NATURAL RESOURCES AND ENVIRONMENTAL SCIENCES

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NRES provides outstanding undergraduate and graduate educational opportunities. Many alumni of our B.S. program have gone on to complete graduate and professional degrees. Our graduates work in environmental science and natural resource management positions in government, corporations, consulting firms, and non-governmental organizations. NRES also offers traditional Master of Science, online Master of Science, and Doctor of Philosophy degrees. Our graduate students gain employment with research universities, government agencies, national and international non-governmental organizations, and business enterprises.

All NRES educational and research programs center on science, applied ecology, and conservation in a variety of aquatic, terrestrial and human dominated ecosystems. Within that framework, our faculty, staff, and students study a wide variety of ecological systems with emphases on soil, water, people and social systems, forests, plants, animals, and microbes. Much of our research focuses on natural and social processes, such as habitat fragmentation, regulation, dispersal, disturbance, invasion, bioactivity, and decision-making. We research and work in locations locally, across the United States, and around the world.

Designed for students interested in careers leading the conservation, protection, and management of natural and environmental resources or in pursuing advanced education in one of its many disciplinary areas, the NRES baccalaureate provides a science-based, application-oriented education. The NRES major is unique in its integration of a comprehensive physical, life, and social sciences background with coursework providing the management, decision-making, and analytical knowledge and skills required to solve the world’s most pressing problems.

Students in the NRES major begin their studies by taking a set of core courses that provides the background for more focused substantive study at the upper level. The NRES core introduces students to the range of physical, life, and social science content most relevant to their future professions and equips them with tools essential for the discovery, analysis, and application of knowledge important for successful environmental management. NRES students then build upon the core by completing one of four upper-level concentrations. Courses in the concentrations involve focused attention to the theories, data, and analytical tools of a particular set of natural resource and environmental science areas, helping students develop the necessary understanding of the complexities underlying resources management. All students in the major are required to complete a combination of field courses and at least one project-oriented capstone course.

All the concentrations prepare students for graduate study as well as for multiple career paths throughout the public and private sectors. Because of its unique orientation toward integrative application of disciplinary knowledge, the NRES major prepares students for a wide range of careers involving the conservation, protection, and management of natural resources. Many occur within business or government agencies that provide services related to environmental and natural resource management. Other careers are found within social, professional, and advocacy institutions that focus on human impacts and environmental sustainability. The major also prepares students for teaching, research, or other professional activities.

Graduates from the NRES major go on to pursue careers in the direction of environmental education centers; ecological management and restoration; enforcement of laws and regulations; environmental advocacy; environmental consulting; forest and environmental economics; land use analysis and management; law; local, state, and federal government; management of parks, forests and rangelands; plant physiology; policy development and implementation; resource planning and policy analysis; social and environmental impact analysis; soil conservation, science, and testing; technical sales; watershed management; and wildlife conservation and management.

For the Degree of Bachelor of Science in Natural Resources and Environmental Sciences

Prescribed Courses including Campus General Education

<table>
<thead>
<tr>
<th>Code</th>
<th>Title</th>
<th>Hours</th>
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<tbody>
<tr>
<td></td>
<td><strong>Composition I and Speech</strong></td>
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<tr>
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<td>Select one of the following:</td>
<td>6-7</td>
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<tr>
<td></td>
<td>RHET 105 Writing and Research</td>
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<tr>
<td></td>
<td>&amp; CMN 101 and Public Speaking (or equivalent) (see College Composition I requirement)</td>
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<tr>
<td></td>
<td><strong>CMN 111 Oral &amp; Written Comm I</strong></td>
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<td>&amp; CMN 112 and Oral &amp; Written Comm II</td>
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<td></td>
<td><strong>Advanced Composition</strong></td>
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<td>Select from campus approved list</td>
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<tr>
<td></td>
<td><strong>Cultural Studies</strong></td>
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<tr>
<td></td>
<td>Select one course from Western culture, one from non-Western culture, and one from U.S. minority culture from campus approved lists.</td>
<td>9</td>
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<tr>
<td></td>
<td><strong>Foreign Language</strong></td>
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<td>Coursework at or above the third level is required for graduation.</td>
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<td></td>
<td><strong>Quantitative Reasoning I</strong></td>
<td>4-5</td>
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<td>Select one of the following:</td>
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<tr>
<td></td>
<td>MATH 220 Calculus</td>
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<td></td>
<td>MATH 221 Calculus I</td>
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<td></td>
<td>MATH 234 Calculus for Business I</td>
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<td></td>
<td><strong>Quantitative Reasoning II</strong></td>
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<td>Select one of the following:</td>
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<tr>
<td></td>
<td>ACE 261 Applied Statistical Methods</td>
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<tr>
<td></td>
<td>CPSC 241 Intro to Applied Statistics</td>
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<td>ECON 202 Economic Statistics I</td>
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<td>PSYC 235 Intro to Statistics</td>
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<td></td>
<td>SOC 280 Intro to Social Statistics</td>
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<tr>
<td></td>
<td>STAT 100 Statistics</td>
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Information listed in this catalog is current as of 03/2018
### Natural Resources and Environmental Sciences

