

Environmental Science

(Bachelor of Science)

The Environmental Science major prepares students to analyze, understand, and solve environmental problems. While many universities are just beginning to recognize the need for environmental science programs, UW-Green Bay has over 50 years of teaching and research experience in the field. This Environmental Science program was one of the first in the nation and the interdisciplinary focus allows students to have a diverse education.

The Environmental Science major is interdisciplinary, emphasizing an integrated approach to knowledge in the field. Because the study of environmental problems requires a sound understanding of scientific principles, the Environmental Science major is grounded in the natural sciences and mathematics. The curriculum also includes a social science component, enabling students to gain an understanding of environmental economic and policy issues. Field experiences, internships, practicums, independent research and travel courses are also emphasized throughout the program.

This major helps students: 1) understand fundamental physical and biological processes of the natural environment; 2) recognize relationships between humans and ecosystems at local, regional, and global scales; 3) apply knowledge from multiple disciplines to environmental challenges and opportunities; 4) build practical skills for scientific problem-solving, including familiarity with laboratory and field instrumentation, ability to use current computer technologies, and experience in statistical modeling techniques; 5) demonstrate competency in collecting, managing, evaluating, interpreting, and communicating information through hands-on research; and 6) critically evaluate strategies for sustainable management and restoration of environmental systems.

Students who plan to pursue this major will apply science and mathematics in their course work. Courses in biology, chemistry, geoscience, mathematics, and physics provide the needed background. They receive hands-on and practical learning experiences in both the laboratory and the field. A significant number of graduates of this major gain entry-level positions in the environmental science field. About one-third of these positions are in the public sector and two-thirds are in the private sector, including positions with industry, business, and engineering consulting firms. Numerous graduates have also successfully completed master's and doctoral degrees.

Faculty members are actively addressing current environmental problems and their solutions through research at the regional, national and international levels. This research keeps them up to date on current trends and topics in the field, while providing opportunities for undergraduates to become involved in their research projects and gain valuable knowledge and experience. Faculty members are highly involved in the students' education, both inside and outside of the classroom and laboratories.

Environmental Science students have access to modern computer facilities which are continually upgraded. Computing software resources emphasizing geographic information systems (GIS), mathematical modeling and statistical analysis tools also are available. In addition to general-access computer laboratories, students can also use a computer laboratory dedicated to the sciences. Students wishing to gain hands-on field experiences have access to the Cofrin Center for Biodiversity, which includes the 290-acre Cofrin Memorial Arboretum on campus and several natural areas in the region including Point au Sable, Tofts Point and Kingfisher Farms. The Gary A. Fewless Herbarium, and the Richter Museum of Natural History on campus include extensive collections of plant and animal specimens. Funding opportunities are also available through the Biodiversity Center for independent student research projects.

A variety of equipment is available for environmental measurements and monitoring. Laboratory instrumentation enhances student opportunities to perform chemical analyses which are important in environmental monitoring. Such instrumentation includes mass spectrometers, infrared and UV-visible spectrophotometers, nuclear magnetic resonance spectrometers, gas chromatographs, ion chromatographs, and high-performance liquid chromatographs. In addition to opportunities to monitor air and surface-water quality, students also have the opportunity to monitor ground water; three wells have been drilled on campus specifically for that purpose.

As industries recognize their responsibility to help create and maintain a sustainable environment, often achieving efficiencies in the process, they create positions dealing with waste management, pollution reduction, and other environmental responsibilities. Many UW-Green Bay Environmental Science graduates find employment in these industries or go on to advanced study in environmental science or other scientific disciplines. The following list represents some careers that have been pursued by Environmental Science graduates: agricultural scientist, botanist, ecologist, forest ranger, oceanographer, agricultural technician, engineering technician, forester, air and water quality manager, environmental analyst, park ranger, air pollution analyst, environmental consultant, environmental educator, geologist, project manager, environmental engineer, geophysicist, biologist, hazardous waste manager, hydrologist, environmental lawyer, chemical technician, soil conservation technician, chemist, management consultant, teacher, meteorologist, urban and regional planner, civil engineer, environmental planner, microbiologist/wastewater plant operator, natural resource specialist, wildlife manager, conservationist, zoologist.

Students may study abroad or at other campuses in the United States through UW-Green Bay's participation in international exchange programs and National Student Exchange. Travel courses are another option for obtaining academic credits and completing requirements. For more information, contact the Office of International Education at (920) 465-2190 or see <http://www.uwgb.edu/international/>.

