College of Life Sciences and Agriculture

Andrew A. Rosenberg, Dean
Patricia D. Bedker, Associate Dean

Department of Animal and Nutritional Sciences
Department of Biochemistry and Molecular Biology
Department of Microbiology
Department of Natural Resources
Department of Plant Biology
Department of Resource Economics and Development
Department of Zoology

Bachelor of Arts
Plant Biology
Zoology

Bachelor of Science
Animal Sciences
- Bioscience and Technology
- Equine Sciences
- Preveterinary Medicine

Biochemistry
Biology
- Ecology, Evolution, and Behavior Biology
- General Biology
- Marine and Freshwater Biology
- Molecular, Cellular, and Developmental Biology

Community Development
Dairy Management
Environmental and Resource Economics
Environmental Conservation
- Environmental Affairs
- Environmental Science

Environmental Horticulture
General Studies
Medical Laboratory Science
Microbiology
Nutritional Sciences
Plant Biology
Soil Science
Tourism Planning and Development
Water Resources Management
Wildlife Management
Zoology

Bachelor of Science in Forestry
Forestry
- Forest Management
- Forest Science

The objectives of the College of Life Sciences and Agriculture are to give students a fundamental education in the biological, natural, and social sciences and to introduce them to the arts and humanities. In addition, advanced technical and professional courses are offered to prepare students for graduate school or entry-level positions in areas concerned with improving the quality of life. Preparation can vary from fundamental studies of cancer cells to community-service planning, resource protection to genetic engineering, and career teaching to molecular biology and biotechnology.

A blend of the basic and applied aspects of life sciences and agriculture, coupled with careful selection of supportive courses, ensures graduates the background and experiences necessary to be competitive in the job market. Potential employers include federal, state, and local governments; consulting firms; and industrial organizations. Graduates are employed as watershed, soil, and natural resource managers; associates in biomedical and agricultural research laboratories; marketing analysts and extension specialists; nutrition supervisors and environmental regulators; and information educators and communications experts.

Community governments employ graduates as service planners and land-use specialists, teachers in traditional and vocational education, public health technicians, and urban pest control specialists.

Positions are available in private and commercial organizations in production agriculture, food processing, landscaping, agribusiness, sales, and private planning. Graduates may also pursue entrepreneurial careers as greenhouse, nursery, farm, and natural resource managers; or as consultants, arborists, and environmental planners.

For those graduates with international aspirations, the Peace Corps and the Foreign Agriculture Service employ farm production experts, soil and water managers, market analysts, agricultural engineers, teachers, plant and animal breeders, and nutrition specialists.

Additionally, departments prepare students for advanced study in their chosen field of interest where graduate study is required for attaining their career goals.

Degrees

The college offers three undergraduate degrees: the bachelor of arts, the bachelor of science, and the bachelor of science in forestry. Some of the courses prescribed in these degree programs partially fulfill the general education requirements. Students should see their adviser for specific information.

Bachelor of Arts

The bachelor of arts degree is available in plant biology and zoology. Students must accumulate 128 credits, attain a 2.00 cumulative grade-point average, satisfy general education requirements, and complete a foreign language requirement (see Degree Requirements under University Academic Requirements for specific B.A. language requirements). Check individual departmental listings for specific major requirements and minimum acceptable grades in major courses.

Bachelor of Science

The bachelor of science degree is available in all departments or programs except forestry. University requirements are the same as for the bachelor of arts degree, except that a foreign language is not required and minimum acceptable grades may differ in some programs. Check individual departmental or program listings for specific major requirements.

Bachelor of Science in Forestry

The bachelor of science in forestry is a professional, designated degree available to students majoring in forestry. (See Forestry for major requirements.)

General Science Certification

Students majoring in animal sciences, biochemistry, biology, environmental conservation, forestry, microbiology, plant biology, soil science, water resources management, wildlife management, zoology, or general studies may seek certification to teach science at the middle, junior, or high school level.

For further information, contact the co-

ordinator of teacher education in the Department of Education.

Advising System

A member of the faculty whose area of interest is closely related to the student's is appointed as an adviser to assist the undergraduate in planning his or her academic program. Further advising is also available in the dean's office, Taylor Hall.

Undeclared Status

Students may select a major upon entering the college or may wait until registration for the sophomore year. Students who are uncertain about choosing a specific major may remain undeclared during their freshman year. In most cases they should take the following courses, after which they should be ready to declare a major:

Fall
CHEM 403
BIOL 411
General education requirement
LSA 400
An introductory course in any department in the college

Spring
CHEM 404
BIOL 412
MATH 424B
General education requirement

Undeclared freshmen should explore possible majors by taking courses in the areas or programs that interest them most. They should talk to faculty, students, and their adviser concerning requirements, job opportunities, etc., in the various programs and should be prepared to declare a major when they register for the first semester of the sophomore year.

