

# NATURAL RESOURCES & ENVIRON SC (NRES)

NRES Class Schedule (<https://courses.illinois.edu/schedule/DEFAULT/DEFAULT/NRES>)

## 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 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, ENVS 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 ENVS 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 HIST 282, 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, PS 273, and SOC 287. 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 Undergrad 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 ENV 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 ENV 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 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 348.

**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 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 (3) 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 statutes 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 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, ENVS 430, and SOC 464. 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, Gulf 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, land-use 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 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.

**NRES 500 Graduate Seminar credit: 0 to 1 Hours.**

Exposure to current research and specialized topics in natural resources and environmental sciences through attending/viewing and responding to the NRES seminar series. 0 to 1 graduate hours. No professional credit. Approved for S/U grading only. May be repeated.

**NRES 501 Special Problems credit: 0 to 4 Hours.**

Individual studies or investigations in selected branches of horticulture, natural resources, and environmental sciences. Approved for letter and S/U grading. May be repeated. No more than 8 hours may be counted toward an MS degree.

**NRES 502 Research Methods in NRES credit: 4 Hours.**

Theory and practice of research methods in natural resources, ecology, and environmental sciences. Provides an overview of experimental design and sampling techniques, and includes discussions of discipline-specific statistical methods. Prerequisite: One upper division course is recommended.

**NRES 503 Capstone Research Project credit: 1 to 4 Hours.**

A supervised individual investigative study in selected areas of natural resources and environmental sciences relevant to the student's career preparation. Open only to NRES graduate students. A summary report of the investigation is required. Approved for letter and S/U grading. May be repeated in separate terms to a maximum of 8 hours. Credit is not given for both NRES 503 and NRES 505 or NRES 507. Prerequisite: Consent of the Academic and Research Advisors.

**NRES 504 Critical Issues Recreation Mgt credit: 4 Hours.**

Same as RST 502. See RST 502.

**NRES 505 Capstone Internship Experience credit: 1 to 4 Hours.**

A formalized learning experience in an appropriate supervised internship related to the student's career preparation in natural resources and environmental sciences. Open only to NRES graduate students. A summary report of the internship is required. Approved for letter and S/U grading. May be repeated in separate terms to a maximum of 8 hours. Credit is not given for both NRES 505 and either NRES 503 or NRES 507. Prerequisite: Consent of Academic Advisor.

**NRES 507 Capstone Group Res Project credit: 1 to 4 Hours.**

A supervised collaborative learning experience in which students work together to design, conduct, and present professional interdisciplinary research related to the students' career preparation in natural resources and environmental sciences. Group project may involve collaboration with outside clients, which include industry, government, and non-governmental organizations. Only open to NRES graduate students pursuing a non-thesis M.S. A project report summarizing the learning experience is required. Approved for letter and S/U grading. May be repeated in separate terms to a maximum of 8 hours. Credit is not given for both NRES 507 and either NRES 503 or NRES 505. Prerequisite: Consent of the Academic and Research Advisors.

**NRES 508 Community & Natural Resources credit: 4 Hours.**

Advanced discussion and analysis of theoretical and empirical approaches to the intersection of social and ecological processes at the human community level emphasizing change, conflict, management, and decision-making. Each student will complete a project applying community-related theory to a particular natural resource or environmental problem. Prerequisite: Upper-level undergraduate course or graduate course in social science related to natural resources or environmental issues in NRES, Geography, Human and Community Development, Political Science, Psychology, Recreation Sport and Tourism, Sociology, or related field.

**NRES 510 Adv Natural Resource Economics credit: 4 Hours.**

Same as ACE 510, ECON 548, and ENVS 510. See ACE 510.

**NRES 511 Principles of Applied Ecology credit: 4 Hours.**

Provides a thorough foundation of fundamental ecological principles that govern the distribution and abundance of organisms with extra attention to applied ecology as it pertains to current-day ecological problems. The approach will include lectures, discussions, hands-on evaluation and interpretation of data and experimental design presented in case studies, and design and implementation of an independent research project. Prerequisite: At least one undergraduate or graduate course in biology or ecology.

**NRES 512 Discussions in NRES credit: 1 to 2 Hours.**

Discussion of recent developments and current literature in natural resources and environmental sciences, with a term-long emphasis on a particular aspect of the subject matter. Approved for Letter and S/U grading. May be repeated to a maximum of 4 hours.