- Environmental Science Major (<http://catalog.uwgb.edu/archive/2018-2019/undergraduate/programs/environmental-science/major>)

- Environmental Science Minor (http://catalog.uwgb.edu/archive/2018-2019/undergraduate/programs/environmental-science/minor/env_sci)
- International Environmental Studies Minor (<http://catalog.uwgb.edu/archive/2018-2019/undergraduate/programs/environmental-science/minor/international>)

The following curriculum guide is for a four-year Environmental Science degree program and is subject to change without notice. Students should consult an Environmental Science program advisor to ensure that they have the most accurate and up-to-date information available about a particular four-year degree option.

- Environmental Science Major Curriculum Guide (<http://catalog.uwgb.edu/archive/2018-2019/undergraduate/programs/environmental-science/cg>)

Cooperative Program in Civil & Environmental Engineering with University of Wisconsin-Milwaukee

Advisers — John Katers, professor; Patricia A. Terry, professor and coordinator

Website: www.uwgb.edu/nas/

Dual Degree Program

UW-Green Bay and UW-Milwaukee also offer a Dual Degree Program in environmental science and civil and environmental engineering. Under this program a student completes three years of study in the Environmental Science major at UW-Green Bay, then transfers to UW-Milwaukee and continues for two years in the civil/environmental engineering major. Upon completion of an outlined series of courses, the student receives both a B.S. degree from UW-Green Bay in Environmental Science and a B.S. degree from UW-Milwaukee in Civil/Environmental Engineering. Students wishing to enroll in this program should see an engineering adviser prior to registration in their freshman year.

Participants in the NEW Engineering Program typically complete 60 to 72 credits at UW-Green Bay toward the degree. This includes the completion of 18 credits of general education requirements specific to this program:

- 3 credits minimum in the arts
- 6 credits minimum in the humanities
- 6 credits minimum in the social sciences
- 3 credits in cultural diversity

General education courses are required of all students. These courses complement and enhance major coursework for additional exposure to other areas of knowledge and bring an understanding of the relationship among and between subject areas. At least 9 of the 18 required credits must be from courses at the 200-level or above or from 100-level courses that require at least one prerequisite.

A grade of C or better in ENG COMP 105 will satisfy UW-Milwaukee's English composition requirement.

UW-Green Bay students are eligible to apply for advancement into the major at UW-Milwaukee at the point of transfer. The UW-Green Bay Academic Advising Office has forms. The filing deadlines are October 1 for spring semester, February 15 for summer session, and June 1 for fall semester.

For information on other engineering options, refer to the Preprofessional Programs of Study section of this catalog or contact one of the engineering advisers listed above.

Requirements for the Cooperative Program

All engineering and dual degree majors must take:

Code	Title	Credits
Required Courses		
CHEM 211	Principles of Chemistry I	4
CHEM 212	Principles of Chemistry II	4
CHEM 213	Principles of Chemistry I Laboratory	1
CHEM 214	Principles of Chemistry II Laboratory	1
ENG COMP 100	English Composition I: College Writing	3
ENGR 213	Mechanics I	3
ENGR 214	Mechanics II	3
ENGR 301	Engineering Materials	4
MATH 202	Calculus and Analytic Geometry I	4
MATH 203	Calculus and Analytic Geometry II	4
MATH 209	Multivariate Calculus	4
PHYSICS 201	Principles of Physics I	5

PHYSICS 202	Principles of Physics II	5
Total Credits		45

See an adviser for additional requirements in aerospace, chemical, nuclear, and petroleum engineering.

Gregory J Davis; Professor; Ph.D., Northwestern University*

Mathew E Dornbush; Professor; Ph.D., Iowa State University*

Michael L Draney; Professor; Ph.D., University of Georgia, chair*

Heidi S FencI; Professor; Ph.D., The Ohio State University*

Kevin J Fermanich; Professor; Ph.D., University of Wisconsin - Madison*

Robert W Howe; Professor; Ph.D., University of Wisconsin - Madison

John F Katers; Professor; Ph.D., Marquette University*

John A Luczaj; Professor; Ph.D., Johns Hopkins University*

Gary L Miller; Professor; Ph.D., Mississippi State University

Patricia A Terry; Professor; Ph.D., University of Colorado*

Amy T Wolf; Professor; Ph.D., University of California - Davis*

Michael E Zorn; Professor; Ph.D., University of Wisconsin - Madison*

Franklin M Chen; Associate Professor; Ph.D., Princeton University*

Ryan M Currier; Associate Professor; Ph.D., Johns Hopkins University*

Patrick S Forsythe; Associate Professor; Ph.D., Michigan State University*

Woo Jeon; Associate Professor; Ph.D., University of Wisconsin - Madison

Michael J McIntire; Associate Professor; Ph.D., University of California - Riverside