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Hours</th>
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<tbody>
<tr>
<td>CHEM 102</td>
<td>General Chemistry I</td>
<td>4</td>
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<tr>
<td>&amp; CHEM 103</td>
<td>and General Chemistry Lab I</td>
<td></td>
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<tr>
<td>CHEM 104</td>
<td>General Chemistry II</td>
<td>4</td>
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<tr>
<td>&amp; CHEM 105</td>
<td>and General Chemistry Lab II</td>
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</tr>
<tr>
<td>IB 103</td>
<td>Introduction to Plant Biology</td>
<td>4</td>
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<tr>
<td>IB 104</td>
<td>Animal Biology</td>
<td>4</td>
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Select one of the following:

<table>
<thead>
<tr>
<th>Course Code</th>
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<tbody>
<tr>
<td>GEOG 103</td>
<td>Earth's Physical Systems</td>
</tr>
<tr>
<td>GEOL 107</td>
<td>Physical Geology</td>
</tr>
<tr>
<td>PHYS 101</td>
<td>College Physics: Mech &amp; Heat</td>
</tr>
<tr>
<td>MCB 100</td>
<td>Introductory Microbiology</td>
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### Humanities and the Arts
Select from campus approved list.

### Social and Behavioral Sciences

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<th>Course Title</th>
<th>Hours</th>
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</thead>
<tbody>
<tr>
<td>ACE 100</td>
<td>Agr Cons and Resource Econ or ECON 102 Microeconomic Principles</td>
<td>3-4</td>
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Select from campus approved list.

### Natural Resources and Environmental Sciences Required

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Hours</th>
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<tbody>
<tr>
<td>NRES 102</td>
<td>Introduction to NRES</td>
<td>3</td>
</tr>
<tr>
<td>NRES 201</td>
<td>Introductory Soils</td>
<td>4</td>
</tr>
<tr>
<td>NRES 219</td>
<td>Principles of Ecosystem Mgmt</td>
<td>3</td>
</tr>
<tr>
<td>NRES 287</td>
<td>Environment and Society</td>
<td>3</td>
</tr>
<tr>
<td>NRES 348</td>
<td>Fish and Wildlife Ecology</td>
<td>3</td>
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<tr>
<td>NRES 454</td>
<td>GIS in Natural Resource Mgmt</td>
<td>4</td>
</tr>
<tr>
<td>NRES 456</td>
<td>Integrative Ecosystem Mgmt</td>
<td>3</td>
</tr>
<tr>
<td>NRES 276</td>
<td>Introduction to Field Pedology</td>
<td>2-4</td>
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<tr>
<td>NRES 285</td>
<td>Field Experience</td>
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### ACES Required

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<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Hours</th>
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<tbody>
<tr>
<td>ACES 101</td>
<td>Contemporary Issues in ACES</td>
<td>2</td>
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### Required Concentration

Concentration prescribed courses. See specific requirements for each concentration listed below.

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Hours</th>
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</thead>
<tbody>
<tr>
<td>NRES 219</td>
<td>Principles of Ecosystem Mgmt</td>
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</tbody>
</table>

### Total Hours

126

### Approved Concentrations:

- Fish and Wildlife Conservation Concentration (http://catalog.illinois.edu/undergraduate/aces/departments/nres/fish-wildlife-conservation-concentration)
- Minor in Spatial and Quantitative Methods in Natural Resources and Environmental Sciences (http://catalog.illinois.edu/undergraduate/aces/departments/nres/minor-spatial-quantitative-methods-natural-resources-environmental-sciences)

HDES Class Schedule (https://courses.illinois.edu/schedule/DEFAULT/HDES)

### Human Dimensions of Env Sys Courses

NRES 100  Fundamentals of Env Sci  credit: 3 Hours.
Introduction to environmental sciences and current environment issues. Topics include population growth, world food supplies, agriculture and the environment, biodiversity, fossil fuels and "green" energy issues, endangered and threatened species, water use, conservation and pollution, global warming, acid rain, ozone depletion, waste management and reduction, recycling, toxins and health, mineral resources, and environmental policies and regulations. Course addresses the complex relationships between the human race and the natural systems that contain our air, water, energy, and biotic and food resources. Credit is not given for both NRES 100 and NRES 102.

This course satisfies the General Education Criteria for: Nat Sci Tech - Phys Sciences

NRES 101  Wildlife Conserv 21st Century  credit: 3 Hours.
This course is an introduction to the conservation, diversity and ecology of animals. The diversity of fish, reptiles, amphibians, mammals, and birds both around the world and in Illinois will be explored. The course will have a strong conservation component where students are introduced to a variety of threats facing animals. The students will be introduced to how to manage sustainable wildlife populations. The students will be exposed to current issues in Illinois to illustrate how people and animals can co-occur and a broad overview of the management, restoration, and conservation techniques.

