

ENVIRONMENTAL SCIENCE

The **Environmental Science** major is an interdisciplinary program that encourages students to investigate local and global environmental and sustainability issues and solutions using core courses in science, and integrative concentration courses in physical, natural and social sciences. The program emphasizes experiential learning via immersive activities such as internships, field studies, research with faculty, and community engagement. Environmental Science majors may pursue either a Bachelor of Science (B.S.) degree with a concentration in **Ecosystem Sciences** or **Geosciences**, or a Bachelor of Arts (B.A.) degree with a concentration in **Environmental and Sustainability Studies**.

In addition to the major requirements, students must complete all CASL Degree Requirements (<http://catalog.umd.umich.edu/undergraduate/college-arts-sciences-letters/>).

Major Requirements

| Code | Title | Credit Hours |
|-----------------------------------|------------------------------|--------------|
| Environmental Science Core | | |
| ESCI 101 | Environmental Science | 4 |
| ESCI 201 | Environmentalism | 4 |
| ESCI 118 | Geology I | 4 |
| ESCI/BIOL 304 | Ecology | 4 |
| ESCI 305 | Intro to GIS | 4 |
| ESCI 385 | Environmental Internship | 3 |
| or ESCI 492 | Capstone Research Experience | |
| or ESCI 498 | Indep Study in Environ Sci | |
| or ESCI 499 | Lab Research in Environ Sci | |
| ESCI 377 | Environmental Field Methods | 1-4 |
| or ESCI 420 | Advanced Field Ecology | |
| or ESCI 478 | Field Geology | |
| Total Credit Hours | | 24-27 |

Concentration

Must select one of the following concentrations: Ecosystem Sciences, Geosciences, Environmental and Sustainability Studies

Notes:

- At least 23 of the minimum 45 upper level hours in the major must be elected at UM-D.
- A maximum of 6 hrs. of independent study/research in any Dept. of Natural Sciences discipline may count towards the 120 hours required to graduate.

Concentrations

Environmental Science majors may pursue either a **Bachelor of Science (B.S.) degree with a concentration in Ecosystem Sciences or Geosciences**, or a **Bachelor of Arts (B.A.) degree with a concentration in Environmental and Sustainability Studies**.

Students must declare one of the following:

Environmental and Sustainability Studies Concentration

The following courses are required:

| Code | Title | Credit Hours |
|--|--|--------------|
| Required Prerequisite Courses: | | |
| BIOL 130 | Intro Org and Environ Biology | 4 |
| CHEM 134 | General Chemistry IA | 4 |
| STAT 263 | Introduction to Statistics | 3 |
| Required Concentration Core Courses: | | |
| ESCI 370 | Environmental Hazards | 4 |
| ESCI 372 | Energy and the Environment | 4 |
| ESCI 401 | Sustainable Cities | 4 |
| ENST 474 | Environmental Education | 2-3 |
| ESCI 486 | Environmental Interpretation | 2-3 |
| Concentration Elective Courses | | |
| Select a minimum of 17 credits from the following: | | 17-20 |
| ANTH 325 | Anth of Health and Environment | |
| CRJ 483 | Justice, Crime and Environment | |
| ECON 351 | Environmental Economics | |
| ESCI 320 | Field Biology | |
| ESCI 340 | Remote Sensing | |
| ESCI 440 | Advanced GIS | |
| ESCI 485 | Spatial Analysis | |
| FNDS 3201 | Weeds, Wastelands and the Salvation of the World | |
| GEOG 320 | Global Climate Change | |
| PHIL 312 | Environmental Ethics | |
| POL 325 | Environmental Politics | |
| POL 445 | Environmental Law | |
| POL 467 | Food Politics and Policy | |
| POL 487 | Comparative Enviro Policy | |
| URS 300 | Urban and Regional Studies | |

