

# Natural Resource Ecology and Management

The department addresses a broad spectrum of natural resource and environmental issues in a holistic approach to learning, discovery and engagement. Our vision of natural resources is that informed protection and management of natural resources involves an integration of biological, economic, and social considerations. Such an integrated and comprehensive approach to the education of future generations of natural resource managers and scientists is needed in order to sustain viable landscapes, facilitate strong communities, and produce desired goods, services, and functions from our natural resources.

Our educational mission for the undergraduate and graduate programs is to provide those learning experiences and opportunities that will ensure students can learn to function effectively in their chosen fields.

Central to that effective functioning are the abilities to:

- Identify, explain and critically evaluate their own beliefs, values and actions in relation to professional and societal standards of ethics.
- Anticipate, analyze and evaluate natural resource issues and opportunities, explaining the ecological, economic, and social consequences of natural resource actions at various scales and over time.
- Actively seek the input and perspectives of diverse stakeholders regarding natural resource problems and issues.
- Assess, analyze, synthesize, and evaluate information fairly and objectively.
- Work effectively, both individually and with others, on complex, value-laden natural resource problems that require holistic problem solving approaches.
- Formulate and evaluate alternative solutions to complex problems and recommend and defend best alternatives.
- Communicate clearly and effectively with all audiences using appropriate oral, visual, electronic, and written techniques.
- Recognize and interpret resource problems and opportunities across spatial scales from local to global.
- Appreciate cultural diversity and understand the impact of the global distribution of people and wealth on natural resource use and valuation.
- Exercise leadership skills as professionals and engaged citizens.
- Demonstrate creativity and innovation in identifying and pursuing opportunities that produce environmental, social, or economic value.
- Exercise life-long learning skills developed before graduation.

## Undergraduate Study

The Department of Natural Resource Ecology and Management offers work for the Bachelor of Science degree with majors in animal ecology or forestry. The department participates in interdisciplinary programs in biology, environmental studies, international studies, and pest management. By proper selection of free and restricted elective courses, students can obtain a minor or a second major in these programs or other disciplines.

The Department provides numerous scholarships; application information is available in the departmental Student Services Center.

## Animal Ecology (A Ecl)

The animal ecology curriculum provides its majors with an understanding of ecological principles and processes and their applications to natural resource management. It is oriented toward students desiring a general and flexible program in environmental biology and for those planning graduate study. Students may select from four options: Fisheries and Aquatic Sciences, Interpretation of Natural Resources, Preveterinary and Wildlife Care, or Wildlife. Graduates find employment as aquaculturists, aquatic ecologists, wildlife biologists, fisheries biologists, resource managers, and ecologists for industry, environmental consulting firms, natural resource and environmental agencies and organizations, zoos, and as educators.

Graduates of the Animal Ecology major understand the basic principles of animal biology, ecology and management, and relevant aspects of scientific communication, basic mathematics and sciences, computing applications, and personal and professional development. Four specific options prepare students for careers in interpretation of natural resources, fisheries and aquatic sciences, pre-veterinary and wildlife care, and wildlife. Each option has specific outcomes expectations that include (1) the scope of the specialization and its relationships to broader aspects of animal ecology, biotic resource management, and other allied scientific disciplines and professions, (2) career opportunities and requirements,

and (3) knowledge and skills appropriate for employment at technical and practitioner levels in each discipline. Graduates are able to communicate and work effectively in the multidisciplinary arena of ecology and natural resource management.

All options require three months (400 hours) of relevant work experience or study at a biological station prior to graduation. The latter may be accomplished at the university's affiliate field stations: Iowa Lakeside Laboratory at West Lake Okoboji, and Gulf Coast Research Laboratory at Ocean Springs, Mississippi. Information on these laboratories is available from the department's Student Services Center.

Preveterinary medicine preparation may be achieved while satisfying degree requirements in animal ecology.

Additional education and training can lead to other opportunities in such areas as research and management, natural resources planning and administration, teaching, and environmental consulting, among others. Graduate training is necessary for many specialized positions within the fields of animal ecology. Students preparing for graduate study should consult with their academic adviser concerning appropriate coursework.

Students wishing to be certified by the American Fisheries Society or The Wildlife Society need to consult with their advisors in selecting required courses in their respective programs. The formal application then needs to be completed and submitted for review by their professional societies. Certification in either society has many professional benefits and may be required or recommended for employment by federal and state agencies and private industry.

Students seeking certification to teach biology in secondary schools must meet requirements of the College of Human Sciences as well as those of the Animal Ecology curriculum. In addition, they must apply formally for admission to the teacher education program (see Index, Teacher Education Program). Students with an interest in careers in outdoor writing are encouraged to obtain a minor or a second major in journalism (see Index, Journalism and Communication, Courses and Programs). Students who wish to pursue a job as a conservation officer may wish to minor in criminal justice (see Index, Criminal Justice Studies).

## Minor - Animal Ecology

The department offers a minor in animal ecology that may be earned by taking 15 credits in the department including:

A ECL 312	Ecology	4
A ECL 365	Vertebrate Biology	4
NREM 120	Introduction to Renewable Resources	3

Plus four additional credits of Animal Ecology or NREM courses at the 300 level or above.

## Forestry (For)

The forestry curriculum offers courses dealing with the management of forest ecosystems for multiple benefits including wood and fiber products, biodiversity, recreation, water, wilderness, and wildlife. Conservation and preservation of natural resources are emphasized. The department offers work for the Bachelor of Science degree with a major in forestry and options in forest ecosystem management, interpretation of natural resources, urban and community forestry, natural resource conservation and restoration, or sustainable materials science and technology. All options lead to a professional degree in forestry (Bachelor of Science). The forestry major has been accredited by the Society of American Foresters (SAF) since 1935. The Council for Higher Education Accreditation recognizes SAF as the specialized accrediting body for forestry education in the United States. The primary goal of the undergraduate curriculum in forestry is to educate foresters to be capable of scientifically managing the nation's forest lands and related ecosystems - private and public.

Graduates understand and can apply scientific principles associated with forests, forest ecosystem management, and wood and non-wood products. Graduates are able to communicate effectively and work well in teams. They are capable of preparing and delivering effective oral and written communication of scientific and technical decisions to professional and lay audiences. They are proficient in technical skills such as measurements, computer usage, inventory, economic analysis, data and situation analysis, and ecosystem assessment. They recognize the importance of ethics in forestry and are sensitive to cultural diversity and broad environmental concerns.

Graduates of the forest ecosystem management option are skilled at understanding how forests function and how forests can be managed to produce desired goods (wood, fiber, recreation, wildlife habitat) and services (clean water, carbon sequestration, wilderness) in the long-run. They are skilled at interpretation of interactions and effects of abiotic and biotic factors in forests and quantification of bio-physical, social, and economic outputs from forest ecosystems. They are

skilled at complex decision-making involving private and public forest resources where ethical, legal, social, economic, and ecological dimensions are explicitly considered.

Graduates of the interpretation of natural resources option are skilled at communicating with the public about the values associated with forest ecosystems and providing educational programs for all ages.

Graduates of the urban and community forestry option are able to combine biological, social, legal, and economic expertise to effectively manage trees or forests in an urban setting. They are skilled at decision-making related to site assessment, and long-term management of urban trees and forests to achieve multiple goals.

Graduates of the natural resource conservation and restoration option are skilled at assessing the natural functions of the environment and human impacts. They are skilled at interpretation of forest and other natural environments and making decisions relating to their conservation and preservation.

Graduates of the sustainable materials science and technology option understand the anatomical, physical, and chemical properties of wood and other bio-renewable materials and know wood processing operations involved in drying, composite materials manufacturing, and chemical treatment.

In consultation with their adviser, students can select elective courses related to elective courses in the forest ecosystem management option to emphasize forest ecology; wildlife, wilderness, and recreation management; water quality and erosion protection; quantitative-analytical techniques; business and marketing; and other areas related to natural resource management. Elective courses in the urban and community forestry option can be selected to emphasize plant health, policy and planning, ecology, hydrology, sociology, business administration, or horticulture/design. Elective courses related to the natural resource conservation and restoration option can be selected to emphasize, ecology, wildlife, recreation, nature interpretation, landscape design, sociology and ethics of conservation and preservation. Similarly, elective courses in the sustainable materials science and technology option can be selected to emphasize wood production, bio-renewable materials, wood fiber, business and marketing, and quality assurance. Elective courses in the interpretation of natural resources option can be selected to emphasize natural history, animal ecology, and environmental education.

Many private firms as well as national, regional, state, and local agencies seek forestry graduates to fill positions in management of natural resources for commodity and non-commodity multiple benefits. Graduates in forestry are prepared to be involved with evolving forestry systems, such as agroforestry and urban forestry. Wood processing industries, such as composite products, plywood, particle board, lumber, and pulp and paper offer professional opportunities in production, product development, quality control, and marketing.

With advanced graduate study, the range of professional job opportunities for a person with a B.S. in forestry is expanded. Opportunities include research and education as well as more specialized managerial and administrative positions with private firms and public agencies.

During fall semester of the second year of study (sophomore year, typically), forestry students are required to enroll in the department's integrated forestry modules consisting of:

FOR 201	Forest Biology	2
FOR 202	Wood Utilization	2
FOR 203	Resource Measurements/Evaluation	2
FOR 204	Forest Ecosystem Decision-Making	2
FOR 205	Integrated Forestry Laboratory	3
FOR 206	Fall Forestry Camp	4

That semester, consisting entirely of forestry coursework, is designed to give students an early understanding of the many aspects of forestry and how they are interrelated. In addition to work in the classroom, students will spend time in laboratory and field work each week. A 3-week off-campus fall camp during the semester will reinforce concepts learned both in the classroom and during laboratory/field sessions. Transfer students should check with the department for counsel on timing their completion of the integrated forestry modules.