Combined Programs of Study

In addition to pursuing a single major, students may combine programs of study as follows (check University Academic Requirements for more information):

Minors: See page 20.
Second Majors: See page 20.
Dual-Degree Programs: See page 19.
Student-Designed Majors: See page 105.
Other combined and interdisciplinary opportunities: See page 102.

Interdisciplinary Minors

Agribusiness

The agribusiness minor is designed to provide students in disciplines other than environmental and resource economics training in the economics and management of agricultural and other natural resource business firms. This program prepares students to work for private companies, governmental agencies or nonprofit, nongovernmental organizations. Students who are interested in operating their own business will also find this minor very useful. The courses in the agribusiness minor emphasize the applications of economic and business management principles.

Required
EREC 411, Environmental and Resource Economics Perspectives
EREC 501, Agricultural and Natural Resource Product Marketing *or* MKTG 550, Survey of Marketing
EREC 504, Business Management for Natural Resource Firms
EREC 606, Land Economic Perspectives: Uses, Policies, and Taxes
EREC 715, Linear Programming and Quantitative Models

For additional information, contact Alberto B. Manalo, Environmental and Resource Economics Program Coordinator, 309 James Hall, (603) 862-3917.

Animal Behavior Minor

The animal behavior minor is designed for students who are interested in learning more about the mechanisms underlying the behavior of many different types of animals, as well as the reasons why certain behaviors may have evolved. Students interested in the animal behavior minor must complete a total of 20 credits of coursework (approximately 5 courses), from the list of courses below. Students must receive a grade of C- or better in each of these courses and no more than eight major requirement credits can be counted toward the minor. If a student is interested in using a relevant course that is not included in the following list, they must seek permission from either Dr. Michelle Scott or Dr. Win Watson, in the Zoology Department.

Required Courses (2):
ZOOL 713, Animal Behavior
ZOOL 777, Neurobiology and Behavior
Elective Courses (must take three, and one must be a psychology course):
PSYC 512, Psychology of Primates
PSYC 521, Behavior Analysis
PSYC 531, Psychobiology
PSYC 710, Visual Perception
PSYC 711, Sensation and Perception
PSYC 721, The Experimental Analysis of Behavior
PSYC 731, Brain and Behavior
PSYC 732, Evolution and Behavior
PSYC 733, Drugs and Behavior
PSYC 735, Neurobiology of Mood Disorders
PSYC 737, Behavioral Medicine
BCHM 702, Endocrinology
BCHM 761, Cellular Signaling Transduction in Health and Disease
KIN 652, Clinical Kinesiology
ZOOL 709, Environmental Physiology of Animals
ZOOL 714, The Ecology of Animal Behavior (Shoals)
ZOOL 733, Behavioral Ecology
ZOOL 778, Neuroscience Techniques

Community Planning

Land use and its impact on the quality of life has emerged as a major policy issue in New Hampshire, as well as at the national and global levels. Planning is a multidisciplinary profession that requires people who understand the technical tools and social concepts required to guide the selection and implementation of alternative schemes compatible with long term environmental and economic objectives. Students may supplement their major and general education course requirements with specific courses that will enhance their ability to find employment that requires knowledge of planning concepts and tools used in the formulation and implementation of effective land and resource planning by government agencies, nonprofit organizations, and private business firms.

Required

Group I-Theory and practice of planning (both courses required)
CD 614, Fundamentals of Planning (prereq: EREC 411)
CD 777, Topics in Community Planning (prereq: CD 614)

Group II-Tools and applications in planning (choose two)
CIE 505, Surveying (coreq: MATH 426)
NR 757, Photo Interpretation and Photogrammetry
NR 760, Geographic Information Systems in Natural Resources
NR 609, Soils and Community Planning *or* NR 703, Watershed Water Quality Management (prereq: NR 504 or permission)
SOC 660, Community Sociology *or* GEOG 590, Introductory Cartography

Group III-Resource management theory (choose one)
CD 717, Law of Community Planning
ECON 641, Public Economics (prereq: ECON 401, ECON 605, or permission)

EREC 572, Introduction to Natural Resource Economics
EREC 606, Land Economic Perspectives: Uses, Policies, and Taxes
EREC 627, Community Economics (prereq: EREC 411 or equivalent)
EREC 756, Rural and Regional Economic Development (prereq: ECON 605)
TOUR 767, Social Impact Assessment

Group IV-Additional complementary electives (optional)
CD 794, Community Planning Internship
GEOG 582, Economic Geography
GEOG 583, Urban Geography

For additional information, contact Professor Alberto B. Manalo, Community Development Program coordinator, 309 James Hall.

Genetics

The interdepartmental program in genetics involves faculty from the departments of animal and nutritional sciences, biochemistry and molecular biology, microbiology, plant biology, and zoology. Course descriptions can be found in the genetics entry on page168 of this catalog, as well as in the listings of the cooperating departments. M.S. and Ph.D. degrees in genetics are offered through the Graduate School. An undergraduate major in genetics is not currently offered. Undergraduates interested in genetics can pursue a minor (see requirements below). Students interested in preparing for graduate work in genetics should contact the chairperson of the genetics program early in their undergraduate careers for advice on courses.