Ecosystem Sciences Concentration

The following courses are required:

| Code | Title | Credit Hours |
|--|---|--------------|
| Required Prerequisite Courses: | | |
| BIOL 130 | Intro Org and Environ Biology | 4 |
| CHEM 134 | General Chemistry IA | 4 |
| CHEM 136 | General Chemistry IIA | 4 |
| Select one of the following STAT, MATH options: | | |
| STAT 263 | Introduction to Statistics | 3 |
| MATH 113 & STAT 301 | Calc I for Biology & Life Sci and Biostatistics I | 8 |
| MATH 115 & STAT 301 | Calculus I and Biostatistics I | 8 |
| Required Concentration Core Courses: | | |
| ESCI 340 | Remote Sensing | 4 |
| ESCI 348 | Environmental Chemistry | 4 |
| ESCI 350 | Geomorphology | 4 |
| ESCI 440 | Advanced GIS | 4 |
| Concentration Elective Courses: | | |
| Select a minimum of 17 credits from the following: | | 17-20 |
| BIOL 333 | Plant Biology | |
| BIOL 353 | Ornithology | |

| | |
|----------|----------------------------|
| BIOL 380 | Epidemiology |
| ESCI 320 | Field Biology |
| ESCI 337 | Plant Ecology |
| ESCI 352 | Introduction to Toxicology |
| ESCI 420 | Advanced Field Ecology |
| ESCI 422 | Conservation Biology |
| ESCI 485 | Spatial Analysis |
| GEOG 320 | Global Climate Change |

Geosciences Concentration

| Code | Title | Credit Hours |
|---|---|--------------|
| Required Prerequisite Courses: | | |
| BIOL 130 | Intro Org and Environ Biology | 4 |
| CHEM 134 | General Chemistry IA | 4 |
| CHEM 136 | General Chemistry IIA | 4 |
| Select one of the following STAT, MATH options: | | |
| STAT 263 | Introduction to Statistics | 3 |
| MATH 113 & STAT 301 | Calc I for Biology & Life Sci and Biostatistics I | 8 |
| MATH 115 & STAT 301 | Calculus I and Biostatistics I | 8 |
| Required Concentration Core Courses: | | |
| ESCI 313 | Earth Materials | 4 |
| ESCI 340 | Remote Sensing | 4 |
| ESCI 348 | Environmental Chemistry | 4 |
| ESCI 350 | Geomorphology | 4 |
| ESCI 370 | Environmental Hazards | 4 |
| ESCI 372 | Energy and the Environment | 4 |
| ESCI 375 | Groundwater Hydrology | 4 |
| ESCI 440 | Advanced GIS | 4 |
| ESCI 485 | Spatial Analysis | 3 |

Minor or Integrative Studies Concentration Requirements

A minor consists of 16 credit hours of upper-level courses in Environmental Science (ESCI).

| Code | Title | Credit Hours |
|--|-----------------------|--------------|
| Required Courses: | | |
| GEOG 320 | Global Climate Change | 4 |
| ESCI 401 | Sustainable Cities | 4 |
| Elective Courses: | | |
| Select any upper-level ESCI courses (300-400 level): | | 8 |
| Total Credit Hours | | 16 |

- A minimum GPA of 2.0 is required for the minor/concentration. The GPA is based on all coursework required within the minor (excluding prerequisites).
- A minimum of 9 credits must be completed at UM-Dearborn for a 12 credit minor/concentration.
- A minimum of 12 credits must be completed at UM-Dearborn for a 15 or more credit minor/concentration.

- Courses within a minor/concentration cannot be taken as Pass/Fail (P/F)
- Only 3 credit hours of independent study or internship may be used to fulfill the requirements for a 12 credit hour minor/concentration. Only 6 credit hours of such credit may be used in a 15 or more credit hour minor/concentration.
- Minors requiring 12 credits may share one course with a major. Minors requiring 15 credits or more may share two courses with a major. This does not apply to concentrations for the Integrative Studies major.

