

## Key to Course Listings

**Catalog numbers** are part of a University-wide numbering system. Generally, courses numbered 100 to 199 are introductory, 200-299 are intermediate, and 300-499 are advanced (upper-level).

**Reorganized or renumbered courses** are denoted by a parenthetical number in boldface following the course number. When renumbering or reorganization has left the SUBJECT unchanged, only the previous catalog number is given; if the SUBJECT has also changed, the previous SUBJECT name and course number appear. A reorganized or renumbered course cannot be repeated for credit without special permission.

**Cross-listed courses** are sponsored by more than one department or program and may be elected in any of the participating units. Cross-listings appear in boldface and are denoted by a slash between the participating units.

**Course titles** appear in boldface after the catalog number.

**Prerequisites** appear in italics after the course title. Some prerequisites are advisory. They suggest the assumed background or level of academic experience, and students should be guided by these statements. Some prerequisites are mandatory and are enforced at the point of registration. The *Course Guide* and the *LS&A Bulletin* indicate the cases when prerequisites are enforced.

Prerequisites are of three types:

- *Courses*. Unless otherwise stated, the phrase "or equivalent" may be considered an implicit part of the prerequisite for any course. When a student has satisfactorily completed a course(s) at the required level of competency and when that course is believed to be substantially equivalent to one listed as a prerequisite, the student must consult the instructor or department. If equivalency is determined to have been satisfied, election may be approved by issuance of electronic permission.
- *Class standing* (first year, sophomore, junior, senior). A course might be appropriate for "first and second year students only," or for "juniors and seniors."
- *Permission of instructor*. The phrase "or permission of instructor" may be considered an implicit part of the statement of prerequisites for any course. When permission is a stated requirement, or when a student does not have the stated prerequisite for a course but can give evidence of sufficient background, the student should obtain approval from the instructor or department concerned and an electronic permission issued.

**The Credit Symbol**, an Arabic numeral in parentheses, denotes the credits earned for the course. Credit is granted in semester hours. Except for small seminars where the reading and/or writing requirements are intensive, one credit represents no less than one hour of class meeting time each week of the term, and usually represents two hours of work outside of class for each class hour.

**Area distribution designation** is approved by the LS&A Curriculum Committee on a yearly basis. A course may be approved with the designation natural science (*NS*), social science (*SS*), humanities (*HU*), mathematical and symbolic analysis (*MSA*), creative expression (*CE*), interdisciplinary (*ID*), or excluded from distribution (*Excl*).

**Courses meeting certain college requirements** are so listed. Language other than English (*LR*) courses may be used toward meeting the Language Requirement. The First-Year Writing Requirement may be met by courses designated (Introductory Composition). Courses approved with the designation "Language Requirement" or "Introductory Composition" may not be used as part of an area distribution plan. If an introductory language course is designated "Excluded" (*Excl*), it may not be used to satisfy the LS&A language requirement. (*BS*) means that the course may be used toward the 60 approved credits required for the B.S. degree. Courses meeting or partially meeting the Quantitative Reasoning

requirement are designated (*QR/1*) or (*QR/2*). Courses with standard approval for meeting the Race & Ethnicity (*R&E*) requirement are so indicated. Other courses may meet the R&E or QR requirements on a term-by-term basis and are listed on the LS&A website (<http://www.lsa.umich.edu/>).

**Experiential, Independent Study, and Tutorial** courses are so designated. (See Experiential and Directed Reading/Independent Study Courses in *Chapter IV*.)

**Repetition** of a course that varies in content from term to term is permitted only under certain conditions. When a department or program has a policy about the repetition of a course for credit, that policy is included in the course listing. The general statement "May be repeated for credit with permission" usually means "With permission of a concentration advisor." In all other instances, a student must get permission from both the department or program and the Academic Standards Board to repeat a course for credit. Generally, a course may be elected for credit once only.

**Excluded combinations of course elections** are designated in the listing of affected courses.

**Special Grading pattern** for a course is indicated in the course listing. Some LS&A courses are offered *mandatory credit/no credit*. (See Non-Graded Courses in *Chapter IV*.)

**The Term Symbol**, a Roman numeral, denotes the term(s) some courses are offered. The University year is divided into three terms: Fall (I), Winter (II), and Spring-Summer (III). The Spring-Summer Term is further divided: Spring-Half (IIIa) and Summer-Half (IIIb).

### Courses That Count Toward Graduate Programs

*Courses Approved for Regular Rackham Graduate Credit*. All courses taken in fulfillment of Rackham degree requirements must be approved for Rackham graduate credit. Be certain that any courses you plan to take--especially those numbered in the 400s--are approved for Rackham credit before you enroll in them. The Graduate School policy on courses is as follows: Courses at the 400 level and above are acceptable for graduate credit if they have been approved by the Graduate School.

If you are uncertain whether or not a course is approved for Rackham credit, check with the department offering the course or with the Rackham Course Approval Officer (764-8221).

If you elect a course that has not been approved for Rackham graduate credit, the course will appear on your university transcript with the notation "Not for Graduate Credit. The course grade will appear on the transcript, but it will not be averaged into your cumulative grade point average or your credit toward program (CTP) total.

*Courses Not Approved for Graduate Credit*. Courses at the 300 level and below are not acceptable for graduate credit, without exception. Undergraduate level foreign language courses may occasionally be used in fulfillment of some departmental foreign language requirements.