Genetics Minor

Completion of 20 credits from the following courses is required for a minor in genetics. At least one course should be selected from each of the subdisciplines listed below. Three (or more) credits of GEN 795, Investigations in Genetics, may be counted as one course toward fulfillment of the minor.

Transmission Genetics
GEN 702, Genetics Lab (prereq: BIOL 604)
GEN 706, Human Genetics (prereq: BIOL 604)
GEN 753, Cytogenetics (prereq: BIOL 604)

Molecular Genetics
GEN 711, Genomics and Bioinformatics (prereq: BIOL 604)
GEN 715, Molecular Evolution (prereq: BIOL 604)
GEN 754, Laboratory in Biochemistry *and* Molecular Biology of Nucleic Acids (prereq: BCHM 658/659 or 751; or permission)
GEN 771, Molecular Genetics (prereq: BCHM 658 or 751; BIOL 604)
GEN 774, Plant Biotechnology and Genetic Engineering (prereq: BIOL 604)
GEN 782, Developmental Genetics (prereq: BIOL 604; BCHM 658 or 751)

Population and Quantitative Genetics
GEN 705, Population Genetics (prereq: BIOL 604)
GEN 723, Quantitative Genetics (prereq: BIOL 604)

Marine Biology

The minor in marine biology, available to all students in the University, consists of 20 credits with grades of C- or better and no pass/fail courses.

Department Requirements
Introductory course (choose one)
ESCI 501, Introduction to Oceanography
ZOOL 503, Introduction to Marine Biology
ZOOL 674, Field Marine Science

Interest concentration courses (choose four)
BCHM 702, Endocrinology
EREC 610, Coastal and Oceanic Law and Policy
EREC 611, Marine Resource Economics
ESCI 501, Introduction to Oceanography
MICR 707, Marine Microbiology
MICR 714, Water Pollution Microbiology
NR 610, Coastal and Oceanic Law and Policy
PBIO 625, Introduction to Marine Botany
PBIO 721, The Microscopic Algae
PBIO 722, Marine Phycology
PBIO 725, Marine Ecology
PBIO 727, Algal Physiology
TECH 797, Undergraduate Ocean Research Program
ZOOL 610, Principles of Aquaculture
ZOOL 611, Principles of Aquaculture Lab
ZOOL 628, Marine Invertebrate Evolution and Ecology
ZOOL 674, Field Marine Science
ZOOL 710, Ichthyology
ZOOL 711, Zooplankton Ecology
ZOOL 712, Mammalogy
ZOOL 720, Marine Biology for Teachers
ZOOL 722, Ecology of Marine Fishes
ZOOL 725, Marine Ecology
ZOOL 730, Underwater Research
ZOOL 750, Biological Oceanography
ZOOL 751, Research in Marine Biology
ZOOL 753, Marine Vertebrates
ZOOL 772, Fisheries Biology
ZOOL 773, Physiology of Fish
ZOOL 775, Reproduction and Development of Marine Invertebrates
ZOOL 795, Underwater Research

Sustainable Living

Issues of sustainable living involve every aspect of life. To learn about sustainable living, a community and bioregional context is desirable. The student must be aware of environmental issues and problems, have an understanding of ecology, increase his or her capacity to think about complex problems, and have hands-on learning experiences to approach effectiveness in sustainable living. Students taking the sustainable living minor will, at minimum, take the courses listed below. Courses should be taken in roughly the order listed.

Required
BIOL 541, General Ecology, *or* NR 527, Forest Ecology, *or* equivalent
NR 535, Contemporary Conservation Issues and Environmental Awareness, *or* NR 502, The Endangered Forest, *or* equivalent
NR 784, Sustainable Living
NR 785, Systems Thinking for Sustainable Living

Choose one of the following
AOE 630, Development of Food and Fiber in Third-World Countries
ECON 607, Ecological Economics
GEOG 673, Environmental Geography
PBIO 407, Sustainable Gardening (summers only)
PBIO 682, Sustainable Food Systems
NR 501, Introduction to Soil Sciences
NR 504, Freshwater Resources
NR 719, Wetlands Mitigation and Restoration
NR 720, International Environmental Politics and Policies for the 21st Century
NR 724, Resolving Environmental Conflicts
NR 725, Environmental Communications and Advocacy

(Other course selections must be approved by Dr. Robert Eckert.)

Choose one of the following
NR 601, Environmental Conservation and Sustainable Living Internship
NR 750, Applied Environmental Philosophy

For additional information please contact Dr. Robert Eckert, Natural Resources Department, James Hall.