Steven J Meyer; Associate Professor; Ph.D., University of Nebraska - Lincoln*

Julie M Wondergem; Associate Professor; Ph.D., Marquette University

Lisa Grubisha; Assistant Professor; Ph.D., University of California - Berkeley

Jeremy J Intemann; Assistant Professor; Ph.D., Iowa State University

Mohammad Mahfuz; Assistant Professor; Ph.D., University of Ottawa

Tetyana Malysheva; Assistant Professor; Ph.D., University of Oklahoma

Megan J Olson-Hunt; Assistant Professor; Ph.D., University of Pittsburgh

Brian Welsch; Assistant Professor; Ph.D., Montana State University

Theresa E Adsit; Senior Lecturer; M.S., University of Wisconsin - Milwaukee

Mary E Guy; Senior Lecturer; M.S., University of Wisconsin - Oshkosh

James M Meyer; Senior Lecturer; Ph.D., University of North Carolina

Nydia D Villanueva; Senior Lecturer; Ph.D., University of Connecticut

Courses

ENV SCI 102. Introduction to Environmental Sciences. 3 Credits.

Examines the interrelationships between people and their biophysical environment, including the atmosphere, water, rocks and soil, and other living organisms. The scientific analysis of nature and the social and political issues of natural resource use.

Fall and Spring.

ENV SCI 198. First Year Seminar. 3 Credits.

Reserved for New Incoming Freshman.

ENV SCI 260. Energy and Society. 3 Credits.

The issues relating energy and society rather than energy technology per se: global energy flows; sources of energy; energy-related problems, policy and conservation; energy growth; future scenarios.

Fall and Spring.

ENV SCI 299. Travel Course. 1-4 Credits.

Travel courses are conducted to various parts of the world and are led by one or more faculty members. May be repeated to different locations.

P: cons of instr & prior trip arr & financial deposit.

ENV SCI 301. Radioactivity: Past, Present, and Future. 3 Credits.

Radioactive isotopes play a significant role in many aspects of the natural and human environments. People are affected throughout their lives by natural and anthropogenic isotopes at local, national, and global scales. From radon in houses and radium in local drinking water supplies to fallout from Chernobyl, humans are directly impacted through health, economic, and technological pathways.

REC: HS chemistry or earth science, or Geosci 102 with at least a C grade

Fall Only.

ENV SCI 302. Principles of Ecology. 4 Credits.

Ecological principles governing interactions of plants and animals in their physical and biotic environments. Focuses on organisms and their environment, populations, communities, ecosystems, and global dimensions.

P: Math 104 or Math Placement of Math 202 or greater; Math 260 or enrolled concurrently in Math 260; Biology 203 all with a C or better

Fall and Spring.

ENV SCI 303. Environmental Sustainability. 3 Credits.

Principles of environmental sustainability rooted in interdisciplinary and systems perspectives; sustainability of our natural resource system; natural chemical, physical and biological systems which affect and influence sustainable practices; politics and economics of environmental sustainability.

P: None. REC: Env Sci 102

Fall and Spring.

ENV SCI 305. Environmental Systems. 4 Credits.

Physical and chemical aspects of natural environmental processes. The movement, transformation, and fate of materials and contaminants.

P: Chem 212 with at least a C grade and Geosci 202 with at least a C grade and Math 104 with at least a C grade and Biology 201/202 with at least a C grade.

Fall and Spring.

ENV SCI 318. Pollution Control. 3 Credits.

Government regulations, manufacturing processes, waste minimization, pollution prevention methods and pollution control techniques of major industries.

P: Chem 212 with at least a C grade.

Fall Only.

ENV SCI 320. The Soil Environment. 4 Credits.

The physical, chemical and biological properties and principals of soils; formation, classification and distribution of major soil orders; function and management of soils in natural, agricultural and urban environments. Includes field and laboratory experiences.

P: Chem 108 with at least a C grade or 212 with at least a C grade; REC: Geosci 202.

Fall Only.

ENV SCI 323. Pollution Prevention. 3 Credits.

Emphasizes principles of pollution prevention and environmentally conscious products, processes and manufacturing systems. Also addresses post-use product disposal, life cycle analysis, and pollution prevention economics.

P: Env Sci 318 with at least a C grade, OR instructor consent

Spring Odd.

ENV SCI 330. Hydrology. 3 Credits.

Study of the principal elements of the water cycle, including precipitation, runoff, infiltration, evapotranspiration and ground water; applications to water resource projects such as low flow augmentation, flow reregulation, irrigation, public and industrial water supply and flood control.