**NRES 516 Ecosystem Biogeochemistry credit: 4 Hours.**

Biological, geological, and chemical processes of forest, agricultural, freshwater and marine ecosystems. The effects of pollutants and global change on each ecosystem are addressed along with the biogeochemical interactions among ecosystems. Each student completes a detailed biogeochemical study for a particular ecosystem. A 400-level course in two or more of the following areas are recommended: soil science, aquatic science, ecology, and hydrology. Same as IB 516.

**NRES 565 Spatial Ecological Modeling credit: 2 Hours.**

Computer-based, spatially explicit models are useful for simulating the long-term dynamics and stability of complex ecological systems and can provide a basis for the development of tools for management support and policy advice. This course will build on landscape ecology principles and GIS skills to develop and analyze spatial ecological models. Emphasis will be on building and applying individual- and agent-based models to understand and predict how systems respond to environmental change. 2 graduate hours. No professional credit. Prerequisite: NRES 454, NRES 465, or equivalent. Graduate students only.

**NRES 572 Chemistry of Soil Fertility credit: 4 Hours.**

The chemistry of essential plant nutrients in soils, and their quantitative relationships to plant growth. Offered in alternate years. Prerequisite: NRES 201 and CHEM 222.

**NRES 580 Solute Transport in Soils credit: 4 Hours.**

Theoretical and practical aspects of modeling the fate and transport of chemicals through unsaturated soil. Topics include spatial variability (scaling theories, geostatistics), fate and coupled transport processes (adsorption, degradation, preferential flow, dispersion, advection, diffusion, volatility), and associated modeling (parameter estimation; screening, regulatory, and research models, including CDE, stochastic-convective, stream-tube, particle tracking, kinematic wave, stochastic continuum) using analytical and numerical methods. Offered in alternate years. Prerequisite: NRES 489 and MATH 342 or MATH 345.

**NRES 586 Soil Organic Matter credit: 4 Hours.**

Explores soil organic matter as one of the most important and integrative characteristics of terrestrial ecosystems. Topics include the nature and origin of humic and non-humic substances in soils and sediments, their critical environmental functions (chemical reactivity and role in nutrient cycling), and the primary methods (elemental analysis, spectroscopy, isotopic methods, and C and N models) used to characterize organic matter and its dynamics. Offered in alternate years. Prerequisite: CHEM 232.

**NRES 590 Professionalism and Ethics credit: 2 Hours.**

Same as CPSC 590. See CPSC 590.

**NRES 592 Sustainable Urban Systems credit: 4 Hours.**

Same as CEE 592 and UP 576. See CEE 592.

**NRES 593 Statistical Methods in Ecology credit: 4 Hours.**

Focuses on statistical methods used to analyze ecological data. Includes application of general and generalized linear models including use of several probability distributions such as normal, binomial, Poisson, and negative binomial. Course also focuses on mixed models and approaches for imposing structure onto the variance-covariance matrix to account for non-independence or heterogeneous variance. Emphasis throughout is on evaluating and presenting results using both traditional ( $p$ -value) and information-theoretic (AIC) approaches. 4 graduate hours. No professional credit. Prerequisite: At least one course in ecology, including basic concepts of population and community ecology, and at least one course in statistics, including basic concepts of sampling, hypothesis testing, and techniques such as  $t$ -tests, linear regression, and ANOVA (e.g., CPSC/NRES 440 or equivalent). Graduate standing or permission of instructor required.

**NRES 594 NRES Professional Orientation credit: 1 Hour.**

The philosophy and components of graduate education with development of the principles useful in teaching, research, and extension in horticulture, natural resources and environmental sciences. Students will be required to develop and submit a proposal describing planned research for their M.S. or Ph.D. thesis. Approved for S/U grading only.

**NRES 598 Experimental Graduate Courses credit: 1 to 4 Hours.**

Experimental course on a special topic in natural resources and environmental sciences. May be repeated to a maximum of 12 hours.

**NRES 599 Thesis Research credit: 0 to 12 Hours.**

Research conducted in various phases of horticulture, natural resources, and environmental sciences leading to a thesis in natural resources and environmental sciences. Approved for S/U grading only. May be repeated.