Wetland Ecology

Students in biology, environmental conservation, forestry, plant biology, soil science, water resources management, wildlife management, and zoology should consider obtaining a minor in wetland ecology. There is a strong demand among consulting firms, and state and federal agencies for employees with knowledge and experience in wetland soils, vegetation, and hydraulic functions. Fulfilling the requirements of this minor in combination with one of the above bachelor programs will enhance employment opportunities.

Required
NR 504, Freshwater Resources, *or* NR 703, Watershed Water Quality Management
NR 711, Wetland Resource Management
NR 716, Wetland Delineation, *or* NR 719, Wetlands Mitigation and Restoration, *or* ZOOL 708, Stream Ecology

Recommended
EOS 713, Biogeochemical Dynamics
ESCI 653, Estuaries and Coasts
PBIO 566, Systematic Botany
PBIO 625, Introduction to Marine Botany
PBIO 721, The Microscopic Algae
PBIO 747, Aquatic Higher Plants
NR 425, Field Dendrology
NR 501, Introduction to Soil Sciences
NR 602, Natural Resources and Environmental Policy
NR 611, Soils and Environmental Quality
NR 704, Soil Genesis and Classification
ZOOL 725, Marine Ecology

Programs of Study

Adult and Occupational Education

(For program description, see page 36. For descriptions of courses, see page 157.)

Animal Sciences

(For descriptions of courses, see page 133. See also page 210, Nutritional Sciences.)

The undergraduate animal sciences program at UNH provides students with fundamental and applied education in nutrition, reproduction, genetics, physiology, pathology, cell biology, and large animal management. Courses are offered in all areas of dairy and light horse production.

The Department of Animal and Nutritional Sciences is housed in Kendall Hall, a five-story animal research facility. This building houses the New Hampshire Veterinary Diagnostic Lab; an electron microscopy facility; and nutrition, physiology, and cell culture labs, all of which provide opportunities for students interested in basic animal sciences. The department maintains a light horse center and offers an equine program with courses in management, equine diseases, equine discipline, physical performance, and horsemanship specializing in dressage and combined training. Dairy facilities include housing for more than one hundred milking-age cows in the new $1.6-million Dairy Teaching and Research Center. Miniature swine are maintained at the Burley-Demerritt farm. Extensive poultry facilities also permit research and work experience in poultry science.

The animal sciences program offers two majors: animal science-with options in (1) equine sciences, (2) bioscience and technology, and (3) preveterinary medicine-and dairy management. In addition to satisfying the specific requirements of these majors or options, all animal science and dairy management majors must complete the University general education requirements. The department also offers a program in nutritional sciences.

The equine sciences option is intended to prepare students for a career in the equine industry. While the basic curriculum for this option provides students with the fundamental background in the equine sciences, preparation in a particular area of specialization is achieved by choosing courses from one of the following two areas of concentration: equine industry equestrian management or equine industry agribusiness management.

Students in the bioscience and technology option often specialize in nutrition, reproduction, genetics, or cell biology. This curriculum prepares students for advanced training in graduate school programs or in various medical professions; entry-level positions in biomedical, biotechnical, pharmaceutical, and other scientific companies; or technical positions in many research and medical units.

The preveterinary medicine option is designed to meet the academic requirements of most veterinary schools. Requirements may be met within three years, allowing students to apply to veterinary school during their senior year. However, most students finish their senior year, thus allowing more time for electives, concentration in areas of secondary interest, and completion of graduation requirements.

Employers in agriculture prefer to hire an agricultural graduate with extensive knowledge in a related field (e.g., computer science) rather than a graduate in one of these areas with no knowledge of agriculture. Hence, animal science students are encouraged to obtain training in a field that complements study in animal sciences. Such areas may include cell biology, biotechnical skills, communications, computer science, education, or business. This is generally accomplished by either taking a concentration of courses or obtaining a minor in a "specialty" area. Attainment of sufficient training in a "specialty" area enhances opportunity for employment. A careers course is offered to help students select and prepare for a particular career area.

Development of optional career goals is important for preveterinary students. Admission to schools of veterinary medicine is highly competitive. Therefore, students in this option are urged to prepare for alternative careers as they complete preveterinary requirements.

All animal science majors are required to complete ANSC 406; CHEM 403-404; and either ENGL 501, 502, 503, 519, or 529. In addition, the requirements in one of the three following options must also be completed:

Equine Sciences Option
ANSC 511-512; EREC 411 or ECON 402; BIOL 528 or PSYC 402 or SOC 502; ANSC 404, 600, 605, 609, 612, 620, 622, 625, 697, or 796; two 700-level ANSC courses; and at least five courses from one of the following two groups: (A1.) Equine Industry Equestrian Management Group: ANSC 507, 604, 605, 653-654; KIN 501; CMN 500 or MGT 580; EREC 501 or MKTG 550, EREC 504; DCE 491-492 or CS 401. (A2.) Equine Industry Agribusiness Management Group: ANSC 605, 701, 724; EREC 501 or MKTG 550, EREC 504; DCE 491-492 or CS 401, MGT 580 and MGT 713.