## Minor - Forestry

The department offers a minor in forestry which can be earned by completion of a minimum of 15 credits in forestry courses. Students wishing to emphasize management and environmental aspects of forestry must select at least 15 credits from the following courses:

FOR 302	Silviculture	3
FOR 356	Dendrology	4

FOR 451	Forest Resource Economics and Quantitative Methods	4
FOR 452	Ecosystem Management	3
FOR 475	Urban Forestry	3
NREM 120	Introduction to Renewable Resources	3
NREM 301	Natural Resource Ecology and Soils	4
NREM 345	Natural Resource Photogrammetry and Geographic Information Systems	3
NREM 390	Fire Ecology and Management	3
NREM 407	Watershed Management	4

Students wishing to emphasize sustainable materials science and technology must complete 280 and an additional 12 credits from the following courses:

FOR 480	Wood Anatomy and Fiber Analysis	3
FOR 481	Conversion of Lignocellulosic Materials	3
FOR 483	Wood Deterioration and Preservation	3
FOR 485	Wood and Natural Fiber Composites	3
FOR 486	Drying Processes for Wood and Other Lignocellulosic Materials	3
FOR 487	Physical Properties of Wood	4
NREM 490B	Independent Study: Forestry	1-4

## Graduate Study

The Department of Natural Resource Ecology and Management offers work for the degrees Master of Science and Doctor of Philosophy with majors in fisheries biology, forestry, and wildlife ecology. A non-thesis masters degree is available for students desiring a general degree program without thesis research. Students may also major in interdepartmental graduate majors in biorenewable resources technology, ecology and evolutionary biology, environmental science, genetics, plant physiology, sustainable agriculture, or toxicology (see Index ). All students are required to teach and conduct research as part of their training for the Ph.D. degree.

## Fisheries Biology and Wildlife Ecology

Graduates have a broad understanding of the basic principles of animal biology, ecology and management, and relevant aspects of basic mathematics and natural sciences, computing applications, and personal and professional development. They are able to execute rigorous independent research, have developed problem-solving and critical-thinking skills, and can communicate effectively with scientific colleagues and the general public in both formal and informal settings.

Personnel of the U.S. Geological Survey's Iowa Cooperative Fish and Wildlife Research Unit contribute significantly to the graduate program of the department through teaching and research. Governmental agencies such as the U.S. Fish and Wildlife Service, Natural Resources Conservation Service and the Iowa Department of Natural Resources, and non-governmental agencies such as The Nature Conservancy and the Iowa Natural Heritage Foundation also contribute to the graduate program by funding research, providing in-kind support, and providing numerous formal and informal mentoring relationships.

No more than two dual-listed animal ecology courses may be applied for major graduate credit. Additional work is expected of students taking a dual-listed course for credit at the 500 level.

## Forestry

The department offers programs leading to the degrees of Master of Science and Doctor of Philosophy with a major in forestry and minor work to students taking major work in other departments.

Graduates are skilled at defining a research problem in forestry, applying scientific principles and appropriate methods, and analyzing the results. They are capable of understanding the many facets of forest and wood science and are very knowledgeable in specific areas in forestry. They are able to deal with complex forestry problems, and where appropriate, they are capable of blending ecological, social, ethical, legal, and economic factors in the research process. They are very skilled at communicating, both in written and oral form, research results to professional and lay audiences. They are sensitive to cultural diversity and work effectively with peers, natural resource professionals, and the public.

The graduate program is open to, and suitable for, students who have majored in forestry or related natural resource fields. A non-thesis master's option is available.

The department participates in the Masters in Business Administration (M.B.A.), with specialization in the agriculture program administered by the College of

Business, providing an opportunity to obtain an M.B.A. degree while taking advanced courses in forestry and maintaining contact with the profession of forestry.

## Curriculum in Animal Ecology

### Total Degree Requirement: 128 cr.

Only 65 cr. from a two-year institution may apply which may include up to 16 technical cr.; 9 P-NP cr. of free electives; 2.00 minimum GPA.

### International Perspective: 3 cr.

### U.S. Diversity: 3 cr.

### Communications Proficiency (with a C or better):

English composition	6
Speech fundamentals	3

### Communication/Library 16 cr.

ENGL 150	Critical Thinking and Communication	3
ENGL 250	Written, Oral, Visual, and Electronic Composition	3
SP CM 212	Fundamentals of Public Speaking	3
Plus 6 credits of the following:		6

ENGL 207	Introduction to Creative Writing	
ENGL 302	Business Communication	
ENGL 303	Free-Lance Writing for Popular Magazines	
ENGL 304	Creative Writing--Fiction	
ENGL 305	Creative Writing--Nonfiction	
ENGL 306	Creative Writing--Poetry	
ENGL 309	Report and Proposal Writing	
ENGL 310	Rhetorical Analysis	
ENGL 312	Biological Communication	
ENGL 314	Technical Communication	
AGEDS 311	Presentation and Sales Strategies for Agricultural Audiences	
JL MC 201	Reporting and Writing for the Mass Media	
JL MC 305	Publicity Methods	
SP CM 312	Business and Professional Speaking	
SP CM 313	Communication in Classrooms and Workshops	
LIB 160	Information Literacy	1
Total Credits		16

### Humanities and Social Sciences: 6 cr.

Approved Humanities course	3
Approved Social Science course	3
Total Credits	6

### Ethics: 3 cr.

3 cr. from approved ethics list.

### Life Sciences: 6 cr.

BIOL 211	Principles of Biology I	3
Approved Life Sciences course		3
Total Credits		6

### Mathematical Sciences: 9 cr.

MATH 140	College Algebra	3
MATH 142	Trigonometry and Analytic Geometry	3
STAT 101	Principles of Statistics	3-4
or STAT 104	Introduction to Statistics	
Total Credits		9-10

### Physical Sciences: 13-14 cr.

CHEM 163	College Chemistry	4
CHEM 163L	Laboratory in College Chemistry	1
or CHEM 177 and CHEM 177L		
CHEM 231	Elementary Organic Chemistry	3
CHEM 231L	Laboratory in Elementary Organic Chemistry	1
or CHEM 331, CHEM 331L, CHEM 332		

PHYS 115	Physics for the Life Sciences	4
PHYS 115L	Laboratory in Physics for the Life Sciences	1
or PHYS 111		
Total Credits		14

### Biological Sciences: 20 cr.

NREM 110	Orientation in Natural Resource Ecology and Management	1
NREM 120	Introduction to Renewable Resources	3
NREM 211	Careers in Natural Resources	1
A ECL 312	Ecology	4
A ECL 365	Vertebrate Biology	4
BIOL 211	Principles of Biology I	3
BIOL 211L	Principles of Biology Laboratory I	1
BIOL 212	Principles of Biology II	3
BIOL 212L	Principles of Biology Laboratory II	1
Total Credits		21

### Practical Experience:

NREM 104 Practical Work Experience

## Fisheries and Aquatic Sciences option

A ECL 321	Fish Biology	3
A ECL 486	Aquatic Ecology	3
A ECL 486L	Aquatic Ecology Laboratory	1

One of the following:

MATH 160	Survey of Calculus	
MATH 165	Calculus I	
MATH 181	Calculus and Mathematical Modeling for the Life Sciences I	

Plus 20 credits from approved list		20
Total Credits		31

## Interpretation of Natural Resources option

A ECL 366	Natural History of Iowa Vertebrates	3
BIOL 366	Plant Systematics	4
ENT 370	Insect Biology	3
NREM 303	Internship	1-3
NREM 330	Principles of Interpretation	3
BIOL 474	Plant Ecology	3-4
or FOR 356	Dendrology	

One of the following:

AGRON 154	Fundamentals of Soil Science	
AGRON 206	Introduction to Weather and Climate	
ASTRO 120	The Sky and the Solar System	
GEOL 100	The Earth	
GEOL 101	Environmental Geology: Earth in Crisis	
GEOL 108	Introduction to Oceanography	

Plus additional credits from approved list to total 33 credit hours.		12
Total Credits		32-35

## Preveterinary & Wildlife care option

AN S 214	Domestic Animal Physiology	3
or B M S 329	Anatomy and Physiology of Domestic Animals	
NREM 330	Principles of Interpretation	3

One of the following:

A ECL 551	Behavioral Ecology	
AN S 336	Domestic Animal Behavior and Well-Being	
BIOL 354	Animal Behavior	
ANTHR 438	Primate Evolutionary Ecology and Behavior	

One of the following:

A ECL 321	Fish Biology	
A ECL 366	Natural History of Iowa Vertebrates	
A ECL 457	Herpetology	

A ECL 458	Ornithology	
A ECL 459	Mammalogy	
One of the following:		3
B M S 415	Anatomy of Laboratory Animals	
B M S 416	Avian Anatomy	
BIOL 335	Principles of Human and Other Animal Physiology	
BIOL 351	Comparative Chordate Anatomy	
BIOL 352	Vertebrate Histology	
BIOL 434	Endocrinology	
One of the following:		3
AN S 331	Domestic Animal Reproduction	
BIOL 313	Principles of Genetics	
BIOL 423	Developmental Biology	
GEN 320	Genetics, Agriculture and Biotechnology	
NREM 315	Genetics for Natural Resource Managers.	3
One of the following:		3
A ECL 401	Intro to Aquatic Animal Medicine	
A ECL 442	Aquaculture	
A ECL 454	Principles of Wildlife Disease	
AN S 319	Animal Nutrition	
AN S 493	Workshop in Animal Science	
BIOL 353	Introductory Parasitology	
MICRO 201	Introduction to Microbiology	
MICRO 201L	Introductory Microbiology Laboratory	
3 cr from course level 300-500 from A ECL or NREM		3
Plus additional credits from approved list to total 33 credit hours.		12
Total Credits		39

### Wildlife option

A ECL 371	Ecological Methods	3
A ECL 451	Wildlife Ecology and Management	3
BIOL 313	Principles of Genetics	3
or GEN 320	Genetics, Agriculture and Biotechnology	
or NREM 315	Genetics for Natural Resource Managers.	
BIOL 366	Plant Systematics	4
One of the following:		4
MATH 160	Survey of Calculus	
MATH 165	Calculus I	
MATH 181	Calculus and Mathematical Modeling for the Life Sciences I	
Six hours from the following:		6
A ECL 457	Herpetology	
A ECL 458	Ornithology	
A ECL 459	Mammalogy	
Six hours from the following:		6
A ECL 455	International Wildlife Issues	
ENV S 293	Environmental Planning	
ENV S 383	Environmental Politics and Policies	
FOR 453	Forest Resource Policy and Administration	
NREM 270	Foundations in Natural Resource Policy and History	
NREM 385	Natural Resource Policy	
NREM 452	Ecosystem Management	
NREM 460	Controversies in Natural Resource Management	
Three hours from the following:		3
A ECL 415	Ecology of Freshwater Invertebrates, Plants, and Algae	
A ECL 454	Principles of Wildlife Disease	
A ECL 516	Avian Ecology	
A ECL 551	Behavioral Ecology	
ANTHR 438	Primate Evolutionary Ecology and Behavior	
BIOL 315	Biological Evolution	
BIOL 336	Ecological and Evolutionary Animal Physiology	
BIOL 354	Animal Behavior	

BIOL 354L	Laboratory in Animal Behavior	
BIOL 471	Introductory Conservation Biology	
EEOB 507	Advanced Animal Behavior	
ENT 370	Insect Biology	
Five hours from the following:		5
A ECL 415	Ecology of Freshwater Invertebrates, Plants, and Algae	
AGRON 317	Principles of Weed Science	
BIOL 355	Plants and People	
BIOL 454	Plant Anatomy	
BIOL 456	Principles of Mycology	
BIOL 474	Plant Ecology	
EEOB 564	Wetland Ecology	
FOR 356	Dendrology	
Plus additional credits from approved list to total 42 credit hours.		1
Total Credits		38

### Curriculum in Forestry

#### Total Degree Requirement: 128 cr.

Only 65 cr. from a two-year institution may apply which may include up to 16 technical cr.; 9 P-NP cr. of free electives; 2.00 minimum GPA.