Under unusual circumstances you may petition to receive graduate credit for a course not normally approved for graduate credit (*e.g.*, such as an undergraduate course where you will be expected to perform more advanced work than the undergraduates). Because there is no guarantee of approval, you should submit your petition to the Graduate School's Office of Academic Records and Dissertations (OARD) before taking the course. Your petition must be endorsed by the course instructor and by the graduate chair of your department or program, and it must include an explanation for requesting the exception. You will be expected to perform graduate level work in the course, and the petition must show how this will be accomplished. You may obtain a petition form from your department, from OARD, or online.

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**Program in the Environment****Environment****Environment** ENVIRON 367

LSA

Program in the Environment

Environment

<http://environment.lsa.umich.edu/environ/>**Undergraduate Courses****110 ENVIRON 110(UC 110) / BIOLOGY 110 / GEOSCI 171 / AOSS 171 / ENSCEN 171.****Introduction to Global Change: Physical Processes.**

(4,4) : May not be repeated for credit.

(NS). (BS).

*I.*

The University of Michigan offers an interdisciplinary three-term introductory course sequence which investigates the causes and potential impacts of these changes using a combination of traditional lecture-based and modern web-based teaching methodologies. In this course, students learn about the evolution of the universe, Earth, our changing environment and our planet's living organisms. Students apply learned knowledge by using systems modeling software to investigate the dynamics of natural systems.

**111 ENVIRON 111(UC 111) / GEOSCI 172 / SOC 111 / GEOG 111 / AOSS 172 / ENSCEN 172.****Introduction to Global Change: Human Impacts.**

(4,4) : May not be repeated for credit.

(SS).

*No credit for seniors. II.*

In this course, students study the explosive growth of human population, and the impacts on land, air, water and energy resources, and on biological diversity produced by human advances in technology and institutions. We also examine the political and policy considerations of a more sustainable future. Global Change II is appropriate for all students and assumes no prior background. It can be taken without prior enrollment in Global Change I. Homework and laboratories use computer-based spatial analysis, encourage students to write critically and promote personal interaction with expert faculty from NRE, LS&A and Engineering.

**116 ENVIRON 116 / GEOSCI 116.****Introductory Geology in the Field.**

(6) : May not be repeated for credit.

(NS). (BS).

*Reduced credit if taken: GEOSCI 117/ENVIRON 117 receive 2 credits; GEOSCI 119 or 120 or ENVIRON 119 or 120, 3 credits; GEOSCI 205 and GEOSCI 206/ENVIRON 206, 4 credits; one of GEOSCI 205 OR GEOSCI 206/ENVIRON 206, 5 credits. IIIb at Camp Davis, Wyoming.*

An introduction to geology in the field, this course is the equivalent of ENVIRON 117 or GEOSCI 121 but is taught at Camp Davis, the University's Rocky Mountain Field Station near Jackson, Wyoming. The principles and procedures involved in the study of earth materials and processes are stressed. Minerals, rocks, and fossils are studied in their natural settings. Lectures are given both in camp and in the field, but a majority of time is spent outdoors in the nearby Teton, Hoback, Gros Ventre, and Snake River Ranges. Trips are also taken to areas of special significance including the Wind River Range, Craters of the Moon, and Yellowstone Park. Lectures, laboratory, and extensive field studies. Contact the department at 2534 C.C. Little Building between November and February for application form and more detailed information.

**118 ENVIRON 118 / GEOSCI 118.****Introductory Geology Laboratory.**

(1,1) : May not be repeated for credit.

(NS). (BS).

*Prior or concurrent enrollment in ENVIRON 119, or GEOSCI 205 and ENVIRON 206, or GEOSCI 135. No credit if completed an introductory course in geology (GEOSCI 116, 117 or 218, or ENVIRON 116, 117).I and II.*

A one-term laboratory course covering the laboratory portion of ENVIRON 117. Provides background in physical aspects of geological materials.

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- 119 **ENVIRON 119 / GEOSCI 119.**  
**Introductory Geology Lectures.**  
 (4,4) : May not be repeated for credit.  
 (NS). (BS).  
*No credit granted if completed or enrolled in GEOSCI 116, 117, 120 or ENVIRON 116, 117, 120. No credit granted if completed both GEOSCI 205 and GEOSCI 206/ENVIRON 206. Only 3 credits with GEOSCI 205 or GEOSCI 206/ENVIRON 206.I and II.*  
 Consists of lectures shared with ENVIRON 117 but does not include the laboratory section. A separate discussion section is also scheduled to ensure continuity with class material and student-teacher contact. Students interested in a one-term laboratory introductory science course should elect ENVIRON 117. Lectures and discussion.
- 120 **ENVIRON 120 / GEOSCI 120.**  
**Geology of National Parks and Monuments.**  
 (4,4) : May not be repeated for credit.  
 (NS). (BS).  
*No credit if completed GEOSCI 116, 117, 119 or ENVIRON 116, 117, 119, or both GEOSCI 205 AND GEOSCI 206/ENVIRON 206. Only 3 credits with GEOSCI 205 or GEOSCI 206/ENVIRON 206. II.*  
 This course approaches earth history by examining the geology of places rather than geological processes. There are three lectures each week and one two-hour demonstration. Lecture material covers the geologic history of selected National Parks and Monuments chosen so that those in which the oldest rocks are exposed are discussed first. The demonstrations provide first-hand experience with rocks, minerals, and fossils and an opportunity to discuss these in small groups.
- 139 **ENVIRON 139.**  
**First-Year Seminar in the Environment.**  
 (3) : May not be repeated for credit.  
 (ID).  
*Only first-year students, including those with sophomore standing, may pre-register for First-Year Seminars. All others need permission of instructor. I and II.*  
 Seminar on environmental topics for first-year students.
- 160 **ENVIRON 160.**  
**Habitats and Organisms: Terrestrial Ecosystems.**  
 (3) : May not be repeated for credit.  
 (NS). (BS).  
 II.  
 Introduces students to fundamental principles of terrestrial ecology and ecosystem management. Gives examples of common habitats in North America, emphasizing the vegetative components. Another focus is on various types of organisms that comprise these terrestrial communities. Finally, examines current threats to the health of terrestrial ecosystems and challenges present in ecosystem management.
- 201 **ENVIRON 201.**  
**Ecological Issues.**  
 (4) : May not be repeated for credit.  
 (NS). (BS).  
 A non-laboratory course incorporating ecological principles and concepts underlying the management and use of natural resources, with consideration of socio-economic factors and institutional roles. Throughout the course, emphasis is placed on the importance of interdisciplinary approaches to matters concerning the allocation of natural resources and the quality of our environment.
- 206 **ENVIRON 206 / GEOSCI 206.**  
**How the Earth Works: the Water Cycle and Environment.**  
 (2,2) : May not be repeated for credit.  
 (NS). (BS).  
*No credit granted to those who have completed or are enrolled in GEOSCI 116, 117, 119, 120 or ENVIRON 116, 117, 119, 120. Those with credit for GEOSCI 109 may only elect ENVIRON 206 for 1 credit.*  
 Earth surface processes as they affect water and the global biogeochemical environment. Quantifies rates of water and elemental exchange between major earth surface reservoirs. Surface rock weathering and geochemical exchange described.