Bioscience and Technology Option
BIOL 411-412; PHYS 401-402; MATH 424B; BIOL 528; MICR 503 or BIOL 541; ANSC 511-512 or ZOOL 518 and 625/626; CHEM 545 or 651-652; BIOL 604; BCHM 658/659 or 751-752; ANSC 750 and one 700-level ANSC course.

Preveterinary Medicine Option
BIOL 411-412; PHYS 401-402; MATH 424B; BIOL 528; MICR 503; ANSC 511-512; BIOL 604; CHEM 651/653 and 652/654; BCHM 658/659; ANSC 750 and one 700-level ANSC course.

(For course requirements for the B.S. degree in dairy management, see Dairy Management, page 85.)

General Science Certification
See pages 33 and 78.

Biochemistry and Molecular Biology

(For descriptions of courses, see page 141.)

The field of biochemistry and molecular biology encompasses a broad range of the molecular life sciences, from biophysics and biochemistry to applied biology and medicine. The B.S. in biochemistry is based on a solid foundation in biology, chemistry, physics and math, along with advanced courses in molecular biology, biochemistry, cell biology, and genetics. The combined B.S.-M.S. degree program allows outstanding students with well-defined career plans to augment their bachelor's degree program with an intensive research program and graduate-level course work leading to the master's degree.

The department offers specialized training in the areas of molecular genetics, signal transduction, gene regulation, bioinformatics, molecular evolution, cancer biology, macromolecular interactions, glycobiology, lipid metabolism, endocrinology, genomics, and proteomics. Undergraduate students are encouraged to become involved in research projects sponsored by external granting agencies such as the National Institutes of Health, the National Science Foundation, and others.

Students interested in the biochemistry

major should consult with the department chairperson or a faculty member as early as possible to ensure the most effective curricular planning.

For first-year students with a strong high school preparation in both chemistry and mathematics (including calculus), the following schedule is recommended:

Fall
BIOL 411, Principles of Biology I
CHEM 403, General Chemistry I
MATH 425, Calculus I
ENGL 401, Freshman English

Spring
BIOL 412, Principles ofBiology II
CHEM 404, General Chemistry II
MATH 426, Calculus II
General education course

For first-year students lacking a strong background in chemistry and mathematics, the following schedule is recommended:

Fall
BIOL 411, Principles of Biology I
CHEM 403, General Chemistry I
any course
ENGL 401, Freshman English

Spring
BIOL 412, Principles of Biology II
CHEM 404, General Chemistry II
MATH 424B, Calculus for Life Sciences
General education course

Bachelor of Science in Biochemistry

The bachelor's degree in biochemistry consists of a set of core requirements (Group I) and a set of required electives from several subject areas (Groups II-V):

I. All of the following
BIOL 411, 412, Principles of Biology I, II
CHEM 403, 404, General Chemistry I, II
MATH 425, 426, Calculus I, II, *or*
424B, Calculus for Life Sciences *and*
BIOL 528, Applied Biostatistics I
MICR 503, General Microbiology
BIOL 604, Principles of Genetics
BIOL 605, Eukaryotic Cell and Developmental Biology
CHEM 547/549 and 548/550, Organic Chemistry,
or CHEM 651/653 and 652/654, Organic Chemistry,
or CHEM 545/546, Organic Chemistry
and BCHM 658/659, General Biochemistry
PHYS 401, 402, Introduction to Physics I, II,
or PHYS 407, 408, General Physics I, II
CHEM 517, Quantitative Analysis
BCHM 751-752, Principles of Biochemistry
BCHEM 755, Laboratory in Biochemistry and Molecular Biology

II. One of the following molecular biology courses
BCHM 711, Genomics and Bioinformatics
BCHM 766, Environmental Genomics
BCHM 771, Molecular Genetics
BCHM 782, Developmental Genetics

III. One of the following biochemistry courses
BCHM 702, Endocrinolgy
BCHM 750, Physical Biochemistry,
or CHEM 683, 684, Physical Chemistry I, II
BCHM 761, Cellular Signaling Transduction in Health and Disease
BCHM 794, Protein Structure and Function

IV. One of the following laboratory techniques courses
BCHM 754, Laboratory in Biochemistry and Molecular Biology of Nucleic Acids,
or BCHM 799, Senior Thesis (4 cr.),
or BCHM 795, Investigations in Biochemistry and Molecular Biology (4 cr.)
ANSC 714, Research Methods in Endocrinology,
or ANSC 746, Animal Cell Culture,
or ANSC 751, Cell Culture,
or ANSC 752, Mammalian Cell Culture
CHEM 756, Advanced Organic Chemistry Laboratory,
or CHEM 763, Instrumental Methods of Chemical Analysis Laboratory
GEN 702, Genetics Lab,
or GEN 753, Cytogenetics
MICR 602, Pathogenic Microbiology,
or MICR 704, Genetics of Prokaryotic Microbes,
or MICR 705, Immunology,
or MICR 706/708, Virology and Virology Lab,
or MICR 717, Microbial Physiology
PBIO 774/775, Plant Biotechnology and Genetic Engineering
ZOOL 778, Neuroscience Techniques

V. One additional course from groups II-IV

The biochemistry curriculum provides most of the required and recommended courses for students seeking admission to professional schools in medicine, dentistry, veterinary medicine, and pharmacy. Students who major in biochemistry can also use their training in conjunction with advanced degrees in law and business.