P: GEOSCI 202 with a grade of C or better and MATH 104 or higher

Fall Only.

ENV SCI 334. Solid Waste Management. 3 Credits.

This course will focus on technical concepts of solid waste management related to the design and operation of landfills, waste-to-energy systems, composting facilities, recycling facilities, and other emerging waste management technologies.

P: ET 202

Spring Odd.

ENV SCI 335. Water and Waste Water Treatment. 3 Credits.

Water and waste water treatment systems, including both sewage and potable water treatment plants and their associated collection and distribution systems. Study of the unit operations, physical, chemical and biological, used in both systems.

P: Geosci 202 with at least a C grade or Chem 211 with at least a C grade or Biology 201/202 with at least a C grade.

Spring.

ENV SCI 336. Environmental Statistics. 2 Credits.

This course emphasizes the principles of data analysis using advanced statistical software (such as R, SAS, etc.). It employs primarily environmental examples to illustrate procedures for elementary statistical analysis, regression, analysis of variance and nonparametric statistics.

P: Math 260

Fall and Spring.

ENV SCI 337. Environmental GIS. 2 Credits.

This is a project based course where students conduct geospatial data manipulation, analysis and management with a suite of GIS software tools and web-based GIS interfaces. Students will learn about a range of applications of remotely sensed and other geospatial data to natural science problems. Through the course project, students will create a functional GIS to study or model an environmental phenomena or problem.

P: PU EN AF 250 or concurrent enrollment. REC: GEOSCI 202

Fall and Spring.

ENV SCI 338. Environmental Modeling. 2 Credits.

This course introduces the fundamental concepts and approaches in dynamic modeling of environmental systems, in which system changes through time are a concern. The course will be focused on the creation, analysis, and interpretation of dynamic models within the framework of systems thinking for exploring a variety of environmental problems. Throughout the course, we will use the STELLA software as a tool to assist us in modeling of environmental systems.

P: Math 104, 202 or 203

Fall Only.

ENV SCI 339. Scientific Writing. 2 Credits.

This course focuses on key elements of scientific writing, including grammar, attention to audience, and building a logical argument. Students will develop their writing skills through mock grant applications, reports, and journal articles.

Fall and Spring.

ENV SCI 401. Stream Ecology. 4 Credits.

The goal of this course is to develop a profound understanding of the abiotic and biotic processes responsible for shaping the ecosystem in running waters. Focus will be on ecological processes, but nutrient dynamics and fluid mechanics are also important issues as well as the fauna associated to the streambed, mainly macro invertebrates and their ecological role. Theory will be combined with hands on experience providing the student with a tool to manage a stream based on ecological principles.

P: Biology 203

Fall Even.

ENV SCI 403. Limnology. 4 Credits.

Limnology is a broad sub-discipline of ecology that is the study of the structural and functional interrelationships of organisms of inland waters as they are affected by their dynamic physical, chemical and biotic environments. In this course, we will examine the dominant organizing principles and the current conceptual advances in the field of limnology focusing on lakes.

P: Biology 203

Fall Odd.

ENV SCI 415. Solar and Alternate Energy Systems. 3 Credits.

Study of alternate energy systems which may be the important energy sources in the future, such as solar, wind, biomass, fusion, ocean thermal, fuel cells and magneto hydrodynamics.

P: Physics 104 with at least a C grade or 202 with at least a C grade.

Spring Even.

ENV SCI 421. Geoscience Field Trip. 1-3 Credits.

Intensive three or four-day field study tour of the geology, soils, and landscapes of Wisconsin and/or surrounding states. Each offering will focus on a different geological theme and will focus on a specific region. Cost of transportation, guidebook, meals and lodging borne by student.

P: Geosci 202 with at least a C grade OR Consent of the instructor.

Fall and Spring.

ENV SCI 424. Hazardous and Toxic Materials. 3 Credits.

The handling, processing, and disposal of materials which have physical, chemical, and biological properties that present hazards to human, animal, and plant life; procedures for worker safety and for compliance with regulations. The metals and nonmetals, carcinogens, radioactive materials, and pathogenic human, animal, and plant wastes.

P: CHEM 212

Spring Odd.

ENV SCI 425. Global Climate Change. 3 Credits.

Examines changes in global climate with emphasis on the processes by which climate change occurs. Focuses on the recent changes in the concentration of atmospheric greenhouse gases and their impact on the earth's global energy budget. Examines the potential environmental impact of a changed climate.

P: Geosci 222 with at least a C grade or Env Sci 102 with at least a C grade.

Spring.

ENV SCI 432. Hydrogeology. 3 Credits.