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- 210 **ENVIRON 210.**  
**Introduction to Environmental Policy Making.**  
 (3) : May not be repeated for credit.  
 (Excl).  
*I.*  
 Introduces social, political, and organizational processes that influence and shape environmental and natural resources policy. Topics include the legislative processes; agency functioning and behavior; interest-group activity; interaction in the political arena; the role and influence of technical information, public opinion, historical antecedent, and prevailing social conditions and institutions.
- 211 **ENVIRON 211.**  
**Social Sciences and Environmental Problems.**  
 (4) : May not be repeated for credit.  
 (SS).  
*II.*  
 Introduces a variety of social sciences and how they can contribute to understanding and addressing environmental problems. The first half of the course surveys the social sciences using environmental case studies. The second half applies concepts and tools from the social sciences to address a specific environmental problem.
- 212 **ENVIRON 212(UC 212).**  
**Introduction to Global Change III: Studies of Global Sustainability.**  
 (4,4) : May not be repeated for credit.  
 (SS).  
*ENVIRON 110 and 111. II.*  
 This course builds on the foundation laid by the first two Global Change courses, through in-depth examination of case studies integrating natural and human aspects inherent in Global Change issues. Students integrate previously learned materials with new lecture material and discussions, and modern simulation tools. Expert faculty in the topic of each module (from NRE, LS&A , Public Health, Engineering, Information) will guide students' exploration of each case in a discussion format. The topics covered include human health impacts of global change, water resources, implications of land settlement, and the Framework Convention on Climate Change. In order to register for Global Change 3, a student must have completed both Global Change 1 and 2 or have completed one and be registered for the other.
- 222 **ENVIRON 222(492).**  
**Introduction to Environmental Justice.**  
 (3) : May not be repeated for credit.  
 (SS).  
*I.*  
 This course explores people of color environmental concerns and specifically focuses on the connection between communities of color and low-income groups and the location of hazardous waste sites. This course also explores Native American environmental issues and the connection between the transboundary shipping of hazardous waste from developed countries to developing ones.
- 232 **ENVIRON 232 / GEOSCI 222.**  
**Introductory Oceanography.**  
 (3,3) : May not be repeated for credit.  
 (NS). (BS). (QR/2).  
*No credit granted to those who have completed or are enrolled in AOSS 203.*  
 The oceans of earth, their circulation, biology, chemistry, geology of the sea floor, and marine resources. Emphasis is on understanding the oceans as a single ecosystem.
- 233 **ENVIRON 233 / GEOSCI 223.**  
**Introductory Oceanography, Laboratory.**  
 (1,1) : May not be repeated for credit.  
 (NS). (BS). (QR/2).  
*Concurrent enrollment in ENVIRON 232.*  
 Laboratory course to be elected concurrently with ENVIRON 222. One three-hour lab each week.

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- 256 **ENVIRON 256 / ANTHRCUL 256.**  
**Culture, Adaptation, and Environment.**  
 (3) : May not be repeated for credit.  
 (SS).  
*II.*  
 Course provides an introduction to anthropological perspectives on the relationships of human societies to their environments. The methods and perspectives of sociocultural anthropology, systems ecology, and behavioral ecology are explored through the use of case studies. Topics include the behavioral ecology of Homo sapiens; comparative studies of foraging, tribal, *etc.*
- 263 **ENVIRON 263(ENVRNSTD 263) / RCNSCI 263 / UP 263.**  
**Energy and the Environment.**  
 (4,4) : May not be repeated for credit.  
 (NS). (BS).  
*Two and one-half years of high school mathematics, or any college course in mathematics or natural science.*  
 Introduces the concepts of energy and the environment which then serve as a basis for discussion of pollution, scarcity of resources, possible technological catastrophe, and man's future.
- 270 **ENVIRON 270.**  
**Our Common Future: Ecology, Economics & Ethics of Sustainable Development.**  
 (4,4) : May not be repeated for credit.  
 (Excl).  
*I.*  
 An interdisciplinary foundation of the concepts and strategies of sustainability from an ecological, economic, and socio-political perspective. The quest for sustainable development is the most critical, yet challenging, issue of our times. Defining what sustainable development is and how it ought to be accomplished is profoundly influencing government, academics, business, science, and people's culture and livelihoods at the local, national, and global levels.
- 281 **ENVIRON 281 / BIOLOGY 281.**  
**General Ecology.**  
 (3,3) : May not be repeated for credit.  
 (NS). (BS).  
*BIOLOGY 162 and a laboratory course in chemistry. No credit granted to those who have completed or are enrolled in EEB 381.*  
 The course introduces the basic concepts and principles of ecology as applied to the study of individuals, populations, and communities of both plants and animals.
- 284 **ENVIRON 284 / GEOSCI 284.**  
**Environmental Geology.**  
 (4,4) : May not be repeated for credit.  
 (NS). (BS).  
*No credit granted to those who have completed or are enrolled in GEOSCI 148. Those with credit for GEOSCI 147 may only elect GEOSCI 284/ENVIRON 284 for 3 credits.*  
 Deals with interactions between people and Earth. It begins with an introduction to geologic materials and processes and goes on to specific topics such as soil, surface and groundwater, natural hazards (volcanism, landslides, earthquakes, floods, coastal processes), geomedicine, and waste disposal.
- 300 **ENVIRON 300.**  
**Special Problems and Research.**  
 (1-4,1-4) : May be repeated for credit for a maximum of 8 credits.  
 (Excl). (INDEPENDENT).  
*Consent of instructor required (Prerequisites enforced at registration).*  
 Independent study covering different resource issues.