Approximately 50 percent of the students who graduate with a major in biochemistry seek advanced degrees. Many biochemistry majors go on to attend graduate school in all areas of the life and biomedical sciences, especially graduate programs in genetics, molecular biology, biochemistry, cell biology, and chemistry. Recipients of an M.S. degree are more attractive to employers and often obtain better positions, greater salaries, and more responsibility and independence. A Ph.D. degree is eventually required for those who wish to direct research programs, be involved in state-of-the-art scientific research, become a professor in a college or university, or obtain an executive position in a science-related area of industry or government.

Students obtaining the B.S. in biochemistry enjoy excellent job prospects immediately upon graduation. There is currently a demand for skilled research technicians in biotechnology companies, pharmaceutical companies, government agencies, forensics, academic research laboratories, and hospitals. Students graduating in biochemistry have knowledge that is valuable in the fields of management, sales, marketing, regulatory affairs, technical writing, and scientific journalism. With additional courses in education, the B.S. in biochemistry also qualifies graduates to teach at the elementary, junior high, and high school levels.

Combined Bachelor of Science and Master of Science in Biochemistry

This accelerated five-year program leading to a combined bachelor and master's degree in biochemistry is designed for highly motivated and qualified students seeking additional training to further their career goals as a researcher in the life sciences.

Admission Policy

Admission to the combined degree program is highly competitive. Students wishing to pursue this option must have a grade-point average greater than 3.20 at the time of application. A thesis adviser must be identified during the junior year, and the approval of the adviser and department chairperson must be obtained. Prior to the first semester of the senior year, the student must formally apply to the Graduate School and receive early admission. The requirement for the Graduate Record Examinations is waived for combined degree applicants.

Requirements

Thirty credits of graduate level (800-900) coursework (including dual credit courses) must be completed. Six to 8 credits must be taken during the senior year, and are applied to both the B.S. and M.S. requirements. All other requirements for the M.S. degree (see Graduate School catalog) must be followed, including completion of preliminary exams, conducting a research project, and passing an oral examination based on the master's thesis project.

Suggested Program

Because of the intensive nature of the combined degree program, the thesis research project should be initiated as early as possible. A guidance committee should be established no later than the beginning of the fifth year to approve the student's proposed course of study. The following schedule is recommended:

Junior year
Identify thesis adviser and begin research project during the summer following junior year.

Senior year
Senior thesis (BCHM 799) during both semesters and the following summer, along with two dual-credit courses (800/900 level).

Fall semester, fifth year
Two 800/900 level courses (6-8 cr.)
BCHM 997 (1 cr.)
BCHM 899 (5 cr.)

Spring semester and summer, fifth year
One 800/900 level course (3-4 cr.)
BCHM 998 (1 cr.)
BCHM 899 (5 cr.)
Special topics (1-2 cr. as needed)

Research should be completed and the master's thesis defended during the summer.

Support
Students in the B.S./M.S. program are eligible for support through University Financial Aid. Additional support may be available from the student's adviser.

General Science Certification

See pages 33 and 78.

Biology

(For descriptions of courses, see page 141.)

The interdepartmental program in biology is designed to provide a strong and a broad background in biological sciences to students interested in education in the life sciences. The biology program integrates theoretical and practical (hands-on laboratory and field work) courses in different aspects of the biology of animals, microbes and plants. The curriculum is designed to reflect the diversity of the biological systems in nature. It encompasses the study of structural and functional relationships of living organisms at the molecular, cellular, and organismal level; the interactions of the living systems with the environment and with each other; and the evolutionary relationships of various forms of life. The goal is to create a facilitative environment for those with a scholarly interest in the biological sciences, and to extend their understanding, awareness, and appreciation of the diversity of the biological sciences.

The program is aimed at promoting excellence in biological science education by involving undergraduate students in strong interaction with faculty both in the classroom and research laboratories, and to encourage the development of high-quality undergraduate programs in all aspects of biology.

The biology program prepares students for graduate work in the biological, medical and agricultural sciences, and for job opportunities in industry (biomedical, pharmaceutical, agrochemical, environmental, and biotechnological) and governmental research, secondary school teaching or a general education about living organisms. Completion of the four-year undergraduate program plus a fifth-year internship will be necessary for biology teaching certification. Students who plan to enter medical, dental, or related professional schools are advised to confer with their faculty adviser to build the requirements for these programs into their academic programs.