NRES 102  Introduction to NRES  credit: 3 Hours.
Introduction to natural resources (forests, fisheries, soils, aquatic systems) and environmental science. Emphasizes renewable natural resources, ecological concepts, energy use, biodiversity of species, biogeochemical cycles, and air, water, and soil pollution. Provides natural science basis for understanding contemporary environmental issues and natural resource management. Credit is not given for both NRES 100 and NRES 102.

NRES 103  The Great Lakes - Freshwater Wonder at Risk  credit: 3 Hours.
Introduction to the ecology of freshwater systems, viewed through the lens of the Great Lakes and associated tributaries. The Great Lakes hold 20% of the world’s freshwater and 95% of the freshwater in North America. They have sustained human and wildlife populations for at least 10,000 years. Now, the integrity of this unique and priceless resource is threatened as never before. This eight-week online course will enhance student understanding of the ecology of this imperiled system, as well as the historical events and policies that have led to the present crisis, and the men and women who have played key roles in this unfolding story.
NRES 108  Env Sc & Nat Resource Careers  credit: 1 Hour.
Explores career options in the fields of Natural Resource Management and Environmental Sciences. Students will improve understanding of their career goals, expand their knowledge of careers available in these fields, improve their job searching skills, and develop a plan for pursuing a career. Approved for S/U grading only.

NRES 109  Global Environmental Issues  credit: 3 Hours.
Discussion course that focuses on analyzing opposing points of view on contemporary environmental issues. Students engage in role-playing activities, debates, and other participatory activities to explore the ecological and social dimensions of the issues.

NRES 199 Undergraduate Open Seminar  credit: 1 to 5 Hours.
Experimental course on a special topic in natural resources and environmental sciences. Topic may not be repeated except in accordance with the Code. May be repeated in the same or subsequent terms. No more than 12 hours may be counted toward graduation.

NRES 201  Introductory Soils  credit: 4 Hours.
The nature and properties of soil including origin, formation, and biological, chemical, and physical aspects. Prerequisite: Successful completion of MATH 234, or equivalent and CHEM 102 is required. CHEM 104 is recommended.

NRES 202  American Environmental History  credit: 3 Hours.
Same as ESE 202 and HIST 202. See HIST 202. This course satisfies the General Education Criteria for: Humanities - Hist Phil
Cultural Studies - Western

NRES 210  Environmental Economics  credit: 3 Hours.
Same as ACE 210, Econ 210, ENV 210, and UP 210. See ACE 210. This course satisfies the General Education Criteria for: Social Beh Sci - Soc Sci

NRES 219  Principles of Ecosystem Mgmt  credit: 3 Hours.
The principles of ecosystem management are based in ecology, which is the branch of science that explores how organisms interact with their environment. In this course, students will learn about ecological principles that are the foundation for understanding biological systems on many different levels of organization. Topics include abiotic influences on organisms, energy acquisition, population ecology, species interactions, biological communities, and ecosystem ecology. Particular attention is given to integrating these basic principles into a better understanding of ecology in a world that is increasingly dominated by human activities. Completion of a prior course in biology, zoology, or botany is recommended.

NRES 220  Communicating Agriculture  credit: 3 Hours.
Same as AGCM 220 and ENV 220. See AGCM 220. This course satisfies the General Education Criteria for: Advanced Composition

NRES 223  Watching the Environment  credit: 3 Hours.
Same as MDIA 223. See MDIA 223. This course satisfies the General Education Criteria for: Social Beh Sci - Soc Sci

NRES 242  Nature and American Culture  credit: 3 Hours.
Same as LA 242 and RST 242. See RST 242. This course satisfies the General Education Criteria for: Cultural Studies - Western

NRES 270  Applied Entomology  credit: 3 Hours.
Same as CPSC 270 and IB 220. See CPSC 270. This course satisfies the General Education Criteria for: Nat Sci Tech - Life Sciences

NRES 276  Introduction to Field Pedology  credit: 2 Hours.
Laboratory and field course involving description, interpretation, and classification of soil profiles. Several day, overnight field trip required; fee required. Additional fees may apply. See Class Schedule. May be repeated to a maximum of 4 hours. Prerequisite: NRES 201.

NRES 285  Field Experience  credit: 1 or 2 Hours.
Field based course that exposes students to procedures and methods used in various resource settings in a hands-on manner. Includes weekly field trips to visit representative natural resource and environmental science settings with supporting laboratory exercises. Content of offerings vary by section, but all focus on resource management, environmental quality and assessment, and effects of consumption and use on the environment. Field trips required. Additional fees may apply. See Class Schedule. May be repeated in the same or subsequent semesters to a maximum of 6 hours. Prerequisite: NRES 201 and NRES 219.

NRES 287  Environment and Society  credit: 3 Hours.
Examination of the relationship between environment and society and implications for ecological and human well-being. Social science perspective covered on topics such as environmental change, environmental decision-making, natural resource management, agricultural systems, and environmental risks, hazards, and disasters. Students will build critical thinking skills focused on contemporary problems in the interface between people and the physical environment. Same as ESE 287, GEOG 287, and PS 273. Prerequisite: NRES 102 and sophomore or higher standing. Introductory social science course recommended.