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- 302 **ENVIRON 302.**  
**Topics in Environmental Social Science.**  
 (3-4) : May be elected for a maximum of 12 credits. May be elected more than once in the same term.  
 (Excl).  
*I and II.*  
 Special topics course seeks to examine environmental problems and issues from a social science perspective. Specific topics vary term to term.
- 303 **ENVIRON 303.**  
**Topics in Environmental Natural Science.**  
 (3-5) : May be elected for a maximum of 12 credits. May be elected more than once in the same term.  
 (Excl).  
*I and II.*  
 Special topics course seeks to examine environmental problems and issues from a humanities perspective. Specific topics vary term to term.
- 304 **ENVIRON 304.**  
**Topics in Culture and Environment.**  
 (3-4) : May be elected for a maximum of 12 credits. May be elected more than once in the same term.  
 (Excl).  
*II.*  
 Special topics course seeks to examine environmental problems and issues from a natural science perspective. Specific topics vary term to term.
- 310 **ENVIRON 310.**  
**Toxicology: The Study of Environmental Chemicals and Disease.**  
 (3) : May not be repeated for credit.  
 (NS). (BS).  
*Introductory Biology and Chemistry. II.*  
 Explores the relationship between environmental chemical exposures and adverse health consequences, examining factors that determine and influence toxicity, such as chemical dose and structure, metabolism, and the age and genetic make-up of the individual. The role of chemical exposure in the etiology of specific diseases, such as cancer, birth defects, and neurological disorders, is described. The assessment of risk to human health from chemicals is discussed. This course aims to improve students abilities to interpret the risk to human health from exposure to environmental chemicals. It is intended for non-toxicology students.
- 311 **ENVIRON 311 / EEB 320.**  
**Rivers, Lakes, and Wetlands: Introduction to Aquatic Ecosystems.**  
 (4,5) : May not be repeated for credit.  
 (NS). (BS).  
*One course in biology. Laboratory fee (\$35) required. II and IIIa at the Biological Station.*  
 Field and lecture based introduction to the scientific study of rivers, lakes, and wetlands. Introduces basic physical/chemical/biological concepts and techniques; emphasized ecological literacy and seeks to develop interpretive skills and reasoning. Includes overview of aquatic fauna and flora, and a survey of the ecology of major types of rivers and streams, lakes, wetlands, and ocean estuaries. Interactions between the hydrological cycle, the landscape, and human activities provide the basic theme around which ecosystem presentations are organized. Lab sections develop basic chemical and biological identification skills during the first half of the course; the second half focuses on weekly field trips to representative ecosystems and their ecological evaluation.
- 312 **ENVIRON 312(NRE 480) / POLSCI 380.**  
**Environmental Politics and Policy.**  
 (3) : May not be repeated for credit.  
 (Excl).  
 This course is an advanced offering on environmental politics and the environmental policy-making process. The course considers both processes of policy formation and implementation, placing particular emphasis on the development of alternatives to conventional regulatory practices at federal, state, and local levels of government.