Courses in the biology program are selected from departments that constitute the biological sciences community at UNH. The flexibility of the curriculum allows students wide selection of courses in various departments. Student in the biology major take a common core curriculum involving introductory and upper level courses. They select one of three areas of concentration (options). These are: (1) ecology, evolution, and behavior biology; (2) marine and freshwater biology; and (3) molecular, cellular, and developmental biology. For students who prefer a broader background without specialization, or are interested in pursuing a career in teaching, the fourth option, *general biology* (with an additional choice of teaching certification), is available.

While students are advised to declare the biology major as incoming freshmen to assure adequate program planning, transfer into the program at a later stage is also possible. Students who wish to concentrate in a specific area of biological sciences other than the options within the biology program should consider a major in animal science, biochemistry, microbiology, plant biology, or zoology. The biology core curriculum is followed by students in all these programs. This makes changing majors a very simple process.

Biology Core Curriculum

All biology and several of the biological sciences majors begin with the biology core curriculum. The biology courses in the core curriculum constitute an integrated sequence of courses imparting basic knowledge of biology in order to expose the students to the breadth of knowledge inherent in the biological sciences. The biology core allows a student to obtain a broad background in biology and related physical sciences and math. While it is recommended that the core curriculum be substantially completed in the first two years, students are encouraged to consult with their academic adviser to select one or more courses in their major during the sophomore year that may provide a gateway to the major. This may result in delaying one or more of the core courses in the junior year. By the end of the sophomore year, students are expected to have selected a departmental major or one of the four biology options leading to a B.S. degree. These options are: (1) *general biology*; (2) *ecology, evolution, and behavior biology*; (3) *marine and freshwater biology*; and (4) *molecular, cellular, and developmental biology*.

Biology Core Curriculum Courses
BIOL 400, Perspectives in Biology[1]
BIOL 411 & 412, Introductory Biology[2]
BIOL 541, Ecology
MICR 503, Microbiology
BIOL 604, Genetics

CHEM 403 & 404, Introductory Chemistry
CHEM 545/546 and BCHM 658/659, Organic Chemistry[3]
or CHEM 651/653 and CHEM 652/654, Organic Chemistry[3]

MATH 424B or 425, Calculus
BIOL 528 or MATH 426, Statistics[4]

PHYS 401 and 402, Introduction to Physics
ENGL 501 (or equivalent), Introduction to Creative Nonfiction[3]
EDUC 500[5]

Typically, students take BIOL 400; BIOL 411 & 412; CHEM 403-404; and Calculus 424B in their freshman year, and then complete the remainder of their core requirements during the sophomore and junior years.

In addition to the core curriculum, the requirements for individual options are described separately.

[1]BIOL 400 is required only for first year biology majors.
[2]BIOL 411 and 412 are not sequential and may be taken in reverse order.
[3]CHEM 651/653 and 652/654 and ENGL 501 are required for premedical or affiliated professional programs.
[4]MATH 425, Calculus II can be substituted for Statistics, but we recommend Statistics.
[5]Required only for those preparing for teacher certification.

Academic Requirements

To receive the B.S. degree in biology, students must complete 128 credit hours with a 2.0 cumulative grade-point average (GPA). Courses must include all UNH General Education requirements, biology core curriculum requirements, and the requirements for the selected option. A minimum grade of C- is required in all biological science courses that are counted towards the requirements for a degree in biology (all four

options). The only exception is that a passing grade below a C- will be accepted in a student's first biology course (BIOL 411 or 412). Students who expect to complete successfully for post-baccalaureate programs should attain a cumulative GPA of 3.0 or higher by the end of the sophomore year and maintain it at this level.

Students should consult with their academic adviser during their freshmen and sophomore years for assistance in determining the most appropriate option or major for their professional goals. Since biology core courses are required of all biological science majors, it is relatively easy to change majors within the biological sciences during this period.

Note: It is strongly recommended that students participate in an exchange semester at another university or in a field-oriented program or internship. There are many exchange opportunities available in which a full semester of credits toward the major may be earned. In addition, students should explore the courses at the Shoals Marine Laboratory (SML), which provides an excellent setting for several "field-oriented" courses during the summer. Often there is financial support available for the SML programs (see the SML Web site for details (www.shoals.unh.edu) or the Cornell Web site at www.sml.cornell.edu. It is further recommended that students explore possibilities of one or more semesters of Independent Investigation (research projects). For details, students should contact their adviser or the biology program office. Financial support is available for most of these programs.

Premedical and other pre-health professional students should visit the premedical office in Hood House for additional information on requirements for specific professional schools. The following elective courses will be helpful in preparing for admission to post-baccalaureate programs in the health professions and for their required aptitude examinations: BCHM/ANSC 702, ZOOL 518, ZOOL 625/626, BIOL 605, BCHM 751/752, ANSC 511/512.