#### International Perspective: 3 cr.

#### U.S. Diversity: 3 cr.

#### Communications Proficiency (with a C or better):

English composition	6
Speech fundamentals	3
Total Credits	9

#### Communication/Library: 12.5 cr.

ENGL 150	Critical Thinking and Communication	3
ENGL 250	Written, Oral, Visual, and Electronic Composition	3
One of the following:		3
ENGL 302	Business Communication	
ENGL 309	Report and Proposal Writing	
ENGL 312	Biological Communication	
ENGL 314	Technical Communication	
SP CM 212	Fundamentals of Public Speaking	3
LIB 160	Information Literacy	1
Total Credits		13

#### Humanities and Social Sciences: 6 cr.

Three credit hours from approved humanities list	3	
SOC 130	Rural Institutions and Organizations	3
or SOC 134	Introduction to Sociology	
Total Credits		6

#### Ethics: 3 cr.

3 cr. from approved list.

#### Life Sciences: 6 cr.

BIOL 211	Principles of Biology I	3
Approved Life Science course		3
Total Credits		6

#### Mathematics, Physical and Life Sciences: 22 cr.

MATH 140	College Algebra	3
MATH 150	Discrete Mathematics for Business and Social Sciences	3
STAT 101	Principles of Statistics	4
CHEM 163	College Chemistry	4
CHEM 163L	Laboratory in College Chemistry	1
BIOL 211	Principles of Biology I	3
BIOL 211L	Principles of Biology Laboratory I	1
AGRON 154	Fundamentals of Soil Science	3
Total Credits		22



**Forestry: 29 cr.**

NREM 120	Introduction to Renewable Resources	3
NREM 104	Practical Work Experience	R
NREM 110	Orientation in Natural Resource Ecology and Management	1
NREM 211	Careers in Natural Resources	1
FOR 201	Forest Biology	2
FOR 202	Wood Utilization	2
FOR 203	Resource Measurements/Evaluation	2
FOR 204	Forest Ecosystem Decision-Making	2
FOR 205	Integrated Forestry Laboratory	3
FOR 206	Fall Forestry Camp	4
FOR 302	Silviculture	3
FOR 451	Forest Resource Economics and Quantitative Methods	4
FOR 454	Forestry Practicum	3
Total Credits		30

**Electives:** Students majoring in forestry are required to choose one of the following options at the end of their sophomore year: forest ecosystem management; sustainable material science and technology; urban and community forestry; natural resource conservation and restoration; or interpretation of natural resources.

**Forest Ecosystem Management**

BIOL 212	Principles of Biology II	3
BIOL 212L	Principles of Biology Laboratory II	1
FOR 280	Wood Properties and Identification	4
FOR 342	Dynamics of Forest Stands	3
FOR 356	Dendrology	4
FOR 452	Ecosystem Management	3
MATH 151	Calculus for Business and Social Sciences	3-4
or MATH 181	Calculus and Mathematical Modeling for the Life Sciences I	
NREM 301	Natural Resource Ecology and Soils	4
NREM 345	Natural Resource Photogrammetry and Geographic Information Systems	3
PL P 416	Forest Insect and Disease Ecology	4
One course from the following:		3
FOR 453	Forest Resource Policy and Administration	
NREM 385	Natural Resource Policy	
or NREM 460	Controversies in Natural Resource Management	
Total Credits		35-36

**Interpretation of Natural Resources**

A ECL 365	Vertebrate Biology	4
A ECL 366	Natural History of Iowa Vertebrates	3
BIOL 212	Principles of Biology II	3
BIOL 212L	Principles of Biology Laboratory II	1
BIOL 366	Plant Systematics	4
ENT 370	Insect Biology	3
FOR 452	Ecosystem Management	3
NREM 303	Internship	1-3
NREM 330	Principles of Interpretation	3
One course from the following:		3
BIOL 474	Plant Ecology	
FOR 356	Dendrology	
One course from the following:		3
AGRON 206	Introduction to Weather and Climate	
ASTRO 120	The Sky and the Solar System	
GEOL 100	The Earth	
GEOL 101	Environmental Geology: Earth in Crisis	
GEOL 108	Introduction to Oceanography	
One course from the following:		3
FOR 453	Forest Resource Policy and Administration	
NREM 385	Natural Resource Policy	

NREM 460	Controversies in Natural Resource Management	
Total Credits		34-36

**Natural Resource Conservation and Restoration**

A ECL 312	Ecology	4
BIOL 212	Principles of Biology II	3
BIOL 212L	Principles of Biology Laboratory II	1
BIOL 204	Biodiversity	2
FOR 356	Dendrology	4
FOR 452	Ecosystem Management	3
NREM 301	Natural Resource Ecology and Soils	4
NREM 330	Principles of Interpretation	3
NREM 390	Fire Ecology and Management	3
NREM 407	Watershed Management	4
MATH 151	Calculus for Business and Social Sciences	3-4
or MATH 181	Calculus and Mathematical Modeling for the Life Sciences I	
PL P 416	Forest Insect and Disease Ecology	4
One course from:		3
FOR 453	Forest Resource Policy and Administration	
NREM 385	Natural Resource Policy	
NREM 460	Controversies in Natural Resource Management	
Three credit hours from approved list of electives		3
Total Credits		44-45

**Sustainable Materials Science and Technology**

FOR 280	Wood Properties and Identification	4
FOR 480	Wood Anatomy and Fiber Analysis	3
FOR 481	Conversion of Lignocellulosic Materials	3
FOR 483	Wood Deterioration and Preservation	3
FOR 485	Wood and Natural Fiber Composites	3
FOR 486	Drying Processes for Wood and Other Lignocellulosic Materials	3
FOR 487	Physical Properties of Wood	4
MATH 151	Calculus for Business and Social Sciences	3
TSM 270	Principles of Injury Prevention	3
or TSM 310	Total Quality Improvement	
Total Credits		29

**Urban and Community Forestry**

BIOL 212	Principles of Biology II	3
BIOL 212L	Principles of Biology Laboratory II	1
FOR 280	Wood Properties and Identification	4
C R P 201	The American Metropolis	3
or C R P 301	Planning Methods Studio	
FOR 356	Dendrology	4
FOR 452	Ecosystem Management	3
FOR 475	Urban Forestry	3
MATH 151	Calculus for Business and Social Sciences	3-4
or MATH 181	Calculus and Mathematical Modeling for the Life Sciences I	
PL P 416	Forest Insect and Disease Ecology	4
SOC 310	Community	3
or SOC 382	Environmental Sociology	
One course from the following:		3
FOR 453	Forest Resource Policy and Administration	
NREM 385	Natural Resource Policy	
NREM 460	Controversies in Natural Resource Management	
Total Credits		34-35

**Courses primarily for undergraduates:**

**A ECL 312. Ecology.**

(Cross-listed with BIOL, ENSCI). (3-3) Cr. 4. F.SS. *Prereq: BIOL 211L and BIOL 212L*

Fundamental concepts and principles of ecology dealing with organisms, populations, communities and ecosystems. Laboratory and field exercises examine ecological principles and methods as well as illustrate habitats.

**A ECL 312I. Ecology.**

(Cross-listed with IA LL, ENSCI). Cr. 4. SS.

An introduction to the principles of ecology at the population, community and ecosystem level. Field studies of local lakes, wetlands and prairies are used to examine factors controlling distributions, interactions, and roles of plants and animals in native ecosystems.

**A ECL 321. Fish Biology.**

(2-3) Cr. 3. S. *Prereq: A ECL 365*

Biology, ecology, and evolution of fishes. Emphasis on structure, physiology, and behavior, including a focus on the conservation and management of fishes and their habitats. Laboratory focus on fish morphology, survey methods, identification, distribution, habits, and habitats of fishes.

**A ECL 326I. Ornithology.**

(Cross-listed with IA LL). Cr. 4. SS.

The biology, ecology, and behavior of birds with emphasis on field studies of local avifauna. Group projects stress techniques of population analysis and methodology for population studies.

**A ECL 365. Vertebrate Biology.**

(Cross-listed with BIOL). (3-2) Cr. 4. F. *Prereq: BIOL 212, BIOL 212L*

Evolution, biology, and classification of fish, amphibians, reptiles, birds, and mammals. Emphasis on a comparative analysis of the structure and function of organ systems. Laboratory exercises concentrate on morphology and identification of orders of vertebrates.

**A ECL 366. Natural History of Iowa Vertebrates.**

(2-3) Cr. 3. S. *Prereq: BIOL 211, BIOL 211L, BIOL 212, BIOL 212L*

Vertebrate fauna of Iowa, including fishes, amphibians, reptiles, birds, and mammals. Species identification, habitat requirements, community structure and assessment, conservation issues that include historical population changes and value of wild animals to the region's ecological and economic health.

**A ECL 371. Ecological Methods.**

(Cross-listed with BIOL). (2-3) Cr. 3. F. *Prereq: A ECL 312; STAT 101 or STAT 104*

Quantitative techniques used in management of natural resources with emphasis on inventory and manipulation of habitat and animal populations. Nonmajor graduate credit.

**A ECL 401. Intro to Aquatic Animal Medicine.**

(Cross-listed with B M S). (1-2) Cr. 1. S.

8 week course. Introductory course with focus on fin fish production, health and medicine. Course content will help define future roles for veterinarians, producers, and service providers. Emphasis will be placed on anatomy, pathology, infectious diseases, nutrition, regulatory constraints in production, food safety, and current research. Field trip to aquaculture facility.