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- 315 **ENVIRON 315 / EEB 315.**  
**The Ecology and Evolution of Infectious Diseases.**  
 (3) : May not be repeated for credit.  
 (NS). (BS).  
*BIOLOGY 100 or 162. I.*  
 Introduces the population ecology and evolution of parasites and disease-causing agents impacting human, animal, and plant health. The emphasis is on patterns of temporal change and spatial spread at the population level. Main themes include the impact of environmental change, particularly in climate, on infectious diseases, the connection between biodiversity and health, the role of disease in conservation, and the co-evolution of hosts and parasites.
- 317 **ENVIRON 317.**  
**Conservation of Biological Diversity.**  
 (3) : May not be repeated for credit.  
 (Excl). (BS).  
 Overview of historic and present-day causes of species extinction, and of biological principles central to species conservation and sustainable management of ecosystems. Topics covered include episodes of extinction and diversification over earth history; geographic distribution strategies; and sustainable use of ecosystems. Satisfies the upper-level writing requirement.
- 318 **ENVIRON 318(ENVRNSTD 311) / RCIDIV 318.**  
**Food, Land, and Society.**  
 (6) : May not be repeated for credit.  
 (ID).  
*Consent of instructor required (Prerequisites enforced at registration). One year of college-level biology, environmental science or environmental studies; general ecology recommended.*  
 The course is a field-based introduction to ecology, especially as it applies to agricultural ecosystems; to the cultural and environmental history of food-production systems, especially in Michigan; and to the current ecological and socioeconomic crises in agriculture, especially as they affect biodiversity and the sustainability of rural communities.
- 320 **ENVIRON 320.**  
**Environmental Journalism: Reporting About Science, Policy, and Public Health.**  
 (3) : May not be repeated for credit.  
 (Excl).  
*Completion of the First-Year Writing Requirement. I.*  
 This course gives students the basic research and writing skills to cover emerging issues related to the environment and public health. Students learn to produce journalistic writing, which differs markedly from academic writing. The emphasis is on communicating to a wide audience. Students also become more savvy news consumers.
- 325 **ENVIRON 325 / GEOSCI 325.**  
**Environmental Geochemistry.**  
 (3,3) : May not be repeated for credit.  
 (NS). (BS).  
*Introductory chemistry.*  
 This course deals with the geochemistry of our environment. It focuses on the geochemistry of the lithosphere, hydrosphere and atmosphere and the ways in which they affect the biosphere. Applications of these principles to present-day problems in environmental geochemistry are discussed.
- 335 **ENVIRON 335 / CAAS 322.**  
**Introduction to Environmental Politics: Race, Class, and Gender.**  
 (4,3) : May not be repeated for credit.  
 (SS). (R&E).  
 Analyzes the role of race, gender and class in defining environmental issues and environmental action.
- 336 **ENVIRON 336 / CAAS 332 / NRE 336.**  
**Environment and Inequality.**  
 (4) : May not be repeated for credit.  
 (SS). (R&E).  
 This course explores the relationship between environment and social inequality. It focuses on American urban environments. The course examines how educational experiences impacts occupational and social class outcomes.

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- 337 **ENVIRON 337 / EEB 355.**  
**Woody Plants I: Biology and Identification.**  
 (4) : May not be repeated for credit.  
 (Excl). (BS).  
*BIOLOGY 162. Laboratory fee (\$75) required. I.*  
 The identification of trees, shrubs, and vines is the basis for the study of their biology and ecology. Woody plants are studied in their natural habitats and communities. Non-native species and ornamental plants are taught in Nichols Arboretum, Main Campus, and Saginaw Forest. An introduction to the biology and ecology of woody plants is given in lectures. Topics include vegetative and reproductive morphology, fruit types, life history, forest ecology, variation, systematics, conifers, and winter identification. Also discussed are important trees of southern and western U.S., of Europe and the Tropics.
- 341 **ENVIRON 341 / GEOSCI 341.**  
**Ecosystem Science in the Rockies.**  
 (5) : May not be repeated for credit.  
 (NS). (BS).  
*Introductory course in geology, ecology, or global change. IIIb at Camp Davis, Wyoming.*  
 A four week course taught at Camp Davis, WY, using the Rocky Mountains as a field laboratory to gain field-based knowledge and experience while developing an understanding of geological and meteorological processes and the distribution and function of grasslands, forests, and alpine ecosystems of the region. The course is designed for concentrators in geological and environmental sciences, natural resources, and other students who have a general interest in the subject matter. Contact the department in 2534 C.C. Little Building for application form and more detailed information.
- 345 **ENVIRON 345.**  
**Environmental Public Opinion Analysis.**  
 (3) : May not be repeated for credit.  
 (SS).  
 Examines trends in environmental public opinion, influences on people's concerns about the environment, the depth and strength of concerns, and how environmental concerns affect personal behaviors and the political process. It also introduces students to useful statistical concepts and procedures for analyzing and interpreting public opinion data.
- 348 **ENVIRON 348 / EEB 348.**  
**Forest Ecosystems.**  
 (5) : May not be repeated for credit.  
 (NS). (BS).  
*BIOLOGY 162, or two BIOLOGY courses III B at the Biological Station.*  
 Focused on ecology of forest species and components of ecological systems, this course emphasizes hands-on field study in diverse upland and wetland forests. It stresses integrating topography, soil, climate, and vegetation, plus the dynamics of fire and regeneration ecology. This ecocentric approach is applicable in temperate forest ecosystems throughout the world.
- 350 **ENVIRON 350.**  
**The Built Environment: Introduction to Landscape Change.**  
 (3) : May not be repeated for credit.  
 (Excl).  
*II.*  
 An introduction to the role of humans in shaping the built environment. It explores physical design and cultural meaning at various scales and contexts in the landscape. We explore the power of physical design and planning to enrich the human spirit, provide functional needs, interpret cultural history, and sustain natural systems.
- 360 **ENVIRON 360 / PSYCH 384.**  
**Behavior and Environment.**  
 (3) : May not be repeated for credit.  
 (Excl).  
*I.*  
 This course deals with two central themes: First, environmental problems are people problems, requiring an understanding of how people think, what they care about, and the conditions under which they behave most reasonably. Second, human behavior makes the most sense when studied in the context of the environment both present and evolutionary. The course builds a model of human nature based upon research in the field of environmental psychology.

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361 **ENVIRON 361 / PSYCH 385.****The Psychology of Environmental Stewardship.**

(3) : May not be repeated for credit.

(Excl).

*II.*

One of the enduring challenges of crafting a sustainable society is to create one in which people will want to live. A restrained and austere existence will likely prove to be an ecologically necessity. It is unlikely, however, that people will eagerly pursue such a life if it is presented as the unfortunate necessity of survival. The issue here is how to reframe and then promote such a future so that people not only willingly accept it but actually seek it out. This is primarily a behavioral, not a political or technological, challenge. To meet this challenge behavior change tools and strategies are developed.