Learning Goals

1. Have a strong background in areas of science which are relevant to environmental problems
2. Have sufficient scientific skills, knowledge, and intellectual abilities to approach future—as well as current—environmental issues
3. Have strong professional ethics
4. Be able to synthesize information obtained from different sources
5. Be able to read, understand, interpret, and critically evaluate scientific literature
6. Be able to extract useful information from oral presentations
7. Be able to write technical reports (using appropriate scientific language and concepts)
8. Be able to make oral presentations of technical information
9. Use the methodologies and models of science to select, define, solve, and evaluate problems independently and collaboratively
10. Be able to design and carry out data-collection or sampling protocols, using appropriate (and safe) laboratory and field techniques
11. Be able to design and conduct meaningful experiments
12. Be able to critically evaluate experimental data (including statistical analysis of experimental results)
13. Ask meaningful questions about real-world scientific issues
14. Make scientifically based decisions and solve problems drawing on concepts and experiences from relevant areas
15. Be able to describe phenomena with algebraic formulas, interpret graphs, and think quantitatively
16. Be able to use computers to simulate environmental processes
17. Be able to use existing information bases (library resources, computer databases, government documents, etc.)
18. Have a basic understanding of the biological and physical environment (including knowledge of physical geology, atmospheric science, and biogeography).
19. Be familiar with basic ecological concepts and ecological field methods
20. Be familiar with the techniques (and underlying theory) of analytical chemistry
21. Be familiar with geological concepts and field methods
22. Be familiar with a variety of current environmental problems and with remediation and restoration techniques that can be applied to those problems
23. Have in-depth knowledge in one of the fields of science developed in the Environmental Science Program (biology, chemistry, or earth science)

ESCI 101 Environmental Science I 4 Credit Hours

The course is an introduction to environmental science. It aims to identify the underlying concepts of environmental issues and demonstrates the interdisciplinary nature of environmental problem solving. The focus is on the scientific aspects of environmental challenges from local to global scales. Concepts from biology, chemistry, geology, and physics help to analyze these challenges and present solutions. (F, YR).

ESCI 118 Geology I 4 Credit Hours

An introduction to the study of geologic processes at work in the earth's interior and on its surface. Rocks and minerals, the origin and evolution of the continents, and the gradual and catastrophic processes that shape surface and bedrock features. Three hours lecture, three hours laboratory. (F, YR).

Corequisite(s): ESCI 118L

ESCI 201 Environmental Science II 4 Credit Hours

The course is an introduction to environmental science. It aims to identify the underlying concepts of environmental issues and demonstrates the interdisciplinary nature of environmental problem solving. The focus is on the societal aspects of environmental challenges from local to global scales, particularly on environmentalism. Concepts from environmental science, ethics, literature, history, politics, sociology, and economics help to analyze these challenges and present solutions. (W, YR).

Prerequisite(s): (CHEM 124 or CHEM 134 or CHEM 144) and GEOL 118 and BIOL 130

ESCI 218 Geology II 4 Credit Hours

A generalized study of the history of the earth, with emphasis on the fossil record of life development, the stratigraphic sequence of deposits and paleogeography. Laboratory work will include the study of geologic and topographic maps and fossils of prominent invertebrate phyla. (W, YR).

Corequisite(s): ESCI 218L

ESCI 275 Intro to Environmental Science 3 Credit Hours

A distribution course which surveys major environmental problems. Concepts discussed are ecology, environmental chemistry, methods of investigating the environment, and possible solutions to environmental problems. Three hours lecture. (YR).

ESCI 301 Environmental Science 4 Credit Hours

A survey of historical and current environmental problems, with emphasis on understanding causes, consequences, and control. Topics include human population growth, air pollution, water pollution, and waste disposal. Laboratory emphasizes an experimental approach to environmental problems, including data collection, analysis, and interpretation. Lecture and laboratory/recitation.

Prerequisite(s): (CHEM 124 or CHEM 134 or CHEM 144) and GEOL 118 and BIOL 130

ESCI 304 Ecology 4 Credit Hours

Relationships between organisms and their environments. Patterns in the physical environment, physiological and behavioral adaptations, population dynamics, energy flow, nutrient cycling; succession. Three hours lecture, four hours laboratory (with field trips). (F).

Prerequisite(s): BIOL 130 and (MATH 104 or MATH 105 or MATH 113 or MATH 115 or Mathematics Placement with a score of 116)

Corequisite(s): ESCI 304L

ESCI 305 Intro to GIS 4 Credit Hours

An introductory course that examines the digital representation, manipulation, and analysis of geographic data, with the emphasis on the analytical capabilities that GIS brings solutions to geographic problems. Students will explore and learn GIS principles using ESRI's mapping software, as well as complete a major GIS project.

Corequisite(s): ESCI 305L

ESCI 313 Earth Materials 4 Credit Hours

This course provides an overview of Earth materials. It includes topics of mineralogy, optical crystallography, igneous and metamorphic petrology and petrography as well as sedimentology and sedimentary petrology and petrography and how these rock types relate to tectonics. (W, AY).

