamination, risk assessment, site investigation.

**Term Offered:** Fall

**EEES 5480 GIS Applications in ENSC**

[3 credit hours]

An applications course focused on using GIS techniques and applications in environmental problems and research.

**Term Offered:** Fall

**EEES 5490 Remote Sensing of the Environment**

[4 credit hours]

Introduction to theory, methods and techniques used to gather and analyze remote sensor data. Topics range from low altitude air photo interpretation through satellite image acquisition.

**Prerequisites:** GEPL 3550 with a minimum grade of D- and EEES 2100 with a minimum grade of D-

**Term Offered:** Fall

**EEES 5600 Oceanography**

[3 credit hours]

An exploration of the geological, physical, chemical and biological nature of the oceans. Emphasis on the origin and evolution of ocean basins, plate tectonics, properties of seawater, and physical processes of circulation, especially as related to climate, the hydrologic cycle, and life in the oceans.

**Prerequisites:** (EEES 2100 (may be taken concurrently) with a minimum grade of C- or EEES 1010 (may be taken concurrently) with a minimum grade of C-) and (MATH 1210 (may be taken concurrently) with a minimum grade of C- or MATH 1320 (may be taken concurrently) with a minimum grade of C- or MATH 1340 (may be taken concurrently) with a minimum grade of C-)

**Term Offered:** Spring

**EEES 5610 Solid Earth Geophysics**

[3 credit hours]

Survey of theory, field applications, interpretation principles of solid earth and exploration geophysics. Two hours lecture, three hours methods laboratory.

**Prerequisites:** (PHYS 2070 with a minimum grade of D- and PHYS 2080 with a minimum grade of D- and MATH 1850 with a minimum grade of D- and MATH 1860 with a minimum grade of D-)

**Term Offered:** Spring

**EEES 5650 Advanced Geology Field Studies**

[1-4 credit hours]

Intensive field studies to various areas of geologic interest. Studies may involve various geologic field methods and descriptive techniques. Course may be repeated multiple times. Fall and Spring.

**EEES 5730 Advanced Aquatic Ecology**

[3 credit hours]

Advanced cross-disciplinary concepts in the ecology of aquatic environments emphasizing the biology of populations, communities and ecosystems. Includes a project on the application of principles and theory to help understand and solve a management problem in aquatic systems.

**Prerequisites:** EEES 3050 with a minimum grade of D-

**Term Offered:** Fall

**EEES 5740 Advanced Aquatic Ecology Laboratory**

[1 credit hour]

Laboratory exercises on the biology of aquatic populations, communities and ecosystems.

**Corequisites:** EEES 5730

**Term Offered:** Fall

**EEES 5750 Advanced Conservation Biology**

[4 credit hours]

Advanced cross-disciplinary concepts in the application of principles and theory to the study and maintenance of biological diversity in temperate, subtropical and tropical systems. Lectures, classroom discussion and readings.

**Prerequisites:** EEES 3050 with a minimum grade of D-

**Term Offered:** Spring

**EEES 5760 Advanced Landscape Ecology**

[3 credit hours]

This course is for graduate students from a variety of disciplines. Emphasis will be placed on up-to-date knowledge and methods in landscape analysis, pattern-process relationship and potential management applications at multiple spatial and temporal scales.

**Prerequisites:** EEES 3050 with a minimum grade of D-

**Term Offered:** Spring, Fall

**EEES 5790 Ecology Field Study**

[2-4 credit hours]

Field study of globally significant ecosystem(s), including analysis of structural and functional relationships within and between ecosystems. Opportunities for individual student projects.

**Prerequisites:** EEES 3050 with a minimum grade of D-

**Term Offered:** Spring, Summer

**EEES 6100 Glacial Stratigraphy And Geophysics**

[3 credit hours]

To integrate glacial sedimentology and stratigraphy, with near-surface, geophysical methodologies. Field work to collect a variety of field data to analyze in the lab is mandatory. Data to be presented as posters.

**Term Offered:** Fall

**EEES 6250 Graduate Launch**

[1 credit hour]

This course prepares graduate students for success by preparing individual study plans, research proposals and presentations, and launching bibliographic research.

**Term Offered:** Spring, Fall

**EEES 6300 Integrated Environmental & Earth Systems**

[3 credit hours]

Fundamental concepts in environmental science explored through relationships in the integrated earth system.

**Term Offered:** Spring, Fall

**EEES 6400 Biostatistics**

[4 credit hours]

Application of statistical inference with environmental and ecological data, including estimation, testing of hypotheses, and statistical modeling.

**Prerequisites:** EEES 6400 with a minimum grade of C- and EEES 5160 with a minimum grade of C- or EEES 8400 with a minimum grade of C- and EEES 6160 with a minimum grade of C-

**Term Offered:** Spring

**EEES 6440 Contaminant Hydrogeology**

[3 credit hours]

Groundwater contaminant sources, impacts, transport, geochemistry and remediation in relation to geological environments with attention to sampling, detection, characterization, modeling and aquifer protection.

**Prerequisites:** EEES 5410 with a minimum grade of D-

**EEES 6450 Advanced Applied Hydrogeology**

[3 credit hours]

Applications of hydrogeological monitoring, analyses and modeling using mathematics, statistics and computers. Subjects include: well field and pump test design, sampling strategies, data presentation and analysis and modeling fundamentals.