365 **ENVIRON 365.****International Environmental Policy.**

(3) : May not be repeated for credit.

(Excl).

This course explores institutions, actors and outcomes in international environmental policymaking. It examines international dimensions of industrialized and developing country policies and considers normative and ethical issues, effects of political and economic power, institutional setting and world views. Special attention is given to negotiations in bilateral, regional, and global contexts; and to actors ranging from superpowers to small states, international organizations to non-governmental actors. An effort is made to identify the key actors, processes, and institutional arrangements necessary to address critical transboundary environmental problems. The focus is on key actors and the processes by which disputes are or can be managed. The course uses extensive readings, case studies and simulations and applies a variety of theoretical perspectives on international affairs.

367 **ENVIRON 367(465/NRE 465).****Global Enterprise and Sustainable Development.**

(3) : May not be repeated for credit.

(Excl).

Examines how businesses can influence, and are influenced by, issues related to sustainable development. The course identifies external forces and strategy based reasons that motivate corporations to contribute to environmental and social goals. Through guest lectures and case studies, students learn about current best practice and future possibilities.

370 **ENVIRON 370 / UP 423 / ARCH 423.****Introduction to Urban and Environmental Planning.**

(3,3) : May not be repeated for credit.

(Excl).

A comprehensive introductory course. Methods and processes in governmental planning and development of human activity systems requiring space, capital, and management components in the metropolitan environment. Major topics include: space and location planning, zoning and subdivision regulations, urban form and design, new town planning, housing urban renewal, transportation, metropolitan intergovernmental relations, comprehensive urban developmental planning, population and economic planning studies, planning techniques and methods. Emphasis is placed on recent developments and emerging problems.

375 **ENVIRON 375 / ECON 370.****Environmental and Resource Economics.**

(3,3) : May not be repeated for credit.

(SS).

*ECON 101. No credit granted to those who have completed or are enrolled in ECON 471 or 472. II.*

An introduction to environmental and natural resource economics. Topics include externalities, unpriced goods, cost-benefit analysis, resource scarcity, exhaustible resource depletion, renewable resource harvesting, and common property problems.

376 **ENVIRON 376.****Environmental Ethics.**

(3) : May not be repeated for credit.

(HU).

*I.*

Environmental ethics investigates the ways in which humans value nature and explores systems of thought that articulate a variety of human responsibilities to animals, living things, species, and ecosystems. Such systems include anthropocentrism and its e-centric cousins (ecocentrism, biocentrism, zoocentrism, etc.) as well as movements such as deep ecology and ecofeminism.

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- 377 **ENVIRON 377(ENVRNSTD 407).**  
**Literature and the Environment.**  
 (3,3) : May not be repeated for credit.  
 (HU).  
*II.*  
 An examination of the relation between culture and environment, and the ways in which culture creates environmental attitudes and social proprieties. The course begins with definitions of culture and the history of cultural idealism, and works toward the location of social values within various cultures, including our own.
- 380 **ENVIRON 380(ENVIRON 280/ENVRNSTD 280) / GEOSCI 380.**  
**Mineral Resources, Economics, and the Environment.**  
 (4,4) : May not be repeated for credit.  
 (NS). (BS). (QR/2).  
*No previous courses in geology or other sciences are required. II.*  
 This course deals with mineral resource-related problems in a complex society. The course discusses the origin, distribution, and remaining supplies of mineral resources in terms of the economic, engineering, political, and environmental factors that govern their recovery, processing, and use. Topics covered include nuclear waste disposal, strip mining, continent-scale water transfers, mineral profits and taxation, and estimation of remaining mineral reserves.
- 382 **ENVIRON 382(481/NRE 481) / EDCURINS 382.**  
**Introduction to Environmental Education and Sustainable Development.**  
 (3) : May not be repeated for credit.  
 (Excl).  
 As a result of this course, students become certified by the School of Education to teach leading environmental education programs. They learn how to educate a citizenry able and willing to work toward environmental and sustainable development goals, as well as how to develop, implement, and evaluate their own education efforts.
- 391 **ENVIRON 391 / RCIDIV 391.**  
**Sustainability and the Campus.**  
 (3,3) : May not be repeated for credit.  
 (Excl).  
*An introductory course in environmental studies, global change, or related field (e.g., ENVIRON 201, 240, 270).*  
 This course covers the concepts and practice of environmental sustainability as they pertain to the campus of this university. Students design and conduct projects about managing this campus more sustainably than is currently practiced.
- 396 **ENVIRON 396 / CAAS 396.**  
**History of Environmental Thought and Activism.**  
 (3) : May not be repeated for credit.  
 (Excl).  
 This course uses a race, class, and gender approach to examine the history of American environmental activism (1850-Present). It identifies the major period of environmental activism among the middle class, white working class, and people of color.
- 398 **ENVIRON 398.**  
**Environment Internship Program.**  
 (1-3,1-3) : May be repeated for credit for a maximum of 9 credits.  
 (Excl). (EXPERIENTIAL).  
*Consent of instructor (Prerequisites enforced at registration). Offered mandatory credit/no credit.*  
 Undergraduate students, under the guidance of a faculty advisor, participate in an internship relevant to their field of study.
- 399 **ENVIRON 399.**  
**Junior Honors Seminar.**  
 (3) : May not be repeated for credit.  
 (Excl).  
*Consent of instructor required (Prerequisites enforced at registration). II.*  
 This course starts SNRE Honors students on their research projects. During the term students develop a topic of interest into a research proposal. This requires identifying the topic, accessing pertinent literature, finding a faculty sponsor, developing a research design, and writing a research proposal. Course readings and discussions focus on research methodology and dissemination of research findings.