Prerequisite(s): CHEM 134 and (GEOL 118 or ESCI 118)

ESCI 315 Aquatic Ecosystems 4 Credit Hours

An introduction to the physical, chemical, and biological characteristics of lakes, rivers, and wetlands emphasizing a comparison of ecosystem structure and function. Laboratory emphasizes data collection and analysis to characterize a representative lake, river, and wetland. Lecture and laboratory. (AY,F).

Prerequisite(s): BIOL 130 and (CHEM 134 or GEOL 118 or ESCI 118)

ESCI 320 Field Biology 4 Credit Hours

Adaptations, taxonomy, systematics, ecology, and behavior of southeastern Michigan flora and fauna. Techniques of field observation and recording are emphasized. Skills in the use of identification keys and guides are developed. The campus Environmental Study Area is used intensively. Three hours lecture, four hours laboratory (with field trips). (S).

Prerequisite(s): NSCI 120 or NSCI 233 or BIOL 130

ESCI 330 Land Use Planning and Mgmt 4 Credit Hours

Environmental aspects of land use planning, park planning, and site planning. Consideration of soils, groundwater, topography, and sensitive natural features and their role in determining land-use suitability. Examination of the mechanics and effectiveness of the planning process. Lecture and recitation. (AY,W).

Prerequisite(s): (BIOL 130 and GEOL 118) or ESCI 275

ESCI 332 Hazardous Waste Management 3 Credit Hours

Environmental problems associated with solid and hazardous waste. Regulations governing the generation, transport, and disposal of hazardous waste. Waste management techniques, including reduction, reuse, recycling, treatment, incineration, and land disposal. Three hours lecture. (AY,W).

Prerequisite(s): GEOL 118 or ESCI 275

ESCI 337 Plant Ecology 4 Credit Hours

This course focuses on different aspects of the relationship between plants and their environment. Topics include: a) interactions of plants with the physical environment; b) ways in which the environment acts to shape plant populations through evolution; c) intra- and interspecific interactions among individuals; and d) large-scale patterns and processes at the landscape-level. Four hours lecture. (W, AY).

Prerequisite(s): BIOL 130

ESCI 340 Remote Sensing 4 Credit Hours

This course introduces students to the basics of remote sensing, characteristics of remote sensors, and remote sensing applications in academic disciplines and professional industries. Students will explore the physical and mathematical principles underlying remote sensing techniques, and will practice the acquisition, processing, and visualization of remotely derived data. This course emphasizes hands-on learning through projects. (W, YR).

Restriction(s):

Can enroll if Class is Junior or Senior or Graduate

ESCI 348 Environmental Chemistry 3 Credit Hours

Description of the concepts, principles, practices, and current problems in the chemistry of natural waters, the soil, and the atmosphere. Three hours lecture. (AY,W).

Prerequisite(s): CHEM 344 and (CHEM 225 or CHEM 325)

ESCI 349 Environmental Chemistry Lab 1 Credit Hour

Collection and analysis of air, water, soil, and organisms for pollutants such as noxious gases, heavy metals, and trace organics. EPA-approved methods are emphasized. Four hours laboratory. (AY,W).

Prerequisite(s): ESCI 348* or CHEM 348*

ESCI 350 Geomorphology 4 Credit Hours

This introductory course is designed to familiarize students with the fundamentals of river behavior and the general principles in fluvial morphology, sedimentation, and hydraulics and stream bank erosion. Applications of these principles are shown utilizing a stream classification system. Problem solving techniques for watershed management, stream restoration, non-point source pollution and integration of ecosystem concepts in watershed management are presented. A combination of both lecture and field applications are provided. (W, AY).

Prerequisite(s): GEOL 118 or ESCI 118

Restriction(s):

Can enroll if Class is Junior or Senior

Can enroll if Level is Undergraduate

ESCI 352 Introduction to Toxicology 3 Credit Hours

An introduction to the principles of toxicology with an emphasis on environmental toxicology. Major topics include toxic agents, toxicological mechanisms, and use of toxicological reference literature. Discussion of chemical carcinogenesis, genetic toxicology, immunotoxicology, teratology, and toxic responses of the skin, eyes and nervous system. Three hours lecture. (AY,W).