Introduction to the geological and physical principles governing ground water flow. Description of aquifer properties, chemical processes, equation of flow, well hydraulics, and environmental concerns.

P: Geosci 202 with at least a C grade; REC: Env Sci 330 with at least a C grade; Math 202.

Spring.

ENV SCI 433. Ground Water: Resources and Regulations. 3 Credits.

An overview of the geology, properties, flow, and pollution of ground water systems. Techniques of aquifer characterization and water quality monitoring are introduced and evaluated. Regulatory and policy approaches to moderate use and ensure adequate high quality supplies of this valuable resource in the future are also reviewed.

P: GEOSCI 202

Fall Even.

ENV SCI 460. Resource Management Strategy. 3 Credits.

Application of the principles of systems analysis to the sustainable use of material and energy resources. Emphasis on use of analytical tools of economics (e.g. costs-benefit, cost-effectiveness, and risk-benefit analysis) and the process of public policy making and implementation.

REC: background in econ and conservation.

Fall and Spring.

ENV SCI 464. Atmospheric Pollution and Abatement. 3 Credits.

This course will provide students an understanding of atmospheric processes and weather patterns and how they affect pollutant transport. Sources, sinks, environmental effects, and abatement technologies for air pollutants will be addressed. Atmospheric reactions that create pollution or deplete stratospheric ozone will be included.

P: CHEM 212 and CHEM 214 and ET 201

Fall Odd.

ENV SCI 467. Capstone in Environmental Science. 4 Credits.

A project-based course in which students address a practical application of scientific and mathematics skills in the environmental sciences. Topics vary.

P: Env Sci 302 with at least a C grade or 305 with at least a C grade, and Math 260 with at least a C grade

Fall and Spring.

ENV SCI 469. Conservation Biology. 4 Credits.

Overview of the major issues and ecological principles underlying the field of conservation of biology, including patterns and measurement of biological diversity from genetic to community scales.

P: Env Sci 302 with at least a C grade or consent of instructor

Fall Only.

ENV SCI 478. Honors in the Major. 3 Credits.

Honors in the Major is designed to recognize student excellence within interdisciplinary and disciplinary academic programs.

P: min 3.50 all cses req for major and min gpa 3.75 all UL cses req for major.

Fall and Spring.

ENV SCI 490. EMBI Co-Op/Experience. 3 Credits.

Required component of the Certificate in Environmental Sustainability and Business. Enrolled students will be placed by EMBI in a business, nonprofit, or governmental setting that involves interdisciplinary problem solving within an environmental sustainability context. This will be a special co-op/ internship/project experience.

P: Junior standing and enrollment in Environmental Sustainability and Business certificate program.

ENV SCI 491. Senior Thesis/Research in Environmental Science. 3-4 Credits.

A project-based capstone experience where individual students address a specific aspect of the environmental sciences through the use of scientific and mathematical skills.

P: Env Sci 302 with at least a C grade or 305 with at least a C grade; Math 260 with at least a C grade; instr consent. REC: Env Sci 302 and 305.

Fall and Spring.

ENV SCI 492. Practicum in Environmental Science. 1-4 Credits.

A project-based course in which students address a practical application of scientific and mathematics skills in the environmental sciences. Topics vary.

P: Env Sci 302 with at least a C grade or 305 with at least a C grade, and Math 260 with at least a C grade. REC: Env Sci 302 and 305

Fall and Spring.

ENV SCI 497. Internship. 1-12 Credits.

Supervised practical experience in an organization or activity appropriate to a student's career and educational interests. Internships are supervised by faculty members and require periodic student/faculty meetings. All internships must be taken P-NC.

P: jr st and gpa $>$ or $=$ 2.75 and completion of 3 UL cses in maj or min.

Fall and Spring.

ENV SCI 498. Independent Study. 1-4 Credits.

Independent study is offered on an individual basis at the student's request and consists of a program of learning activities planned in consultation with a faculty member. A student wishing to study or conduct research in an area not represented in available scheduled courses should develop a preliminary proposal and seek the sponsorship of a faculty member. The student's advisor can direct him or her to instructors with appropriate interests. A written report or equivalent is required for evaluation, and a short title describing the program must be sent early in the semester to the registrar for entry on the student's transcript.

P: fr or so st with cum gpa $>$ or $=$ 2.50; or jr or sr st with cum gpa $>$ or $=$ 2.00.

Fall and Spring.

ENV SCI 499. Travel Course. 1-6 Credits.

Travel courses are conducted to various parts of the world and are led by one or more faculty members. May be repeated to different locations.

P: cons of instr & prior trip arr & financial deposit.