**A ECL 404I. Behavioral Ecology.**

(Cross-listed with IA LL). Cr. 4. Alt. SS., offered 2012. *Prereq: Two semesters of biology*

Animal coloniality, courtship, territoriality, predator defense, habitat selection, foraging, mating systems, and parental care will be examined in the field in order to evaluate various ecological and evolutionary theories of animal behavior.

**A ECL 415. Ecology of Freshwater Invertebrates, Plants, and Algae.**

(Dual-listed with A ECL 515). (2-3) Cr. 3. Alt. F., offered 2012. *Prereq: A ECL 312*

Identification, biology, and ecological requirements of freshwater invertebrates, plants and algae. Additional emphases on community sampling methods and analysis, and use of organisms as tools for aquatic ecosystem health assessment.

**A ECL 418. Stream Ecology.**

(Dual-listed with A ECL 518). (Cross-listed with ENSCI). (2-3) Cr. 3. Alt. F., offered 2011. *Prereq: 486*

Biological, chemical, physical, and geological processes that determine the structure and function of flowing water ecosystems. Current ecological theories as well as applications to stream management for water quality and fisheries.

**A ECL 419I. Vertebrate Ecology and Evolution.**

(Cross-listed with IA LL). Cr. 4. SS.

Field and laboratory study of representative vertebrates of northwestern Iowa. Observations and experimentation emphasize ecological histories by integrating concepts of functional morphology, behavioral ecology, and evolutionary biology. Nonmajor graduate credit.

**A ECL 420I. Amphibians and Reptiles.**

(Cross-listed with IA LL). Cr. 4. Alt. SS., offered 2012. *Prereq: Two semesters of biology*

Ecology, behavior, and conservation biology of amphibians and reptiles with emphasis on their anatomy and morphology; temperature and water regulation; locomotion; life history; reproduction; population and community ecology; and conservation.

**A ECL 425. Aquatic Insects.**

(Dual-listed with A ECL 525). (Cross-listed with ENT). (2-3) Cr. 3. Alt. S., offered 2013. *Prereq: BIOL 312 or equivalent*

Courtney. Morphology, ecology, diversity, and significance of aquatic insects, with emphasis on the collection, curation and identification of taxa in local streams and lakes.

**A ECL 440. Fishery Management.**

(Dual-listed with A ECL 540). (2-3) Cr. 3. F. *Prereq: A ECL 312, A ECL 321, STAT 101 or STAT 104; credit or enrollment in A ECL 486*

Biological basis of fishery management, fishery problems, and management practices for freshwater, anadromous, and marine fisheries.

**A ECL 442. Aquaculture.**

(Dual-listed with A ECL 542). (3-0) Cr. 3. Alt. S., offered 2012. *Prereq: credit or enrollment in A ECL 321*

Concepts related to the culture of aquatic organisms including culture systems, water quality, nutrition, genetics, diseases, and marketing.

**A ECL 451. Wildlife Ecology and Management.**

(2-3) Cr. 3. F. *Prereq: A ECL 371*

Ecological theory and practice of wildlife management, including, population ecology, habitat management, and current issues in the field. Course involves a series of case studies addressing actual wildlife issues using field and quantitative methods. Nonmajor graduate credit.

**A ECL 454. Principles of Wildlife Disease.**

(Dual-listed with A ECL 554). (3-0) Cr. 3. S. *Prereq: Junior standing and at least 10 credits in biological sciences at the 300+ level*

Ecological and epidemiological aspects of diseases as they relate to wildlife populations. Topics to be covered include: major classes of disease; detection, description, monitoring, and management of disease; characteristics and interactions between disease agents and wildlife hosts; relationships among wildlife, domestic animal, and human health.

**A ECL 455. International Wildlife Issues.**

(3-0) Cr. 3. Alt. F., offered 2012. *Prereq: A ECL 365, A ECL 312 or graduate standing; NREM 120*

Biological, political, social, and economic factors affecting the management of international wildlife resources. Nonmajor graduate credit. Meets International Perspectives Requirement.

**A ECL 457. Herpetology.**

(Dual-listed with A ECL 557). (Cross-listed with BIOL). (2-3) Cr. 3. F. *Prereq: BIOL 351 or BIOL 365*

Dual listed with EEOB 557. Biology, ecology, and evolution of amphibians (salamanders, frogs, caecilians) and reptiles (lizards, snakes, tuatara, turtles, crocodylians). Emphasis on structure, physiological adaptation to different environments, behavior, reproduction, roles of amphibians and reptiles in ecosystems, and conservation. Laboratory focus on survey methods, identification, relationships, distribution, habits, and habitats of amphibians and reptiles.

**A ECL 458. Ornithology.**

(Dual-listed with A ECL 558). (Cross-listed with BIOL). (2-3) Cr. 3. S. *Prereq: A ECL 365 or BIOL 351*

Biology, evolution, ecology and taxonomy of birds. Emphasis on structure, physiology, behavior, communication, navigation, reproduction, and conservation. Laboratory exercises complement lecture topics, emphasize identification and distribution of Midwest birds, and include field trips.

**A ECL 459. Mammalogy.**

(Dual-listed with A ECL 559). (Cross-listed with BIOL). (2-3) Cr. 3. S. *Prereq: BIOL 351 or A ECL 365*

Biology, ecology, and evolution of mammals. Emphasis on structure, physiological adaptation to different environments, behavior, reproduction, roles of mammals in ecosystems, and conservation. Laboratory focus on identification, distribution, habits, and habitats of mammals.

**A ECL 480. Studies in Marine Biology.**

Cr. 1-8. Repeatable. SS.

Courses taken at Gulf Coast Research Laboratory and other marine biological stations are transferred to Iowa State University under this number.

**A ECL 486. Aquatic Ecology.**

(Dual-listed with A ECL 586). (Cross-listed with ENSCI). (3-0) Cr. 3. F. *Prereq: Biol 312 or EnSci 381 or EnSci 402 or NREM 301*

Dual-listed with EEOB 586. Structure and function of aquatic ecosystems with application to fishery and pollution problems. Emphasis on lacustrine, riverine, and wetland ecology. Nonmajor graduate credit.

**A ECL 486L. Aquatic Ecology Laboratory.**

(Cross-listed with ENSCI, BIOL). (0-3) Cr. 1. F. *Prereq: Concurrent enrollment in BIOL 486*

Dual-listed with EEOB 586L. Field trips and laboratory exercises to accompany 486. Hands-on experience with aquatic research and monitoring techniques and concepts. Nonmajor graduate credit.

**Courses primarily for graduate students, open to qualified undergraduates:****A ECL 515. Ecology of Freshwater Invertebrates, Plants, and Algae.**

(Dual-listed with A ECL 415). (2-3) Cr. 3. Alt. F., offered 2012. *Prereq: A ECL 312*

Identification, biology, and ecological requirements of freshwater invertebrates, plants and algae. Additional emphases on community sampling methods and analysis, and use of organisms as tools for aquatic ecosystem health assessment.

**A ECL 516. Avian Ecology.**

(3-0) Cr. 3. Alt. S., offered 2012. *Prereq: A ECL 365, A ECL 312, or graduate standing*

Current topics and theories including avian breeding and foraging ecology, population biology, community structure, habitat selection, field methodologies, and data interpretation.

**A ECL 518. Stream Ecology.**

(Dual-listed with A ECL 418). (Cross-listed with ENSCI). (2-3) Cr. 3. Alt. F., offered 2011. *Prereq: A ECL 486*

Biological, chemical, physical, and geological processes that determine the structure and function of flowing water ecosystems. Current ecological theories as well as applications to stream management for water quality and fisheries.

**A ECL 520. Fisheries Science.**

(3-0) Cr. 3. Alt. S., offered 2013. *Prereq: A ECL 312, A ECL 321*

Concepts, approaches, and techniques for assessment of recreational and commercial fisheries. Scope will range from individual fish to entire ecosystems, both freshwater and marine.

**A ECL 523I. Fish Ecology.**

(Cross-listed with IA LL). Cr. 4. Alt. SS., offered 2012.

Basic principles of fish interaction with the biotic and abiotic environment. Field methods, taxonomy, and biology of fish with emphasis on the fish fauna of northwestern Iowa.

**A ECL 525. Aquatic Insects.**

(Dual-listed with A ECL 425). (Cross-listed with ENT). (2-3) Cr. 3. Alt. S., offered 2013. *Prereq: BIOL 312 or equivalent*

Courtney. Morphology, ecology, diversity and significance of aquatic insects, with emphasis on the collection, curation and identification of taxa in local streams and lakes.

**A ECL 526I. Advanced Field Ornithology.**

(Cross-listed with IA LL). Cr. 2. SS. *Prereq: Concurrent registration in IA LL 326I*

Field study of birds of the upper Midwest; extended field trip to Minnesota and Wisconsin; individual or group project.

**A ECL 531. Conservation Biology.**

(Cross-listed with EEOB). (3-0) Cr. 3. Alt. S., offered 2012. *Prereq: BIOL 312; BIOL 313 or graduate standing*

Examination of conservation issues from a population and a community perspective. Population-level analysis will focus on the role of genetics, demography, and environment in determining population viability. Community perspectives will focus on topics such as habitat fragmentation, reserve design, biodiversity assessment, and restoration ecology.

**A ECL 531I. Conservation Biology.**

(Cross-listed with EEOB, IA LL). Cr. 4. Alt. SS., offered 2012. *Prereq: IA LL 312I* Population-and community-level examination of factors influencing the viability of plant and animal populations from both demographic and genetic perspectives; assessment of biodiversity; design and management of preserves.

**A ECL 535I. Restoration Ecology.**

(Cross-listed with IA LL, ENSCI, EEOB). Cr. 4. Alt. SS., offered 2012. *Prereq: A course in ecology*

Ecological principles for the restoration of native ecosystems; establishment (site preparation, selection of seed mixes, planting techniques) and management (fire, mowing, weed control) of native vegetation; evaluation of restorations. Emphasis on the restoration of prairie and wetland vegetation.

**A ECL 540. Fishery Management.**

(Dual-listed with A ECL 440). (2-3) Cr. 3. F. *Prereq: A ECL 312, A ECL 321, STAT 101 or STAT 104; credit or enrollment in A ECL 486*

Biological basis of fishery management, fishery problems, and management practices for freshwater, anadromous, and marine fisheries.