This course satisfies the General Education Criteria for: Social Beh Sci - Soc Sci
Cultural Studies - Western

NRES 293  Professional Internship  credit: 1 to 4 Hours.
Off-campus experience in a field directly pertaining to a subject matter in natural resources and environmental sciences. Approved for Letter and S/U grading. May be repeated in separate terms up to 4 hours. Prerequisite: Consent of academic advisor or Department Internship Coordinator.

NRES 294  Resident Internship  credit: 1 to 4 Hours.
Supervised, on-campus, learning experience with faculty engaged in research. Approved for Letter and S/U grading. May be repeated in separate terms to a maximum of 4 hours. Prerequisite: Consent of academic advisor or Department Internship Coordinator.

NRES 295  Undergraduate Research or Thesis  credit: 1 to 4 Hours.
Individual research, special problems, thesis, development and/or design work under the supervision of an appropriate member of the faculty. May be repeated in the same or subsequent terms. No more than 12 hours of special problems, research, thesis and/or individual studies may be counted toward degree. Prerequisite: Junior standing, cumulative GPA of 2.5 or above at the time the activity is arranged, and consent of instructor.

NRES 298  Undergraduate Seminar  credit: 1 to 3 Hours.
Group discussion on a special topic in a field of study directly pertaining to subject matter in natural resources and environment sciences. May be repeated to a maximum of 12 hours. Prerequisite: Junior standing.
NRES 302  Dendrology  credit: 4 Hours.
Emphasizes nomenclature, classification, and the distinguishing morphological characteristics of the native and naturalized tree species of North America. Introduces disciplines related to the systematics of tree species, including: morphology, physiology, phenology, ecology, soil-site relationships, silviculture, geographic range and natural distribution, wood characteristics, economic uses, and natural history (including major diseases and insect pests). Incorporates tree and forest habitats that provide cover, breeding sites, and food for a variety of wildlife species. Serves as a basis for studies in natural resources management, environmental science, and for advanced studies of botany, genetics, and tree physiology. Field trips required. Additional fees may apply. See Class Schedule. Prerequisite: IB 103.

NRES 310  Natural Resource Economics  credit: 3 Hours.
Same as ACE 310 and ENVS 310. See ACE 310.

NRES 325  Natural Resource Policy Mgmt  credit: 3 Hours.
Explores policy processes and institutions relating to allocation, utilization, and preservation of natural resources. Considers conceptual models of policy processes, and examines both historical examples and current issues. Prerequisite: ECON 102 or ACE 100.

NRES 330  Environmental Communications  credit: 3 Hours.
Same as AGCM 330 and ENVS 330. See AGCM 330.

NRES 340  Environ Social Sci Res Meth  credit: 3 Hours.
Introduction to social science research methods for addressing environmental issues. It provides basic information about social science concepts and methods (especially observation, surveys, focus groups, and interviews), helps students become informed users of social science research, and guides selection of appropriate social science tools to meet environmental challenges. A group focus on a local environmental issue offers a practical experience in which course content is applied within a specific community context. Field trips within the local community may be required. Additional fees may apply. See Class Schedule. Prerequisite: STAT 100 or equivalent.

NRES 348  Fish and Wildlife Ecology  credit: 3 Hours.
Application of ecological principles and modeling to management of fish and wildlife populations; significance of abiotic and biotic factors, including life-history parameters in population growth and management; and techniques and procedures for the development of management strategies for animal populations, emphasizing vertebrates. A course in statistics is highly recommended. Same as IB 348. Prerequisite: IB 203 or NRES 219.

NRES 351  Introduction to Environmental Chemistry  credit: 3 Hours.
Introduces major inorganic and organic chemical pollutants, their sources and their fates in the atmosphere, hydrosphere and pedosphere. In particular, the course covers 1) translocation/distribution of chemicals in the environment, and 2) abiotic and biotic transformation of chemicals (e.g., photochemical reactions, hydrolysis, redox, adsorption and volatilization). Geared towards students in agricultural, natural, environmental and life science majors. Prerequisite: Successful completion of MATH 234 (or equivalent) and CHEM 104 is required. One semester of organic chemistry (CHEM 232 or CHEM 236) is recommended.

NRES 352  Plant Genetics  credit: 4 Hours.
Same as CPSC 352. See CPSC 352.

NRES 362  Ecology of Invasive Species  credit: 3 Hours.
Focused on the ecology and management of biological invasions, with an emphasis on understanding the introduction, establishment, spread and impact stages of the invasion process. Students will identify the causes and impacts of biological invasions, as well as management strategies for preventing new invasions and mitigating impacts of established invaders in freshwater, marine, and terrestrial ecosystems. No special equipment will be required, and any optional, weekend field trips will occur on campus. Prerequisite: NRES 219 or similar introductory course in ecology.

NRES 368  Vertebrate Natural History  credit: 4 Hours.
Same as IB 368. See IB 368.