Prerequisite(s): CHEM 225

ESCI 370 Environmental Hazards 4 Credit Hours

This course is designed in the context of geosystems sciences. It sheds light on hazardous interactions between people and the physical environment including all four spheres: lithosphere, atmosphere, hydrosphere and biosphere. It explains natural and environmental hazards such as earthquakes, volcanism, floods, mass movements, wildfires, climate change, and severe weather. Theoretical concepts are applied to case studies from around the world. (F, AY).

Prerequisite(s): ESCI 118 or GEOL 118 or ESCI 101 or ESCI 201

ESCI 372 Energy and the Environment 4 Credit Hours

This course examines renewable and non-renewable energy sources: crude oil, gas, coal, radioactive ores, hydro, solar, wind, biomass, geothermal, and others. The energy sources will be discussed in the context of their origin, energy generation and efficiency, environmental impacts, and socio-economic implications. (W, AY).

Prerequisite(s): ESCI 118 or ESCI 101 or ESCI 201 or ESCI 275 or ESCI 301

ESCI 375 Groundwater Hydrology 4 Credit Hours

Sources, occurrence, and movement of groundwater. Surface and subsurface investigations. Principles of hydrogeology. Groundwater pollution and management. Three hours lecture. (AY).

Prerequisite(s): GEOL 118

ESCI 377 Environmental Field Methods 1 Credit Hour

An intensive, off-campus field course that provides students an opportunity to observe and critically study different natural and human environments. Students learn how to collect data in a systematic way and formulate scientific inferences about environmental processes, products, and problems. Students also learn preparation techniques for conducting long days in the field under varying weather conditions and in challenging terrains. The course may be repeated for credit when destination varies. There is a mandatory pre-departure meeting and trip length is typically one to two weeks in length. (YR). (YR).

Prerequisite(s): GEOL 118 or ESCI 118

ESCI 385 Environmental Internship 1 to 9 Credit Hours

A field assignment relating to the student's environmental interests. The student will work in an off-campus government or private business for a prescribed number of hours each week to be arranged by the advisor and employer. May be repeated up to three times. Written permission of instructor. (F, W, S, YR).

Restriction(s):

Can enroll if Class is Junior or Senior or Graduate

ESCI 390 Topics in Environmental Sci 1 to 3 Credit Hours

A course in special topics current to environmental science. Topics and format may vary. See current Schedule of Classes.

ESCI 395 Sem on Environmental Issues 1 Credit Hour

Readings, discussions, and presentations which examine current environmental issues. One hour seminar. Permission of instructor. (FW).

ESCI 401 Sustainable Cities 4 Credit Hours

In 2007, for the first time in human history, the world became an urban one with more than 50 percent of its population living in cities. The unseen influx of people into cities presents socio-ecological challenges of increasing scale. Sustainability and resilience efforts in cities around the world require a multi-disciplinary approach that integrates urban-focused concepts from history, sociology, ecology, geography, and architecture and planning. Topics include, for example, smart growth, renewable energy, public inter- and inner-city transportation, recycling and zero waste, water management, green architecture, environmental and social (in)justice, cultural diversity, and urban forestry and farming. (W, AY).

Prerequisite(s): ESCI 118 or GEOL 118 or ESCI 101 or ESCI 201 or ESCI 275 or ESCI 301

ESCI 420 Advanced Field Ecology 4 Credit Hours

An intense study of behavioral ecology and field-oriented research at an advanced level, utilizing ecological habitats on campus and in surrounding urban areas. Focus will be on plant/animal interactions and will include pollination ecology, reproduction and distribution ecology, optimal foraging theory, as well as hypothesis testing of animal migration and distribution of species in extreme urban environments. Three hours lecture, four hours laboratory. (OC).

Prerequisite(s): BIOL 304 or BIOL 320 or ESCI 320

Restriction(s):

Can enroll if Class is Senior

ESCI 422 Conservation Biology 4 Credit Hours

This course is a study of the historical and current preservation of global biodiversity. The value of biodiversity, extinction, threats to biodiversity, and both ex situ and in situ conservation strategies are considered. (W, AY).