**A ECL 542. Aquaculture.**

(Dual-listed with A ECL 442). (3-0) Cr. 3. Alt. S., offered 2012. *Prereq: credit or enrollment in A ECL 321*

Concepts related to the culture of aquatic organisms including culture systems, water quality, nutrition, genetics, diseases, and marketing.

**A ECL 551. Behavioral Ecology.**

(2-2) Cr. 3. Alt. S., offered 2012. *Prereq: a course in ecology or animal behavior*

The study of how an animal's behavior affects its ability to survive and reproduce in its environment. Course topics, such as foraging behavior, sexual selection, parental care, etc., represent the interface of ecology, evolution, and behavior.

**A ECL 554. Principles of Wildlife Disease.**

(Dual-listed with A ECL 454). (3-0) Cr. 3. S. *Prereq: Graduate classification*

Ecological and epidemiological aspects of disease as they relate to wildlife populations. Topics to be covered include: major classes of disease; detection, description, monitoring, and management of disease; characteristics and interactions between disease agents and wildlife hosts; relationship among wildlife, domestic animal, and human health.

**A ECL 557. Herpetology.**

(Dual-listed with A ECL 457). (Cross-listed with A ECL). (2-3) Cr. 3. F. *Prereq: A ECL 365 or BIOL 351*

Biology, ecology, and evolution of amphibians (salamanders, frogs, caecilians) and reptiles (lizards, snakes, tuatara, turtles, crocodilians). Emphasis on structure, physiological adaptation to different environments, behavior, reproduction, roles of amphibians and reptiles in ecosystems, and conservation. Laboratory focus on survey methods, identification, relationships, distribution, habits, and habitats of amphibians and reptiles.

**A ECL 558. Ornithology.**

(Dual-listed with A ECL 458). (Cross-listed with EEOB). (2-3) Cr. 3. S. *Prereq: A ECL 365 or BIOL 351*

Dual-listed with Biol 458. Biology, ecology, evolution, and taxonomy of birds. Emphasis on structure, physiology, behavior, communication, navigation, reproduction, and conservation. Laboratory exercises complement lecture topics, emphasize identification and distribution of Midwest birds, and include field trips.

**A ECL 559. Mammalogy.**

(Dual-listed with A ECL 459). (Cross-listed with BIOL). (2-3) Cr. 3. S. *Prereq: BIOL 351 or A ECL 365*

Biology, ecology, and evolution of mammals. Emphasis on structure, physiological adaptation to different environments, behavior, reproduction, roles of mammals in ecosystems, and conservation. Laboratory focus on identification, distribution, habits, and habitats of mammals.

**A ECL 570. Landscape Ecology.**

(Cross-listed with EEOB). (2-3) Cr. 3. Alt. F., offered 2012. *Prereq: Permission of instructor; EEOB 588; a course in calculus*

The study of ecological and evolutionary processes within a spatial context with emphasis on behavior, population, and community dynamics.

**A ECL 573. Techniques for Biology Teaching.**

(Cross-listed with EEOB, IA LL). Cr. 1-2. Repeatable. SS.

The development and implementation of laboratory exercises suitable for inclusion in elementary, middle, high school, and community college biology and environmental courses. Exercises will be built around common organisms and ecosystems in Iowa. Field trips.

**A ECL 573A. Techniques for Biology Teaching : Animal Biology.**

(Cross-listed with EEOB, IA LL). Cr. 1-2. Repeatable. SS.

The development and implementation of laboratory exercises suitable for inclusion in elementary, middle, high school, and community college biology and environmental courses. Exercises will be built around common organisms and ecosystems in Iowa. Field trips.

**A ECL 573G. Techniques for Biology Teaching: Limnology.**

(Cross-listed with EEOB, IA LL). Cr. 1-2. Repeatable. SS.

The development and implementation of laboratory exercises suitable for inclusion in elementary, middle, high school, and community college biology and environmental courses. Exercises will be built around common organisms and ecosystems in Iowa. Field trips.

**A ECL 573H. Animal Behavior (Same as Ia LL 573H).**

(Cross-listed with IA LL, EEOB). Cr. 1-2. Repeatable. SS.

The development and implementation of laboratory exercises suitable for inclusion in elementary, middle, high school, and community college biology and environmental courses. Exercises will be built around common organisms and ecosystems in Iowa. Field trips.

**A ECL 573I. Techniques for Biology Teaching: Insect Ecology.**

(Cross-listed with EEOB, IA LL). Cr. 1-2. Repeatable. SS.

The development and implementation of laboratory exercises suitable for inclusion in elementary, middle, high school, and community college biology and environmental courses. Exercises will be built around common organisms and ecosystems in Iowa. Field trips.

**A ECL 573W. Techniques for Biology Teaching: Project WET.**

(Cross-listed with EEOB, IA LL). Cr. 1-2. Repeatable. SS.

The development and implementation of laboratory exercises suitable for inclusion in elementary, middle, high school, and community college biology and environmental courses. Exercises will be built around common organisms and ecosystems in Iowa. Field trips.

**A ECL 589. Population Ecology.**

(Cross-listed with EEOB). (2-2) Cr. 3. F. Prereq: BIOL 312, STAT 101 or STAT 104, a course in calculus, or graduate standing

(Dual-listed with Biol 489.) Concepts and theories of population dynamics with emphasis on models of growth, predation, competition, and regulation.

**A ECL 590. Graduate Independent Study.**

(Cross-listed with ANTHR, IA LL, EEOB). Cr. 1-4. Repeatable. SS. Prereq: Graduate classification and permission of instructor

**A ECL 590I. Special Topics: Graduate Independent Study.**

(Cross-listed with IA LL, ANTHR, EEOB). Cr. 1-4. Repeatable. SS. Prereq: Graduate classification and permission of instructor

**A ECL 599. Creative Component.**

Cr. arr. Prereq: Nonthesis M.S. option only

**Courses for graduate students:****A ECL 611. Analysis of Populations.**

(Cross-listed with EEOB). (2-2) Cr. 3. Alt. F., offered 2011. Prereq: BIOL 312; STAT 401; a course in calculus

Quantitative techniques for analyzing vertebrate population data to estimate parameters such as density and survival. Emphasis on statistical inference and computing.

**A ECL 698. Animal Ecology Teaching Practicum.**

Cr. 1-3. Repeatable. F.S.SS. Prereq: Graduate classification in animal ecology and permission of instructor

Graduate student experience in the animal ecology teaching program. Offered on a satisfactory-fail basis only.

**A ECL 699. Research.**

Cr. arr. Repeatable.

**A ECL 699I. Research.**

(Cross-listed with IA LL, ANTHR, EEOB, GDCB). Cr. 1-4. Repeatable.

**Courses primarily for undergraduates:****FOR 201. Forest Biology.**

(2-0) Cr. 2. F. Prereq: Concurrent enrollment in FOR 202, FOR 203, FOR 204, FOR 205, and FOR 206

Discussion of ecological concepts, individual tree structure and growth, variation and diversity in tree populations. Physical environment of trees and forests, ecological processes in forest communities, and introduction to different regional forest communities.

**FOR 202. Wood Utilization.**

(2-0) Cr. 2. F. Prereq: Concurrent enrollment in FOR 201, FOR 203, FOR 204, FOR 205, and FOR 206

Processing of sustainable materials including wood into products and general properties and proper use of these products.

**FOR 203. Resource Measurements/Evaluation.**

(2-0) Cr. 2. F. Prereq: Concurrent enrollment in FOR 201, FOR 202, FOR 204, FOR 205, and FOR 206; MATH 140

Survey techniques involved in quantification, valuation, and evaluation of tree and stand growth and other variables in the forest environment (e.g., recreational use, wildlife habitat value, biomass, and solid wood).

**FOR 204. Forest Ecosystem Decision-Making.**

(2-0) Cr. 2. F. Prereq: Concurrent enrollment in FOR 201, FOR 202, FOR 203, FOR 205, and FOR 206

Methods of decision-making related to forest ecosystems including communications, teams and conflict resolution. Current issues relating to public, private, and urban forests; quantification of processes, services, and goods produced by the forest and expected by the public such as wildlife, water, range, recreation, wilderness, biodiversity, as well as wood and fiber products.

**FOR 205. Integrated Forestry Laboratory.**

(0-8) Cr. 3. F. Prereq: Concurrent enrollment in FOR 201, FOR 202, FOR 203, FOR 204, and FOR 206

Field and laboratory exercises integrating the evaluation and management of forest goods, services, and the processing of wood products.

**FOR 206. Fall Forestry Camp.**

Cr. 4. F. Prereq: Concurrent enrollment in FOR 201, FOR 202, FOR 203, FOR 204, and FOR 205

Three-week field camp to address topics and issues covered in 201, 202, 203, 204, and 205.

**FOR 280. Wood Properties and Identification.**

(3-3) Cr. 4. S.

Properties of wood and how they relate to its successful use. Comparative anatomical characteristics, scientific nomenclature, and hand lens identification of commercially important North American woods.

**FOR 283. Pesticide Application Certification.**

(Cross-listed with AGRON, ENT, HORT). (2-0) Cr. 2. S.

Holscher. Core background and specialty topics in agricultural, and horticultural pesticide applicator certification. Students can select certification categories and have the opportunity to obtain pesticide applicator certification at the completion of the course. Commercial pesticide applicator certification is emphasized.

**FOR 290. Special Problems.**

Cr. 1-4. Repeatable. Prereq: Freshman or Sophomore classification, permission of instructor

**FOR 290A. Special Problems: Leadership in Forestry Teams (LIFT) Learning Community.**

Cr. 1-4. Repeatable. Prereq: Freshman or Sophomore classification, permission of instructor

**FOR 290B. Special Problems: Forest Ecosystem Management.**

Cr. 1-4. Repeatable. Prereq: Freshman or Sophomore classification, permission of instructor

**FOR 290C. Special Problems: Natural Resource Conservation.**

Cr. 1-4. Repeatable. Prereq: Freshman or Sophomore classification, permission of instructor

**FOR 290D. Special Problems: Urban and Community Forestry.**

Cr. 1-4. Repeatable. Prereq: Freshman or Sophomore classification, permission of instructor

**FOR 290E. Special Problems: Wood Science and Technology.**

Cr. 1-4. Repeatable. Prereq: Freshman or Sophomore classification, permission of instructor

**FOR 302. Silviculture.**

(2-3) Cr. 3. S. Prereq: FOR 201

Manipulation of forest vegetation based on ecological principles for the production of goods and services. Nonmajor graduate credit.