NRES 370  Environmental Sustainability  credit: 3 Hours.
Same as ENSU 300 and LA 370. See LA 370.

NRES 396  UG Honors Research or Thesis  credit: 1 to 4 Hours.
Individual research, special problems, thesis, development and/or design work under the direction of the Honors advisor. May be repeated in the same or subsequent terms. No more than 12 hours of special problems, research, thesis and/or individual studies may be counted toward degree. Prerequisite: Junior standing, admission to the ACES Honors Program, and consent of instructor.

NRES 401  Watershed Hydrology  credit: 3 Hours.
Precipitation, evapotranspiration, stream flow, and other aspects of the hydrologic cycle are studied in a watershed context. Measurement techniques, statistical analyses of hydrologic data, and simulation modeling are discussed. Case studies that quantify water movement in specific watersheds are used to integrate course topics. Same as GEOG 401. 3 undergraduate hours. 3 graduate hours. Prerequisite: CHEM 102, completion of the Quantitative Reasoning I requirement, and completion of the statistics requirement.

NRES 402  Ecohydrology and Water Management  credit: 3 Hours.
Students will focus on understanding the processes of ecohydrology (e.g. physical hydrology, plant water use and stress response), the societal applications of ecohydrology (e.g. irrigation, drought monitoring, water sustainability for ecosystem), and the state-of-the-art methodology to study ecohydrology (e.g. satellite, numerical modeling). Students will gain background in broader applications of ecohydrology; early-stage graduate students will be able to adopt ecohydrology knowledge in their research. Additional fees may apply. See Class Schedule. 3 undergraduate hours. 3 graduate hours. Prerequisite: MATH 220 or 234.

NRES 403  Watersheds and Water Quality  credit: 3 Hours.
Examines water quality in streams, rivers, lakes, and wetlands. The responses of watershed systems to pollution and other human impacts will be described in terms of their biological, geochemical, and physical processes. The technical analyses necessary to establish policies aimed at preserving or restoring these natural resources will be emphasized. 3 undergraduate hours. 3 graduate hours. Prerequisite: One of CEE 330, CHEM 232, NRES 351; one of MATH 220, MATH 221, MATH 234.

NRES 406  Fluvial Geomorphology  credit: 4 Hours.
Same as GEOG 406 and GEOL 406. See GEOG 406.

NRES 407  Wildlife Population Ecology  credit: 4 Hours.
This course includes the application of principles of population biology to the analysis, management, and conservation of wildlife populations, models of population growth, spatio-temporal variation in abundances, estimation of demographic parameters and methods of decision-making. 4 undergraduate hours. 4 graduate hours. Prerequisite: NRES 348. One semester of calculus or statistics is recommended.
NRES 409  Fishery Ecol and Conservation  credit: 4 Hours.  
Ecological and conservation concepts are applied to fisheries management practices. Will discuss current literature related to the interface between basic and applied aspects of fish populations, focusing on life history, conservation biology and genetics, growth and recruitment, competition, predation, trophic and community ecology, ecosystem management, and human dimensions. 4 undergraduate hours. 4 graduate hours. Prerequisite: NRES 219 or LA 450.

NRES 415  Native Plant ID and Floristics  credit: 4 Hours.  
Focuses on gaining skills in identification of native vascular plants in the field and classroom. Methods of plot-based and plotless vegetation sampling methods will be introduced. Procedures and applications for botanical inventory and assessment will be covered. Field trips are required. Additional fees may apply. See Class Schedule. 4 undergraduate hours. 4 graduate hours. Credit is not given for NRES 415 if credit for CPSC 416 has been earned.

NRES 416  Forest Biology  credit: 3 Hours.  
Interactions of biotic and abiotic components of forests as they relate to the health, structure and function of these ecosystems. The course is ecophysiological and organismic in approach, but includes biochemical concepts central to the understanding of forest biology. Lecture-discussion combined with assigned readings, field projects, and a paper. One Saturday field trip required. Additional fees may apply. See Class Schedule. 3 undergraduate hours. 3 graduate hours. Prerequisite: NRES 419 and NRES 302 or HORT 301.

NRES 418  Wetland Ecology & Management  credit: 3 Hours.  
Wetlands are important ecosystems that support high biodiversity and provide numerous benefits to society. This course provides a comprehensive examination of wetland science, management, and governance. Lectures, readings and class discussions will focus on the structure and processes of wetland ecosystems, wetland biota, wetland conservation and management, and U.S. and international wetland policies. Special emphasis will be placed on the application of wetland science to policy and restoration. Offered in alternate years. 3 undergraduate hours. 3 graduate hours. Prerequisite: NRES 201 and NRES 219, or consent of instructor.

NRES 419  Env and Plant Ecosystems  credit: 3 Hours.  
Relationships among environmental factors and plant processes and functions; impact of human activities on the environment and the structure and function of plant ecosystems. Examples will be drawn from a variety of managed and unmanaged plant ecosystems. Field trip required. Additional fees may apply. See Class Schedule. 3 undergraduate hours. 3 graduate hours. Prerequisite: NRES 219 or LA 450 or IB 103 and CHEM 104 or NRES 201.