**Prerequisites:** EEES 5410 with a minimum grade of C

**Term Offered:** Spring

**EEES 6600 Foundations of Ecology**

[3 credit hours]

This course is a thorough review of ecological concepts for graduate students including workshops exploring classic quantitative models in ecology.

**Term Offered:** Spring, Fall

**EEES 6650 Statistical Modeling in Environmental Sciences**

[4 credit hours]

Statistical modeling techniques applied to environmental problems, with an emphasis on multilevel modeling.

**Prerequisites:** EEES 6400 with a minimum grade of D-

**Term Offered:** Spring

**EEES 6810 Writing For The Environmental Sciences**

[3 credit hours]

Learn to write papers that get cited and proposals that get funded. This course focuses on building the fundamental skills required for effective scientific writing. Writing exercises focus on improving the clarity and persuasiveness of student theses, manuscripts, and proposals. This course is for anyone who wants to improve their science writing, is writing theses or proposals, or who may have to write on the job.

**EEES 6930 Seminar**

[1 credit hour]

Individual presentation and discussion of papers in the environmental sciences.

**Term Offered:** Spring, Fall

**EEES 6960 Thesis Research**

[1-15 credit hours]

Research on a particular geologic problem leading to a written thesis which must be presented and defended before a faculty committee.

**Term Offered:** Spring, Summer, Fall

**EEES 6980 Special Topics**

[1-4 credit hours]

A graduate course covering some aspect of environmental sciences not covered in the formal graduate curriculum. Students may repeat the course for credit as topics vary.

**Term Offered:** Spring, Summer, Fall

**EEES 6990 Independent Study**

[1-4 credit hours]

Student selects an approved subject for individual study and prepares a detailed report, or gives equivalent evidence of mastering of the selected subject. Taken only as S/U.

**Term Offered:** Spring, Summer, Fall

**EEES 7730 Advanced Aquatic Ecology**

[3 credit hours]

Advanced cross-disciplinary concepts in the ecology of aquatic environments emphasizing the biology of populations, communities and ecosystems. Includes a project on the application of principles and theory to help understand and solve a management problem in aquatic systems.

**Prerequisites:** EEES 3050 with a minimum grade of D-

**Term Offered:** Fall

**EEES 7790 Ecology Field Trip**

[2-4 credit hours]

Field study of globally significant ecosystem(s), including analysis of structural and functional relationships within and between ecosystems. Opportunities for individual student projects.

**Prerequisites:** EEES 3050 with a minimum grade of D-

**Term Offered:** Spring, Summer

**EEES 8250 Graduate Launch**

[1 credit hour]

This course prepares graduate students for success by preparing individual study plans, research proposals and presentations, and launching bibliographic research.

**Term Offered:** Spring, Fall

**EEES 8300 Integrated Environmental & Earth Systems**

[3 credit hours]

Fundamental concepts in environmental science explored through relationships in the integrated earth system.

**Term Offered:** Spring, Fall

**EEES 8400 Biostatistics**

[4 credit hours]

Application of statistical inference with environmental and ecological data, including estimation, testing of hypotheses, and statistical modeling.

**Prerequisites:** EEES 6400 with a minimum grade of C- and EEES 5160 with a minimum grade of C- or EEES 8400 with a minimum grade of C- and EEES 6160 with a minimum grade of C-

**Term Offered:** Spring

**EEES 8600 Foundations of Ecology**

[3 credit hours]

This course is a thorough review of ecological concepts for graduate students including workshops exploring classic quantitative models in ecology.

**Term Offered:** Spring, Fall

**EEES 8650 Statistical Modeling in Environmental Sciences**

[4 credit hours]

Statistical modeling techniques applied to environmental problems, with an emphasis on multilevel modeling.

**Prerequisites:** EEES 6400 with a minimum grade of D- or EEES 8400 with a minimum grade of D-

**Term Offered:** Spring

**EEES 8810 Writing For The Environmental Sciences**

[3 credit hours]

Learn to write papers that get cited and proposals that get funded. This course focuses on building the fundamental skills required for effective scientific writing. Writing exercises focus on improving the clarity and persuasiveness of student theses, manuscripts, and proposals. This course is for anyone who wants to improve their science writing, is writing theses or proposals, or who may have to write on the job.

**EEES 8930 Seminar In Ecology**

[1 credit hour]

Presentation on research or current literature by graduate doctoral students, faculty or guest speakers.

**Term Offered:** Spring, Fall

**EEES 8960 Doctoral Dissertation Research**

[1-15 credit hours]

Research on a particular problem leading a written dissertation that must be presented and defended before a faculty committee.

**Term Offered:** Spring, Summer, Fall

**EEES 8980 Advanced Topics In Ecology**

[2-4 credit hours]

Course covering some aspect of ecology not covered in the formal graduate curriculum. Students may repeat the course for different topics.

**Term Offered:** Spring, Summer, Fall

**EEES 8990 Advanced Readings In Ecology**

[1-4 credit hours]

Faculty-directed readings or projects in a specific area of ecology. Students may repeat the course for different topics.

**Term Offered:** Spring, Summer, Fall