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414 **ENVIRON 414(ENVRNSTD 415) / RCNSCI 415.****Science and Politics.**

(4) : May not be repeated for credit.

(Excl). (BS).

*One college-level science course.*

Introduction to historical, political, and technical dimensions of policy systems guiding U.S. scientific research and technical development. Examines issues and controversies and social dimensions of scientific knowledge.

490 **ENVIRON 490 / POLSCI 463.****War and the Environment: A Lethal Reciprocity.**

(3) : May not be repeated for credit.

(Excl).

*Coursework in environment or political science. II.*

This seminar examines war and environmental degradation. We begin with the recognition that: a) war and the preparation for war typically lead to depletion and degradation of the biosphere; and b) resource mal-distributions, depletion, and degradation can frequently lead to armed conflict within and between territorial states.

499 **ENVIRON 499 / NRE 499.****Senior Honors Thesis.**

(1-6,1-6) : May be repeated for credit for a maximum of 6 credits.

(Excl). (INDEPENDENT).

*Consent of instructor required (Prerequisites enforced at registration). ENVIRON 399.*

With the aid of the course instructor and faculty sponsor, the research plan developed in the Junior Honors Seminar is implemented and data/information is collected, analyzed, and synthesized. An oral presentation is made and the thesis is submitted to the faculty sponsor.

**Undergraduate and Graduate Courses**403 **ENVIRON 403 / HISTART 403 / NRE 403.****History of Human Interaction with the Land.**

(3;3) : May not be repeated for credit.

(Excl).

*Laboratory fee (\$30) required. II.*

The course surveys the design and management of human settlements and their surrounding landscapes throughout history. The range of examples and sites are viewed within the context of the cultural, political, social and environmental forces which shaped them, and also their lingering effect on 20th century perceptions of the landscape.

409 **ENVIRON 409 / EEB 487 / NRE 409.****Ecology of Fishes.**

(3-4,3-4;3,3) : May not be repeated for credit.

(Excl). (BS).

*One course in ecology. II.*

Physiological, behavioral, and numerical responses of fish to biotic and abiotic factors. The relationships between fish and the physical, chemical, and biological parameters of the major habitat types is emphasized, especially in regards to the adaptations of fish for survival under these different constraints.

411 **ENVIRON 411 / NRE 411.****Fluvial Ecosystems.**

(4;4) : May not be repeated for credit.

(Excl).

*ENVIRON 311, and an upper-level aquatic ecology or hydrology course. Laboratory fee (\$70) required. I.*

Introduces key concepts and theory pertinent to understanding and managing fluvial ecosystems (rivers and streams). Emphasis on rivers as largescale physical and biological systems; properties and processes. Laboratory includes intensive comparative field study of distinctive types of Michigan rivers.

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- 415 **ENVIRON 415 / NRE 415 / EEB 424.**  
**Behavioral Ecology and Conservation Biology.**  
 (4;4) : May not be repeated for credit.  
 (Excl). (BS).  
*BIOLOGY 162. No credit granted to those who have completed or are enrolled in EEB 492.*  
 This course focuses on the ways environments shape the behavior and life histories of animals. Because environments pose constraints, behaviors have "better" and "worse" impacts on an organism's survival and reproduction.
- 416 **ENVIRON 416 / NRE 416 / EEB 425.**  
**Field Skills in Wildlife Behavior.**  
 (2,2;2,2) : May not be repeated for credit.  
 (Excl). (BS).  
*Concurrent enrollment in ENVIRON 415. No credit granted to those who have completed or are enrolled in EEB 492. Laboratory fee (\$40) required.*  
 Students gain field skills in testing behavioral ecological hypotheses. Field work stresses repeatable, quantitative observation, generation of testable hypotheses, graphical and statistical data analyses, and oral and written communication.
- 418 **ENVIRON 418 / NRE 418.**  
**Biology and Management of Insects.**  
 (2-4;2-4) : May not be repeated for credit.  
 (Excl). (BS).  
*Module 1: 2 credits; modules 1 and 2: 3 credits, or modules 1, 2, and 3: 4 credits. II.*  
 Introduction to systems, problems, and current topics of the insect world. Examines relationships of insects to woody plants, other animals, their environment, and each other. Systematically and integratively examines pests of functional plant parts. Selected topics: insect structure and function, adapted features, IPM, control techniques, and insects and their impacts in a variety of ecosystems.
- 422 **ENVIRON 422 / NRE 422 / EEB 440.**  
**Biology of Fishes.**  
 (3,3;3,3) : May not be repeated for credit.  
 (Excl). (BS).  
*BIOLOGY 162 and one additional biology course. I.*  
 An introduction to the science of ichthyology including selected aspects of the anatomy, physiology, natural history, ecology, classification, and evolution of fishes and the dynamic relations of fishes to humans. Also involving field study, collection and identification of local forms.
- 423 **ENVIRON 423 / EEB 441 / NRE 423.**  
**The Biology of Fishes Laboratory.**  
 (1,1;1,1) : May not be repeated for credit.  
 (Excl). (BS).  
*BIOLOGY 162 and one additional biology course. Laboratory fee (\$50) required.*  
 Laboratory providing an introduction to the field methods used in fish biology and fisheries, and examining the diversity of the Michigan ichthyofauna and major groups of world fishes.
- 430 **ENVIRON 430 / EEB 489 / NRE 430.**  
**Soil Ecology.**  
 (3,3;3,3) : May not be repeated for credit.  
 (Excl). (BS).  
*BIOLOGY 162 and chemistry. Concurrent enrollment in ENVIRON 337 and 435 highly recommended. Laboratory fee (\$30) required. I.*  
 Soils as central components of terrestrial ecosystems. Major emphasis on physical and chemical soil properties and their relationships to soil-resource problems: soil-plant relations, site productivity, soil mapping and classification, forest and crop management, soil erosion, pollution effects, and biogeochemical cycling. Quantitative analysis and interpretation of soil data are stressed in lecture and laboratory. Forested soils are a major focus, although soils of other ecosystems are also examined.