This course satisfies the General Education Criteria for: Advanced Composition

NRES 420  Restoration Ecology  credit: 4 Hours.  
Historical development of ecological restoration, its philosophical foundation, multi-disciplinary borrowings from the natural, applied, and social sciences, and varied practical applications, with emphasis on the application of ecological principles. Case studies, field trips, and laboratory activities on restoration planning. Field trip required. Additional fees may apply. See Class Schedule. 4 undergraduate hours. 4 graduate hours. Prerequisite: NRES 219 or LA 450.

NRES 421  Quantitative Methods in NRES  credit: 3 Hours.  
Explores the fundamental principles, procedures, and practices that underlie the most common statistical and sampling methods used in natural resources and environmental sciences. This course covers hypothesis testing, regression, and analysis of variance. There is also a strong focus on sampling theory and experimental design. Computer labs utilize the open source R statistical computing environment. 3 undergraduate hours. 3 graduate hours. Prerequisite: One of MATH 220, MATH 221, MATH 234; completion of the statistics requirement.

NRES 422  Earth Systems Modeling  credit: 4 Hours.  
Same as ATMS 421, ESE 421, GEOG 421 and GEOL 481. See ATMS 421.

NRES 423  Politics of International Conservation and Development  credit: 3 Hours.  
Conserving the earth's rich biological heritage while enhancing the well-being of the poor stands as a critical global challenge. This course examines this complex issue using the lens of political science and allied fields. Readings, discussion, and written work will demonstrate how insights and approaches from these areas of scholarship can help understand and address the twin problems of biodiversity loss and human poverty in developing countries. Examples focus on forest and wildlife conservation and management. Same as GEOG 423. 3 undergraduate hours. 3 graduate hours. Prerequisite: One 200 or 300 level social science course or consent of instructor. Junior class standing required.

NRES 424  US Environ, Justic & Policy  credit: 4 Hours.  
In the course students will: (a) write about the roles that race, class, and other social differences play in shaping human-environment relationships, (b) understand the role of the Environmental Protection Agency in considering environmental justice in policy, and (c) identify ways that policies for ecological sustainability can be configured to improve the equity of environmental and natural resource decision-making. 4 undergraduate hours. 4 graduate hours. Prerequisite: Junior class standing.

NRES 425  Natural Resources Law & Policy  credit: 3 Hours.  
Using the case study method and discussion problems, students in this course will study how laws in the U.S. regulate the use of natural resources, including public ownership and preservation of natural resources through other federal and state public lands. Also examines major federal environmental statues designed to protect natural resources, including the Clean Water Act, the Endangered Species Act, the National Environmental Policy Act, and federal acts related to forest, national parks, and wilderness protection. Additional fees may apply. See Class Schedule. 3 undergraduate hours. 3 graduate hours. Prerequisite: Junior standing.

NRES 426  Renewable Energy Policy  credit: 3 Hours.  
Considers how policies can be designed to optimize economic, environmental, and social solutions to transforming the world’s unsustainable energy production, distribution, and consumption paradigm. Provides an up-front primer on climate change policy in the U.S., Europe, and internationally, which have become the primary driver of sustainability initiatives in the energy sector. Examines policies that define “renewability” within various energy sectors including fossil fuels (e.g., coal, natural gas, petroleum), biofuels, nuclear power, hydropower, wind, solar, geothermal, and wave energy. 3 undergraduate hours. 3 graduate hours. Prerequisite: Junior standing.
NRES 427  Modeling Natural Resources  credit: 4 Hours.
Examines basic modeling concepts and methods. Modeling skills, model development, and natural resource issues and problems will be emphasized. Content areas include fisheries, forests, wildlife, economics, human dimensions, groundwater and surface water. 4 undergraduate hours. 4 graduate hours. Prerequisite: One of MATH 220, MATH 221, MATH 234.

NRES 428  Valuing Nature  credit: 3 Hours.
Building sustainable communities and ecosystems requires an understanding of how and why people make decisions about the environment. This course will explore how values, attitudes, and concepts of place (e.g., attachment, place meanings) relate to environmental behavior. Students will transfer theoretical knowledge of behavior change science and state-of-the-art methodologies to resource management challenges, focusing particular attention on the human dimensions of fisheries management, conservation in parks and protected areas, and sustainable energy use. 3 undergraduate hours. 3 graduate hours. Prerequisite: NRES 287.

NRES 429  Aquatic Ecosystem Conservation  credit: 3 Hours.
Application of the principles of aquatic ecology to a broad range of conservation issues. The structure and function of aquatic systems are discussed from an ecosystem perspective, including the major threats and disturbances to aquatic ecosystems. 3 undergraduate hours. 3 graduate hours. Prerequisite: CHEM 102 and PHYS 101 or PHYS 140, and MATH 220 or MATH 221 or MATH 234, and IB 203 or NRES 219.

NRES 430  Comm in Env Social Movements  credit: 3 Hours.
Same as AGCM 430 and ENVS 430. See AGCM 430.