**FOR 342. Dynamics of Forest Stands.**

(2-3) Cr. 3. Alt. F., offered 2012. *Prereq: FOR 203, STAT 101*  
Change in forest species composition and structure at the stand and landscape scales resulting from site quality, tree growth, competition, succession, and disturbance. Methods for assessing tree growth and reconstructing past stand development. Applications to forest and savanna management. Nonmajor graduate credit.

**FOR 356. Dendrology.**

(Cross-listed with BIOL). (2-4) Cr. 4. F. *Prereq: BIOL 211*  
Identification and ecology of North American woody plant species. Importance of woody plants in timber production and wildlife habitat. Natural disturbances, human impacts, management and restoration concerns for major North American forest regions will be addressed. Nonmajor graduate credit.

**FOR 416. Forest Insect and Disease Ecology.**

(Cross-listed with PL P). (3-3) Cr. 4. F. *Prereq: 8 credits in biological sciences, including BIOL 211*

T. Harrington, M. Harris. Nature of insects and pathogens of forest and shade trees; their role in the dynamics of natural and managed forest ecosystems; and the management of indigenous and exotic pests. Nonmajor graduate credit.

**FOR 451. Forest Resource Economics and Quantitative Methods.**

(3-3) Cr. 4. S. *Prereq: FOR 203, MATH 150*

Application of economic principles to forest resource management considering both market and non-market goods and services. Methods of identifying and specifying problems in the management and use of forest resources. Application of mathematical and statistical models to the solution of managerial problems. Nonmajor graduate credit.

**FOR 452. Ecosystem Management.**

(Cross-listed with NREM). (2-3) Cr. 3. F. *Prereq: Junior classification, and NREM 301 or A ECL 312*

Principles of planning, regulating, and decision-making associated with public and private lands, with consideration of forest, grassland, wetland, and freshwater aquatic ecosystems. Integrated natural resources management within ecological, social, economic and policy constraints. Nonmajor graduate credit.

**FOR 453. Forest Resource Policy and Administration.**

(3-0) Cr. 3. S. *Prereq: junior or senior classification*

Forest and related natural resource policies and contemporary policy issues. Integration of elements of policy development processes, various participants in these processes, and resulting programs. Ethics in professional forestry and natural resource conservation. Participation in the policy process involving communication with policy makers and natural resource professionals, study of current issues, promotion of issues with students as issue educators. Participation in policy meetings to identify/determine various elements and applications of strategies associated with the policy development process. Nonmajor graduate credit.

**FOR 454. Forestry Practicum.**

(1-4) Cr. 3. S. *Prereq: 20 credits in student's major at 300 level or above*

Integrated decision-making related to the conservation, management, and preservation of private and public forests, wildlands, urban/community forests, and/or the production and utilization of wood products. Student teams work with a client and develop management plans that incorporate ecological, social, economic, ethical, and institutional/political factors. Effective teamwork, written/oral/visual communication, and problem-solving stressed. Multiple trips to project site and client. Nonmajor graduate credit.

**FOR 475. Urban Forestry.**

(Cross-listed with HORT). (2-3) Cr. 3. F. *Prereq: Junior or senior classification, 3 credits in biology*

Discussion of establishment and management of woody perennials in community-owned urban greenspaces, consideration of urban site and soil characteristics, plant physiology, plant culture, urban forest valuation, inventory methods, species selection, and urban forest maintenance (health care and pest management). Nonmajor graduate credit.

**FOR 480. Wood Anatomy and Fiber Analysis.**

(2-3) Cr. 3. Alt. F., offered 2011. *Prereq: FOR 280 or permission of instructor*  
Microscopic anatomy and ultrastructure of wood and other industrial lignocellulosic materials. Microscopy techniques for fiber analysis. Comparison of fiber properties. Nonmajor graduate credit.

**FOR 481. Conversion of Lignocellulosic Materials.**

(2-3) Cr. 3. F. *Prereq: FOR 280 or equivalent*

Chemical properties of lignocellulosic materials. Wood chemistry. Various conversion processes. Pulp and paper technology. Biobased products. Other fiber products. Cellulose derivatives. Term paper and/or student project required for graduate level. Nonmajor graduate credit.

**FOR 483. Wood Deterioration and Preservation.**

(Cross-listed with PL P). (2-3) Cr. 3. Alt. F., offered 2011. *Prereq: FOR 280*  
Deterioration of wood in use by biological and physical agents. Wood preservation and fire retardant treatments. Environmental impact of wood treating. Nonmajor graduate credit.

**FOR 485. Wood and Natural Fiber Composites.**

(2-3) Cr. 3. Alt. F., offered 2012. *Prereq: FOR 280 or TSM 240*

Consolidation behavior of wood and other lignocellulosic materials. Principles of adhesion. Manufacturing processes for wood and lignocellulose composites such as plywood, oriented strand products, laminated lumber, particleboard, medium density fiberboard, and bast fiber products. Extrusion processing of natural fiber/plastic composites. Nonmajor graduate credit.

**FOR 486. Drying Processes for Wood and Other Lignocellulosic Materials.**

(2-3) Cr. 3. Alt. S., offered 2012. *Prereq: FOR 280 or TSM 240*

Principles of moisture relations in hygroscopic materials; adsorption, desorption, equilibrium moisture content. Transport processes in natural materials such as wood. Drying processes for wood and other lignocellulosic materials. Influence of moisture on dimensional stability and durability of wood and lignocellulosic composites. Nonmajor graduate credit.

**FOR 487. Physical Properties of Wood.**

(3-3) Cr. 4. Alt. S., offered 2012. *Prereq: FOR 280*

Mechanical, thermal, electrical, and acoustical properties of wood. Lumber grading and stress rating, nondestructive evaluation of wood and wood composite products. Nonmajor graduate credit.

**Courses primarily for graduate students, open to qualified undergraduates:**

**FOR 599. Creative Component.**

Cr. 1-12. Repeatable, maximum of 12 credits.

**FOR 599A. Creative Component: Forest Biology.**

Cr. 1-12. Repeatable, maximum of 12 credits.

**FOR 599B. Creative Component: Forest Biometry.**

Cr. 1-12. Repeatable, maximum of 12 credits.

**FOR 599C. Creative Component: Forest and Recreation Economics.**

Cr. 1-12. Repeatable, maximum of 12 credits.

**FOR 599D. Creative Component: Forest Management and Administration.**

Cr. 1-12. Repeatable, maximum of 12 credits.

**FOR 599E. Creative Component: Wood Science.**

Cr. 1-12. Repeatable, maximum of 12 credits.

**Courses for graduate students:**

**FOR 696. Research Seminar.**

(Cross-listed with AGRON, BBMB, GDCB, HORT, PLBIO). Cr. 1. Repeatable. F.S. Research seminars by faculty and graduate students. Offered on a satisfactory-fail basis only.

**FOR 699. Research.**

Cr. 1-12. Repeatable, maximum of 12 credits.

**FOR 699A. Research: Forest Biology - Wood Science.**

Cr. 1-12. Repeatable, maximum of 12 credits.

**FOR 699B. Research: Forest Biometry.**

Cr. 1-12. Repeatable, maximum of 12 credits.

**FOR 699C. Research: Forest Economics.**

Cr. 1-12. Repeatable, maximum of 12 credits.

**FOR 699D. Research: Forest Management and Administration.**

Cr. 1-12. Repeatable, maximum of 12 credits.

**FOR 699E. Research: Wood Science.**

Cr. 1-12. Repeatable, maximum of 12 credits.

**FOR 699F. Research: Plant Physiology.**

Cr. 1-12. Repeatable, maximum of 12 credits.

**Courses primarily for undergraduates:**

**NREM 104. Practical Work Experience.**

Cr. R.

Three months of relevant work experience in natural resources, animal ecology, or forestry. Study at a summer biological station may be applicable. See adviser for specific requirements and approval process.

**NREM 110. Orientation in Natural Resource Ecology and Management.**

Cr. 1. F.

Orientation to the University and to the Department of Natural Resource Ecology and Management. Discussion of departmental learning outcomes, strategies for academic success and academic planning. Offered on a satisfactory-fail basis only.

**NREM 111. NREM Transitions Learning Community Seminar.**

(1-0) Cr. 1. Repeatable. F.S.

Enrollment limited to members of the NREM Transitions Learning Community. Designed to assist new transfer students and continuing sophomore students with their transition to the academic expectations and professional development aspects of the natural resource program. Offered on a satisfactory-fail basis only.

**NREM 112. Orientation to Learning and Productive Team Membership.**

(Cross-listed with AER E, CON E, FS HN, HORT). (2-0) Cr. 2. F.

Introduction to developing intentional learners and worthy team members. Learning as the foundation of human enterprise; intellectual curiosity; ethics as a personal responsibility; everyday leadership; effective team and community interactions including team learning and the effects on individuals; and growth through understanding self, demonstrating ownership of own learning, and internalizing commitment to helping others. Intentional mental processing as a means of enhancing learning. Interconnectedness of the individual, the community, and the world.

**NREM 114. Developing Responsible Learners and Effective Leaders.**(Cross-listed with CON E, FS HN, HORT). (2-0) Cr. 2. S. *Prereq:* Hort 112 or NREM 112

Focus on team and community. Application of fundamentals of human learning; evidence of development as a responsible learner; intentional mental processing as a habit of mind; planning and facilitating learning opportunities for others; responsibility of the individual to the community and the world; leading from within; holding self and others accountable for growth and development as learners and leaders.

**NREM 120. Introduction to Renewable Resources.**

(Cross-listed with AGRON, ENV S). (3-0) Cr. 3. F.S.

Overview of soil, water, plants, and animals as renewable natural resources in an ecosystem context. History and organization of resource management. Concepts of integrated resource management.

**NREM 130. Natural Resources and Agriculture.**

(Cross-listed with ENV S). (3-0) Cr. 3. S.

Survey of the ecology and management of fish, forest, and wildlife resources in areas of intensive agriculture, with emphasis on Iowa. Conservation and management practices for private agricultural lands. Designed for nonmajors.

**NREM 211. Careers in Natural Resources.**Cr. 1. F.S. *Prereq:* Sophomore classification

Career planning exploration in natural resources. Discussion of the job application process, including techniques for successful interviewing and development of an effective resume. Offered on a satisfactory-fail basis only.