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- 433 **ENVIRON 433 / EEB 433 / NRE 433.**  
**Ornithology.**  
 (4,4;4,4) : May not be repeated for credit.  
 (Excl). (BS).  
*BIOLOGY 162. Laboratory fee (\$75) required. I.*  
 Introduction to the biology of birds. Lectures on behavior, migration, breeding biology, population ecology, and relationships. Laboratory and field work on identification of local birds and their behavior and ecology.
- 437 **ENVIRON 437 / GEOSCI 427.**  
**Environmental and Technological Applications of Mineralogy.**  
 (3;3) : May not be repeated for credit.  
 (Excl). (BS).  
*GEOSCI 231/232, comparable courses in the solid-state, or the approval of the instructor.*  
 This course introduces basic principals of mineralogy and materials science with their application to environmental and technological problems. Topics include phase transitions, corrosion and alteration, trace element behavior, colloids and surfaces. Materials discussed include clays, soils, cement, zeolites, and actinide/toxic metal phases.
- 441 **ENVIRON 441 / NRE 441.**  
**Remote Sensing of the Environment.**  
 (4;4) : May not be repeated for credit.  
 (Excl). (BS).  
*II.*  
 Use of aircraft and satellite remote sensors for inventory, monitoring and assessment of Earth's ever changing resources. Problem analysis to determine which remote sensing systems can supply needed data and determination of cost-effective approaches to problem solution. Case studies from several fields.
- 451 **ENVIRON 451 / NRE 451 / EEB 451.**  
**Biology of Mammals.**  
 (4,4;4,4) : May not be repeated for credit.  
 (Excl). (BS).  
*BIOLOGY 162. Laboratory fee (\$75) required. I. (Offered in alternate years).*  
 Evolution, distribution, ecology, behavior, anatomy, and classification of mammals, with emphasis on North American species. Lecture, laboratory, and seminar.
- 455 **ENVIRON 455 / NRE 455.**  
**Lab in Field Ecology.**  
 (5;5) : May not be repeated for credit.  
 (Excl).  
*A course in ecology or advanced undergraduate biology, and permission of instructor. Laboratory fee (\$120) required.*  
 This is a field course, emphasizing observation and hypothesis formation in ecology.
- 457 **ENVIRON 457 / NRE 457.**  
**Plant Physiological Ecology.**  
 (4;4) : May not be repeated for credit.  
 (Excl). (BS).  
*Calculus and one course in ecology. II.*  
 Examines the physiology of plant environmental responses to understand whole-plant and ecosystem ecology. The focus is on biophysical and biochemical principles relating to plant performance in field environments. Ideas and findings from physiological ecology are applied to topical environmental problems. The laboratory emphasizes tools for investigating ecophysiology in the laboratory and in the field.

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467 **ENVIRON 467 / AOSS 467 / CHEM 467 / GEOSCI 465 / ENSCEN 467.****Biogeochemical Cycles.**

(3,3;3,3) : May not be repeated for credit.

(Excl). (BS).

*MATH 116, CHEM 210, and PHYSICS 240 (or 260).*

The biogeochemical cycles of water, carbon, nitrogen, and sulfur; the atmosphere and oceans as reservoirs and reaction media; the fate of natural and human-made sources of carbon, nitrogen, and sulfur compounds; the interactions among major biogeochemical cycles and resultant global change: greenhouse gases, acid rain, and ozone depletion.

475 **ENVIRON 475 / NRE 475 / EHS 588.****Environmental Law.**

(3;3) : May not be repeated for credit.

(Excl).

*I.*

Introduces students to Environmental Law and the impact of the legal process on decisions that affect the environment. Topics include common law tort actions, toxic tort actions, statutory controls of pollution and other environmentally harmful activities. Additional areas include administrative agency structure and performance, constitutional rights to environmental quality and more.

476 **ENVIRON 476 / EEB 476 / NRE 476.****Ecosystem Ecology.**

(3,3;3,3) : May not be repeated for credit.

(Excl). (BS).

*General ecology and a 400-level course in Aquatic or Terrestrial Ecology. II.*

Current theories about the control and function of ecosystems, the approaches and techniques being used to test these theories, and the application of theory to the management and restoration of ecosystems.

479 **ENVIRON 479 / GEOSCI 477.****Hydrogeology.**

(4;4) : May not be repeated for credit.

(Excl). (BS).

*High school knowledge of physics, chemistry, and geology. MATH 116. MATH 215/216 are recommended.*

Introduction to physical hydrogeology with particular emphasis on process and application to geological settings and problem solving. The hydrologic cycle, physical rock framework and properties of aquifer systems are described and quantified. Groundwater flow and mass transport equations are covered, as well as pump-test design and analysis. Natural tracers and groundwater dating are discussed.

482 **ENVIRON 482 / CAAS 482 / NRE 482.****Environmental Justice: Theoretical Approaches.**

(3,3;3,3) : May not be repeated for credit.

(Excl).

This course examines theoretical approaches that are either being used or could be applicable too environmental justice research. Students study several theories including: race relations theory, power elite theory, social movement theory, and organizational theory.