Prerequisite(s): BIOL 304 or ESCI 304

Restriction(s):

Can enroll if Class is Senior

Can enroll if Level is Undergraduate

ESCI 440 Advanced GIS 4 Credit Hours

This course offers an opportunity for students with a background in the fundamentals of geographic information systems (GIS) to apply the analytical capabilities of geospatial technology to model real-world situations in support of decision making. Particular emphasis is given to data development and management, spatial and statistical analyses, customization, and effective visualization. (W, YR).

Prerequisite(s): GEOL 305 or ESCI 305 or GEOG 305

ESCI 478 Field Geology 4 Credit Hours

Introduction to geological field methods; detailed rock descriptions, how 3-dimensional structures are visualized, described, and how maps and cross sections are constructed from field data. (F, AY).

Prerequisite(s): GEOL 118 or ESCI 118

Restriction(s):

Can enroll if Class is Sophomore or Junior or Senior

ESCI 485 Spatial Analysis 3 Credit Hours

Full Title: Spatial Analysis and the Environment The statistical methods behind analyzing spatial datasets is covered in detail, with a strong emphasis on environmental sciences and human populations. This course complements courses in remote sensing, geographic information systems, and geographic principles and is designed to quantitatively evaluate the relationships between objects and their surroundings. (S)

Prerequisite(s): GEOL 305 or ESCI 305 or GEOL 340 or ENST 340 or GEOG 302 or GEOG 202 or GEOG 305

Restriction(s):

Can enroll if College is Engineering and Computer Science or Education, Health, and Human Services or Business or Arts, Sciences, and Letters

ESCI 486 Environmental Interpretation 2 to 3 Credit Hours

Course deals with the interpretation of the environment, its characteristics, and its presentation to school groups as well as to the general public. Intended to acquaint students with a variety of skills and techniques necessary for interpreting the environment to others. Extensive use is made of the UM-Dearborn Environmental Study Area. (AY).

ESCI 490 Topics in Environmental Sci 1 to 3 Credit Hours

A course in special topics of current interest in environmental science. Topics and course format may vary; see current Schedule of Classes for availability. (OC)

ESCI 490A Topics in Environmental Sci 3 Credit Hours

Topic: Conservation Biology. A scientific study of the concept of conservation biology, including its ecological, economic, ethical, and cultural components. Lectures, assigned readings, and class discussions will explore the major threats to biodiversity, the complexities of conservation issues, and the tools, strategies, and techniques conservation biologists use to implement policies for the protection and preservation of ecosystems from local to global and short-to long-term scales.

Prerequisite(s): BIOL 130

Restriction(s):

Can enroll if Class is Junior or Senior

ESCI 490B Sustainable Cities 3 Credit Hours

Topic Title: Sustainable Cities: In 2007, for the first time in human history, the world became an urban one with more than 50 percent of its population living in cities. The unseen influx of people into cities socio-ecological challenges of increasing scale. This course is a discussion of sustainability and resilience efforts (solution-focused) in cities around the world and follows a multi-disciplinary approach by integrating urban-focused concepts from history, sociology, ecology, geography, and architecture and planning. Topics include, for example, air pollution and climate change, sprawl and smart growth, alternative energy, public transportation, waste management, water management, green architecture, environmental and social (in)justice, cultural diversity, and forestry and farming. (OC).

ESCI 492 Capstone Research Experience 3 Credit Hours

An approved research experience with a full-time Environmental Science faculty member. Research results are reported in a seminar presentation and in a poster, thesis, or a manuscript submitted for publication. (F, W, S)

Restriction(s):

Cannot enroll if Class is Freshman or Sophomore or Junior

ESCI 497 Seminar in Environmental Sci. 1 Credit Hour

Readings, discussion, and presentation of research in selected areas of study. One hour seminar. Permission of instructor. (OC).

ESCI 498 Indep Study in Environ Sci 1 to 3 Credit Hours

Library research and independent study performed under the guidance of a faculty member. Four to twelve hours readings. Permission of instructor. (F,W,S).

ESCI 499 Lab Research in Environ Sci 1 to 3 Credit Hours

Directed laboratory or field research performed under the guidance of a faculty member. Four to twelve hours laboratory. Permission of instructor. (F,W,S).

*An asterisk denotes that a course may be taken concurrently.

Frequency of Offering

The following abbreviations are used to denote the frequency of offering: (F) fall term; (W) winter term; (S) summer term; (F, W) fall and winter terms; (YR) once a year; (AY) alternating years; (OC) offered occasionally