NRES 431  Plants and Global Change  credit: 3 Hours.
Same as CPSC 431 and IB 440. See CPSC 431.

NRES 438  Soil Nutrient Cycling  credit: 3 Hours.
The ecology of decomposition and plant nutrient acquisition in terrestrial soils will be addressed using applied ecology concepts. Discussion will focus on the scientific literature addressing biological, physical, and chemical controls over nutrient availability in soils. Writing assignments will teach students to summarize scientific literature. Students will learn about analytical and quantitative methods used in this field of study and gain the interpretive and communication skills needed to assess and/or carry out applied research in plant and soil science arenas. Same as CPSC 438. 3 undergraduate hours. 3 graduate hours. Offered in alternate years. Prerequisite: IB 203 or NRES 219, and NRES 201.

NRES 439  Env and Sustainable Dev  credit: 3 Hours.
Comprehensive overview and synthesis of global environmental problems and their relationships to human activities, with a focus on ecological and natural resource elements. Concerns include unsound ethics and concepts of development and modernization, the lack of motivation or funding to implement available technical solutions, the promotion of alternative development ethics, and a review of opportunities to maintain or improve the well-being of people, other organisms, and the environment. Same as CPSC 439. 3 undergraduate hours. 3 graduate hours. Prerequisite: NRES 219 or ACE 210.

NRES 440  Applied Statistical Methods I  credit: 4 Hours.
Same as ABE 440, ANSC 440, CPSC 440, and FSHN 440. See CPSC 440.

NRES 441  Biogeography  credit: 3 Hours.
Same as ANTH 436, ESE 439, GEOG 436 and IB 439. See IB 439.

NRES 442  Mammalogy  credit: 4 Hours.
Same as IB 462. See IB 462.

NRES 445  Statistical Methods  credit: 4 Hours.
Same as ABE 445 and ANSC 445. See ANSC 445.

NRES 446  Sustainable Planning Seminar  credit: 4 Hours.
Same as GEOG 446, LA 446, and UP 446. See LA 446.

NRES 452  Community Ecology  credit: 3 Hours.
Same as IB 453. See IB 453.

NRES 454  GIS in Natural Resource Mgmt  credit: 4 Hours.
Geographic Information Systems (GIS) and remote sensing for natural resource management. Personal computers and GIS software are used to demonstrate the utility of these techniques for data acquisition, image processing, and map modeling. Exercises include problems relevant to the management of natural resources such as land cover mapping, monitoring, suitability and productivity assessment, landscape pattern analysis, land use change analysis, spatial modeling, and decision making. 4 undergraduate hours. 4 graduate hours.

NRES 455  Adv GIS for Nat Res Planning  credit: 2 Hours.
Examines the application of Geographic Information Systems (GIS) to natural resource planning and decision making. Integrates principles of decision making in various contexts: public and private, single and multiple criteria, and various forms of management constraints. Management alternatives are then incorporated into a GIS system for further review and analysis. Course combines GIS software with computer-based optimization and quantitative decision making models. 2 undergraduate hours. 2 graduate hours. Offered in alternate years. Prerequisite: GEOG 479 or NRES 454.

NRES 456  Integrative Ecosystem Mgmt  credit: 3 Hours.
Examines ecological and human dimensions of ecosystem management through case studies in settings such as the Pacific Northwest, Southwest, Great Lakes, Golf Coast, and Mississippi River Basin ecosystems. Capstone course for seniors in the NRES major. Additional fees may apply. See Class Schedule. 3 undergraduate hours. 3 graduate hours. Prerequisite: Senior standing; NRES 219 and NRES 287.

NRES 460  Aerial Photo Analysis  credit: 3 or 4 Hours.
Same as GEOG 460. See GEOG 460.

NRES 461  Ornithology  credit: 4 Hours.
Same as IB 461. See IB 461.

NRES 462  Ecosystem Ecology  credit: 3 Hours.
Same as ESE 452 and IB 452. See IB 452.

NRES 463  Ichthyology  credit: 4 Hours.
Same as IB 463. See IB 463.

NRES 464  Herpetology  credit: 4 Hours.
Same as IB 464. See IB 464.

NRES 465  Landscape Ecology  credit: 3 Hours.
Introduction to the theory, methods, and application of landscape ecology, with an emphasis on characterizing heterogeneity and examining its consequences for ecological processes across a variety of spatial and temporal scales. Special attention will be given to the role of natural and human disturbances in shaping spatial patterns. Laboratory exercises are computer-based and focus on concepts and tools in landscape ecology. 3 undergraduate hours. 3 graduate hours. Prerequisite: NRES 219 or equivalent, NRES 454 or equivalent.