**NREM 256. Midwestern Prairie Plants.**

(1-2) Cr. 1. F.

Offered 1st half semester only. Survey of the major plant families, genera, and representative species of Midwestern prairies with emphasis on plant identification and use of keys. Prairie restoration, conservation, and management issues will also be considered.

**NREM 270. Foundations in Natural Resource Policy and History.**

(Cross-listed with L A, ENV S). (3-0) Cr. 3. Alt. S., offered 2014.

The development of natural resource conservation philosophy and policy from the Colonial Era to the present. North American wildlife, forestry, and environmental policy; national parks and other protected lands; federal and state agencies. Relationship to cultural contexts, including urban reform and American planning movement. Discussion of common pool resources, public and private lands.

**NREM 301. Natural Resource Ecology and Soils.**(Cross-listed with ENSCI). (3-3) Cr. 4. F. *Prereq:* BIOL 211, BIOL 211L; FOR 201 or a second course in biology

Effects of environmental factors on ecosystem structure and function using forest, prairie and agricultural ecosystems as models. Special emphasis is given to soil-forming factors and the role of soil in nutrient and water cycling and ecosystem dynamics. Additional emphasis is given to human influences on natural ecosystems and the role of perennial plant communities in agricultural landscapes. Nonmajor graduate credit.

**NREM 303. Internship.**Cr. 1-3. Repeatable, maximum of 6 credits. F.S.SS. *Prereq:* Permission of department mentor and sophomore standing

Placement with county conservation boards, camps, zoos, parks, etc., for experience as interpreters, rangers, and technicians.

**NREM 303I. Undergraduate Internships.**(Cross-listed with IA LL). Cr. 1-5. SS. *Prereq:* Permission of instructor and sophomore standing

Placement with county conservation boards, camps, parks, etc. for experience as interpreters, rangers, and technicians.

**NREM 305. Seminar.**(2-0) Cr. 1-3. Repeatable. F.S. *Prereq:* Permission of instructor

Current topics in natural resources or related issues.

**NREM 315. Genetics for Natural Resource Managers..**(3-0) Cr. 3. F. *Prereq:* Prereq: Biol 211 and 212.

Introduction into how genetic techniques and technologies can aid the management of the earth's biotic resources. Topics include an overview of DNA structure, function and inheritance; tools and techniques for measuring genetic diversity; genetic management of wild and captive populations: DNA forensics as management tool. The goal of this course is to prepare managers/biologists to interpret genetic data as they relate to natural resource conservation.

**NREM 330. Principles of Interpretation.**(2-3) Cr. 3. S. *Prereq:* 6 credits in biological sciences

History, objectives, forms, and techniques of interpretation in the settings of county, state, national parks, and zoos. Principles of effective communication as they apply to natural resource fields including wildlife management, forestry, and wildlife rehabilitation. Planning and use of effective communications and outreach campaigns to manage and conserve natural resources.

**NREM 345. Natural Resource Photogrammetry and Geographic Information Systems.**(Cross-listed with ENSCI). (2-3) Cr. 3. F. *Prereq:* Junior classification

Measurement and interpretation of aerial photos in resource management. Introduction to Geographic Information Systems (GIS) using ArcGIS including digitizing, development and query of attribute tables, georeferencing, and use of multiple GIS layers in simple spatial analyses. Nonmajor graduate credit.

**NREM 385. Natural Resource Policy.**(Dual-listed with NREM 585). (3-0) Cr. 3. S. *Prereq:* Junior classification

Development, theory and practice of natural resource policy. Integrative approach with topical policy studies in North American wildlife, forestry, and water. Policy formation, the role of science, introduction to federal law compliance. Readings, lectures, projects.

**NREM 390. Fire Ecology and Management.**

(3-0) Cr. 3. F.

Characteristics and role of fire in forest ecosystems. Major topics covered include fuels, fire weather, fire behavior, fire danger rating systems, fire control, prescribed burning, and fire dynamics in major ecosystem types. Nonmajor graduate credit.

**NREM 402. Watershed Hydrology.**

(Dual-listed with NREM 502). (Cross-listed with ENSCI, MTEOR, GEOL). (3-3) Cr.

4. F. *Prereq:* Four courses in physical or biological sciences or engineering; junior standing

Examination of watersheds as systems, emphasizing the surface components of the hydrologic cycle. Combines qualitative understanding of hydrological processes and uncertainty with quantitative representation. Laboratory emphasizes field investigation and measurement of watershed processes. Nonmajor graduate credit.

**NREM 407. Watershed Management.**

(Dual-listed with NREM 507). (Cross-listed with ENSCI, ENV S). (3-3) Cr. 4. S.

*Prereq:* A course in general biology

Managing human impacts on the hydrologic cycle. Field and watershed level best management practices for modifying the impacts on water quality, quantity and timing are discussed. Field project includes developing a management plan using landscape buffers.

**NREM 446. Integrating GPS and GIS for Natural Resource Management.** (Dual-listed with NREM 546). (Cross-listed with ENSCI). (2-3) Cr. 3. S. *Prereq:* 12 credits in student's major at 300 level or above, NREM 345 or equivalent experience with ArcGIS

Emphasis on the use of GPS as a data collection tool for GIS. Basic theory of GPS. Use of Global Positioning System technology for spatial data collection and navigation. Post-processing and real-time correction of GPS data. GPS data transfer to GIS for mapping applications. Use of GIS to construct waypoints for use in GPS navigation.

**NREM 452. Ecosystem Management.**

(Cross-listed with FOR). (2-3) Cr. 3. F. *Prereq:* Junior classification, and NREM 301 or A ECL 312

Principles of planning, regulating, and decision-making associated with public and private lands, with consideration of forest, grassland, wetland, and freshwater aquatic ecosystems. Integrated natural resources management within ecological, social, economic and policy constraints. Nonmajor graduate credit.

**NREM 460. Controversies in Natural Resource Management.**

(Cross-listed with ENV S). (3-0) Cr. 3. F.S. *Prereq:* NREM 120, and A ECL 312 or NREM 301, and Junior classification

Analysis of controversial natural resource issues using a case approach that considers uncertainty and adequacy of information and scientific understanding. Ecological, social, political, economic, and ethical implications of issues will be analyzed. Nonmajor graduate credit.

**NREM 465. Landscape Change and Conservation.**

(Dual-listed with NREM 565). (3-0) Cr. 3. F. *Prereq:* L A 202

Exploration of issues in landscape ecology and conservation biology relevant to landscape change, design, and planning. Examination of foundational principles and their applications across a continuum of land uses, from wilderness to urban areas.

**NREM 471. Agroforestry Systems; Local and Global Perspectives.**

(Dual-listed with NREM 571). (2-3) Cr. 3. Alt. S., offered 2012. *Prereq:* 6 credits in biological science at 300 level or above

Concepts of sustainable land use, agroecological dynamics, and component interactions of agroforestry systems. Agroforestry systems in temperate and tropical regions. Design and evaluation techniques for agroforestry systems. Ecological, socioeconomic and political aspects of agroforestry. Meets International Perspectives Requirement.

**NREM 490. Independent Study.**

Cr. 1-4. Repeatable, maximum of 4 credits. *Prereq:* Junior or senior classification, permission of instructor

**NREM 490A. Independent Study: Animal Ecology.**

Cr. 1-4. Repeatable, maximum of 4 credits. *Prereq:* Junior or senior classification, permission of instructor

**NREM 490B. Independent Study: Forestry.**

Cr. 1-4. Repeatable, maximum of 4 credits. *Prereq:* Junior or senior classification, permission of instructor

**NREM 490E. Independent Study: Entrepreneurship.**

Cr. 1-4. Repeatable, maximum of 4 credits. *Prereq:* Junior or senior classification, permission of instructor

**NREM 490H. Independent Study: Honors Program.**

Cr. 1-4. Repeatable, maximum of 4 credits. *Prereq:* Junior or senior classification, permission of instructor

**NREM 490I. Independent Study: Undergraduate Independent Study.**

(Cross-listed with ANTHR, IA LL). Cr. 1-4. Repeatable. SS. *Prereq:* Junior or senior classification and permission of instructor

**NREM 496. Travel Course.**

(Dual-listed with NREM 596B). Cr. 1-5. Repeatable, maximum of 3 times. *Prereq:* Permission of instructor

Limited enrollment. Extended field trips to study ecological and management topics in varied environments. Location and duration of trips will vary. Pre-trip sessions arranged. Trip expenses paid by students. Meets International Perspectives Requirement.

**NREM 496A. Travel Course: International.**

(Dual-listed with NREM 596). Cr. 1-5. Repeatable, maximum of 3 times. *Prereq:* Permission of instructor

Limited enrollment. Extended field trips to study ecological and management topics in varied environments. Location and duration of trips will vary. Pre-trip sessions arranged. Trip expenses paid by students. Meets International Perspectives Requirement.

**NREM 496B. Travel Course: Domestic.**

(Dual-listed with NREM 596). Cr. 1-5. Repeatable, maximum of 3 times. *Prereq:* Permission of instructor

Limited enrollment. Extended field trips to study ecological and management topics in varied environments. Location and duration of trips will vary. Pre-trip sessions arranged. Trip expenses paid by students.

**NREM 498. Cooperative Education.**

Cr. 1-3. *Prereq:* Permission of departmental chair

Required of all cooperative education students. Students must register prior to commencing each work period.

**Courses primarily for graduate students, open to qualified undergraduates:**

**NREM 501. Genecology.**

(3-0) Cr. 3. Alt. F., offered 2011. *Prereq:* GEN 320 or BIOL 313

Genecology principles as they apply to natural and improved populations of plants and animals. Genetic systems as they interact with long-term natural selection to produce clinal or ecotypic variation. The impact of current environments and genetic modifications of domesticated organisms on short-term selection pressures. Special coverage of species of interest to students enrolled in the course.

**NREM 502. Watershed Hydrology.**

(Dual-listed with NREM 402). (Cross-listed with ENSCI, MTEOR, GEOL). (3-3) Cr. 4. F. *Prereq:* Four courses in physical or biological sciences or engineering; junior standing

Examination of watersheds as systems, emphasizing the surface components of the hydrologic cycle. Combines qualitative understanding of hydrological processes and uncertainty with quantitative representation. Laboratory emphasizes field investigation and measurement of watershed processes. Nonmajor graduate credit.