NRES 471  Pedology  credit: 3 Hours.
The science of soil genesis, classification, and morphology. Includes factors of soil formation, properties and methods used in distinguishing soils, interpretation of soil profiles and soil stratigraphy, causes of soil variability, and the impact of soil properties upon soil management, landuse decisions, and the environment. 3 undergraduate hours. 3 graduate hours. Prerequisite: NRES 201.
NRES 472 Environmental Psychology credit: 4 Hours.
Theory and research in environmental psychology. Topics include environmental perception, cognition, experience, values and emotion, perceived environmental quality, environmental hazards and risk perception, and conservation attitudes and behavior. Same as PSYC 472.
4 undergraduate hours. 4 graduate hours. Prerequisite: Jr. standing: PSYC 100 or PSYC 103.

NRES 473 Soil Testing Practicum credit: 2 or 3 Hours.
Chemical procedures useful in assessing soil/plant relationships for field crops. Topics include agronomic principles, field sampling, performance of soil tests, interpretation of analytical results, and formulation of nutrient management programs. 2 or 3 undergraduate hours. 2 or 3 graduate hours. Field trip required. Additional laboratory work and consent of instructor required for 3 hours. Prerequisite: NRES 201.

NRES 474 Soil and Water Conservation credit: 3 Hours.
Application of principles of soil conservation and management to the solution of land-use problems; influence of soil characteristics on erosion control, cropping intensity, water management, and land-use planning. Includes a field trip. Additional fees may apply. See Class Schedule. 3 undergraduate hours. 3 graduate hours. Prerequisite: NRES 201.

NRES 475 Environmental Microbiology credit: 3 Hours.
Introduction to the diversity of microbial populations and their important role in environmental processes in air, water, soils, and sediments. Microbial community ecology and interactions with plants and animals will also be discussed. Students will learn how microbial activities sustain natural ecosystems and contribute to environmental quality, and also how these functions are harnessed to support managed and artificial systems. Molecular biology techniques for investigating microbial communities and their activities will also be discussed. 3 undergraduate hours. 3 graduate hours. Prerequisite: NRES 201 and CHEM 104.

NRES 477 Introduction to Remote Sensing credit: 3 Hours.
Same as GEOG 477. See GEOG 477.

NRES 478 Environmental Stable Isotopes credit: 3 Hours.
Same as ATMS 422, GEOL 488, and IB 488. See IB 488.

NRES 485 Stream Ecosystem Management credit: 4 Hours.
This course relates the structure and function of streams and rivers to challenges and opportunities in their conservation, management, and restoration using a combination of readings, discussions, and field trips to study sites. Students will develop an integrative understanding of stream and river ecosystem management from the site to watershed scale on issues spanning from nutrient pollution, to the natural flow regime, to the design and implementation of freshwater protected areas. No special equipment will be required. Three required field trips will occur on or near campus. Additional fees may apply. See Class Schedule. 4 undergraduate hours. 4 graduate hours. Prerequisite: NRES 219 or similar introductory course in ecology.

NRES 487 Soil Chemistry credit: 3 Hours.
Emphasizes inorganic reactions involved in soil development and plant nutrition in soils; topics include colloid systems, properties of water, ion exchange equilibria, plant nutrient forms, and methods of analyses. 3 undergraduate hours. 3 graduate hours. Prerequisite: NRES 201 and CHEM 104.

NRES 488 Soil Fertility and Fertilizers credit: 3 Hours.
Provides a broad-based understanding of the basic principles of soil fertility and their application. Coverage includes the occurrence, cycling, and plant availability of the essential mineral nutrients in soils; fertilizer sources, soil reactions, and efficiency; evaluating fertilizer and lime needs; methods of fertilizer application; and the economics of fertilization. Same as CPSC 488. 3 undergraduate hours. 3 graduate hours. Prerequisite: NRES 201.

NRES 489 Physics of Plant Environments credit: 4 Hours.
The physics of transport processes in the soil and aerial environment of plants; exchanges of energy and gases in crop canopies, and the retention and flow of water, gases, solutes, and heat in soils. 4 undergraduate hours. 4 graduate hours. Prerequisite: PHYS 101 or PHYS 140; one of MATH 220, MATH 221, MATH 234; NRES 201.

NRES 490 Surface Water System Chemistry credit: 4 Hours.
Examines the interaction of chemical and biological processes that govern the chemistry of streams, lakes, and wetlands, and the response of aquatic organisms to pollution. Chemical equilibrium and kinetic principles are used to analyze the behavior of surface water systems through the use of models. Topics include modeling of field studies in environmental inorganic chemistry and biogeochemistry. The laboratory section will be devoted to instruction in the use of computer models and to their practical application. 4 undergraduate hours. 4 graduate hours. Credit not given for both NRES 490 and CEE 443. Prerequisite: CHEM 104; one of MATH 220, MATH 221, MATH 234.

NRES 494 Democracy and Environment credit: 3 or 4 Hours.
Same as GEOG 493, SOC 493, UP 493. See GEOG 493.

NRES 499 Special Topics credit: 1 to 4 Hours.
Experimental course on a special topic in natural resources and environmental sciences. Additional fees may apply. See Class Schedule. 1 to 4 undergraduate hours. 1 to 4 graduate hours. Approved for both letter and S/U grading. May be repeated in the same or separate terms to a maximum of 12 hours as topics vary.