**NREM 504. Forest Landscapes, Wildlife, and Silviculture.**

(3-3) Cr. 4. F. *Prereq:* NREM 301

Detailed analysis of factors and processes underlying forest and stand growth and development. Applications of this knowledge to forest culture to support a diversity of use and protection objectives. Discussions of regional silviculture, tropical forests, and experimentation in forest biology.

**NREM 505. Seminar.**

(2-0) Cr. 1-3. Repeatable, maximum of 3 times. F.S. *Prereq:* Permission of instructor or graduate classification

Current topics in natural resources research and management.

**NREM 507. Watershed Management.**

(Dual-listed with NREM 407). (Cross-listed with ENSCI, ENV S). (3-3) Cr. 4. S. *Prereq:* A course in general biology

Managing human impacts on the hydrologic cycle. Field and watershed level best management practices for modifying the impacts on water quality, quantity and timing are discussed. Field project includes developing a management plan using landscape buffers.

**NREM 508I. Aquatic Ecology.**

(Cross-listed with ENSCI, IA LL). Cr. 4. SS. *Prereq:* Courses in ecology, chemistry, and physics

Analysis of aquatic ecosystems; emphasis on basic ecological principles; ecological theories tested in the field; identification of common plants and animals.

**NREM 529. Publishing in Biological Sciences Journals.**

(Cross-listed with AGRON, HORT). (3-0) Cr. 3. S. *Prereq:* Permission of instructor; evidence of a publishable unit of the student's research data

Process of preparing a manuscript for submission to a refereed journal in the biological sciences. Emphasis on publishing self-generated data from thesis or dissertation research.

**NREM 535. Restoration Ecology.**

(Cross-listed with ENSCI, EEOB). (2-3) Cr. 3. F. *Prereq:* BIOL 366 or BIOL 474 or graduate standing

Theory and practice of restoring animal and plant diversity, structure and function of disturbed ecosystems. Restored freshwater wetlands, forests, prairies and reintroduced species populations will be used as case studies.

**NREM 542. Introduction to Molecular Biology Techniques.**

(Cross-listed with B M S, EEOB, FS HN, GDCB, HORT, GDCB, NUTRS, V MPM, VDPAM). Cr. 1. Repeatable. F.S.SS. *Prereq:* Graduate classification

Sessions in basic molecular biology techniques and related procedures. Offered on a satisfactory-fail basis only.



**NREM 542A. Introduction to Molecular Biology Techniques: DNA.**

(Cross-listed with B M S, EEOB, FS HN, GDCB, HORT, GDCB, NUTRS, V MPM, VDPAM). Cr. 1. Repeatable. F.S.SS. *Prereq: Graduate classification*  
Includes genetic engineering procedures, sequencing, PCR, and genotyping. Offered on a satisfactory-fail basis only.

**NREM 542B. Introduction to Molecular Biology Techniques: Protein.**

(Cross-listed with B M S, GDCB, EEOB, FS HN, HORT, GDCB, NUTRS). Cr. 1. Repeatable. S.SS. *Prereq: Graduate classification*  
Techniques. Includes fermentation, protein isolation, protein purification, SDS-PAGE, Western blotting, NMR, confocal microscopy and laser microdissection, Immunophenotyping, and monoclonal antibody production. Sessions in basic molecular biology techniques and related procedures. Offered on a satisfactory-fail basis only.

**NREM 542C. Introduction to Molecular Biology Techniques: Cell.**

(Cross-listed with B M S, EEOB, FS HN, GDCB, HORT, GDCB, NUTRS, V MPM, VDPAM). Cr. 1. Repeatable. F.S. *Prereq: Graduate classification*  
Includes immunophenotyping, ELISA, flow cytometry, microscopic techniques, image analysis, confocal, multiphoton and laser capture microdissection. Offered on a satisfactory-fail basis only.

**NREM 542D. Introduction to Molecular Biology Techniques: Plant Transformation.**

(Cross-listed with B M S, EEOB, FS HN, GDCB, HORT, GDCB, NUTRS, V MPM, VDPAM). Cr. 1. Repeatable. S. *Prereq: Graduate classification*  
Includes Agrobacterium and particle gun-mediated transformation of tobacco, Arabidopsis, and maize, and analysis of transformants. Offered on a satisfactory-fail basis only.

**NREM 542E. Proteomics. Includes two-dimensional electrophoresis, laser scanning, mass spectrometry, and database searching. (F.)**

(Cross-listed with B M S, BBMB, EEOB, FS HN, GDCB, HORT, NUTRS, V MPM, VDPAM). Cr. 1. Repeatable. F.S.SS. *Prereq: Graduate classification*  
Sessions in basic molecular biology techniques and related procedures. Offered on a satisfactory-fail basis only.

**NREM 542F. Techniques in Metabolomics, metabolomics and the techniques involved in metabolite profiling. For non-chemistry majoring students who are seeking analytical aspects into their biological research projects.**

(Cross-listed with B M S, BBMB, EEOB, FS HN, GDCB, HORT, NUTRS, V MPM, VDPAM). Cr. 1. Repeatable. F.S.SS. *Prereq: Graduate classification*  
Sessions in basic molecular biology techniques and related procedures. Offered on a satisfactory-fail basis only.

**NREM 542G. Introduction to Molecular Biology Techniques: Genomic.**

(Cross-listed with B M S, EEOB, FS HN, GDCB, HORT, GDCB, NUTRS, V MPM, VDPAM). Cr. 1. Repeatable. S. *Prereq: Graduate classification*  
Offered on a satisfactory-fail basis only.

**NREM 546. Integrating GPS and GIS for Natural Resource Management.**

(Dual-listed with NREM 446). (Cross-listed with ENSCI). (2-3) Cr. 3. S. *Prereq: 12 credits in student's major at 300 level or above, NREM 345 or equivalent experience with ArcGIS*  
Emphasis on the use of GPS as a data collection tool for GIS. Basic theory of GPS. Use of Global Positioning System technology for spatial data collection and navigation. Post-processing and real-time correction of GPS data. GPS data transfer to GIS for mapping applications. Use of GIS to construct waypoints for use in GPS navigation.

**NREM 565. Landscape Change and Conservation.**

(Dual-listed with NREM 465). (3-0) Cr. 3. F. *Prereq: L A 202*  
Exploration of issues in landscape ecology and conservation biology relevant to landscape change, design, and planning. Examination of foundational principles and their applications across a continuum of land uses, from wilderness to urban areas.

**NREM 570. Advanced Decision-making in Natural Resource Allocation.**

(2-2) Cr. 3. Alt. S., offered 2012. *Prereq: FOR 451 or two courses in economics*  
Analytical approach to economic aspects of forest resource management problems. Theory and application of economic decision-making criteria to traditional and modern forest resource management issues. Current problems in the allocation of forest resources.

**NREM 571. Agroforestry Systems.**

(Dual-listed with NREM 471). (2-3) Cr. 3. Alt. S., offered 2012. *Prereq: 6 credits in biological science at 300 level or above*  
Concepts of sustainable land use, agroecological dynamics, and component interactions of agroforestry systems. Agroforestry systems in temperate and tropical regions. Design and evaluation techniques for agroforestry systems. Ecological, socioeconomic and political aspects of agroforestry. Meets International Perspectives Requirement.

**NREM 580. Research Orientation.**

(2-0) Cr. 2. F. *Prereq: 20 credits in biological sciences and a course in statistics*  
Research design, proposal preparation, and technical writing.

**NREM 585. Natural Resource Policy.**

(Dual-listed with NREM 385). (3-0) Cr. 3. Alt. S., offered 2013. *Prereq: Graduate classification or permission of instructor*  
Development, theory and practice of natural resource policy. Integrative approach with topical policy studies in North American wildlife, forestry, and water. Policy formation, the role of science, introduction to federal law compliance.

**NREM 590. Special Topics.**

Cr. 1-4. Repeatable, maximum of 4 credits. *Prereq: Permission of instructor*

**NREM 590A. Special Topics: Animal Ecology.**

Cr. 1-4. Repeatable, maximum of 4 credits. *Prereq: Permission of instructor*

**NREM 590B. Special Topics: Forestry.**

Cr. 1-4. Repeatable, maximum of 4 credits. *Prereq: Permission of instructor*

**NREM 593. Workshop.**

Cr. 1-3. Repeatable. *Prereq: Graduate classification*

**NREM 596. Travel Course.**

(Dual-listed with NREM 496B). Cr. 1-5. Repeatable, maximum of 3 times. *Prereq: Permission of instructor*  
Limited enrollment. Extended field trips to study ecological and management topics in varied environments. Location and duration of trips will vary. Pre-trip sessions arranged. Trip expenses paid by students. Meets International Perspectives Requirement.

**NREM 596A. Travel Course: International.**

(Dual-listed with NREM 496). Cr. 1-5. Repeatable, maximum of 3 times. *Prereq: Permission of instructor*  
Limited enrollment. Extended field trips to study ecological topics in varied environments. Location and duration of trips will vary. Pre-trip sessions arranged. Trip expenses paid by students.

**NREM 596B. Travel Course: Domestic.**

(Dual-listed with NREM 496). Cr. 1-5. Repeatable, maximum of 3 times. *Prereq: Permission of instructor*  
Limited enrollment. Extended field trips to study ecological topics in varied environments. Location and duration of trips will vary. Pre-trip sessions arranged. Trip expenses paid by students.

**NREM 598. Natural Resource Ecology and Management Teaching Practicum.**

Cr. 1. F.S.SS. *Prereq: Graduate classification as M.S. candidate in a NREM major and permission of instructor.*  
Graduate student experience in teaching. Student must plan and present at least one unit of subject matter in a course or extension workshop. Teaching practicum must be documented by the student and approved by the student's POS committee. Offered on a satisfactory-fail basis only.

**NREM 599. Creative Component.**

Cr. arr.

**Courses for graduate students:****NREM 600. Seminar.**

Cr. 1. Repeatable. F.S.  
Current topics in natural resources research and management.

**NREM 698. Natural Resource Ecology and Management Teaching Practicum.**

Cr. 1. F.S.SS. *Prereq: Graduate classification as a Ph.D. candidate in a NREM major and permission of instructor.*  
Graduate student experience in teaching. Student must plan and present substantive subject matter for a minimum of three weeks in lecture and/or laboratory formats, or a series of extension seminars/workshops. Teaching practicum must be documented by the student and approved by the student's POS committee. Offered on a satisfactory-fail basis only.

**NREM 699. Research.**

Cr. 1-12. Repeatable, maximum of 12 credits.