One 600, 795, or 796 experience totaling three or more credits or any two 795-796 experiences of two credits each can fulfill one course requirement in any category with adviser's approval. A Petition for Academic Variance approved by the biology program director is required to count 795-796 experiences for more than one major required course. Students should check the UNH WEBCAT (webcat.unh.edu), the biology Web site (biology.unh.edu), and the UNH online catalog for updates and current course offerings.

Biology Options

In order to receive a B.S. in biology, a student may choose from one of the four biology options: (1) general biology; (2) ecology, evolution, and behavior biology; (3) marine and freshwater biology; and (4) molecular, cellular, and developmental biology. A complete list of approved courses in each option is available from the student's adviser, the biology program office (G-87 Rudman Hall), and the biology program Web site at biology.unh.edu.

The *general biology option* within the biology major provides broad-based training in the biological sciences for students who prefer not to specialize at the undergraduate level. Students must choose eight courses in addition to the biology core curriculum courses as specified in the categories listed in the option requirements (see Web site biology.unh.edu). Within the biology core, BIOL 528 is preferred to MATH 426; however, either is acceptable, and the sequence CHEM 545/546-BCHM658/659 is preferred to CHEM 651/653-652/654, for all students in the option, except for those who are pre-health professionals. Corequisite lecture and lab courses count as one course. Courses listed in more than one category will satisfy requirements in only one category.

The *marine and freshwater biology (MFB) option* provides broad-based training in the aquatic biological sciences for students who prefer to take additional courses in the area of marine and freshwater biology. Students interested in aquaculture and fisheries may also choose this option by taking appropriate courses in consultation with their adviser. Students must choose eight courses in addition to the biology core curriculum courses to fulfill the requirements of this option. All students must take General Limnology (PBIO/ZOOL 717) or Field Limnology (PBIO/ZOOL 719). For additional course requirements, the students should visit the biology Web site at biology.unh.edu.

The *molecular, cellular, and developmental biology (MCDB) option* provides an opportunity for broad training in molecular, cellular, and developmental biology, and the biotechnology area for students who would like to achieve limited specialization in this field. Students interested in the interdisciplinary fields of genetics, genomics, and bioinformatics may also choose this option by taking appropriate courses in consultation with their adviser. This is in addition to broad-based training in the basic areas of biology and related physical sciences covered in the core curriculum. Students choose eight courses from list of approved courses (available on the Web at biology.unh.edu) in addition to biology core curriculum courses, in order to complete this option. The sequence CHEM 651/653-CHEM 652-654 is preferable to CHEM 545/5460BCHM 658/659.

The *ecology, evolution, and behavior (EEB) option* within the biology program provides broad training in organismal and environmental biology, and provides an opportunity for limited specialization in the field of ecology, conservation, evolution, or behavior. Students must choose eight courses in addition to the biology core curriculum to complete this option. All students are required to take ZOOL 690. An additional seven courses should be selected as specified in the list of approved courses (biology.unh.edu). Within the biology core, BIOL 528 is preferred to MATH 426; however, either is acceptable.

Prehealth Professional Program

Students who wish to pursue postgraduate degrees in the health care professions should visit the premedical advising office in Room 9, Hood House. For more information, call (603) 862-3625 or visit the program's Web page at www.unh.edu/premed-advising.

Biology Teacher Certification and General Science Certification

Biology teacher certification for students preparing to teach high school biology may be obtained through the Department of Education's five-year, undergraduate-graduate degree program. Students are required to take EDUC 500 (preferably in the sophomore year), earn a bachelor's degree in one of the biological sciences, and complete a fifth year, which includes an internship and coursework leading to a master's degree in education. General science certification for students preparing to teach science in middle and junior high schools can be obtained through the Department of Education's general science certification program. For further information, see page 33 in Education, or contact the Department of Education's teacher education coordinator.

Biology Minor

A biology minor may be earned by completing the following requirements: (1) BIOL 411-412 or PBIO 412 and ZOOL 412; (2) one course from each of the three major organism groups: (a) animals (ANSC or ZOOL courses), (b) microbes (MICR courses), and (c) plants (PBIO courses); (3) two additional biological sciences courses at the 600-700 level.

Students interested in a biology major or minor should contact the Biology Program Office, G-87 Rudman Hall, 862-3066.

Community Development

(For descriptions of courses, see page 148.)

The community development program prepares students for professional careers as local government administrators, town or regional land-use planners, and community facilitators and educators. It is an applied social science degree program that gives the student an understanding of the interrelated social, economic, political, environmental, and technical factors that influence a community and its residents. The curriculum takes an interdisciplinary approach and includes field experience and internships as vital components that complement classroom and independent research.

Students majoring in community development are encouraged to concentrate in one of three areas: (1) community change and development, (2) community public administration, and (3) community and regional planning. These areas of specialty provide the necessary background and training to prepare graduates for entry-level positions with local municipalities and agencies throughout the nation. The community development program also provides a firm base for graduate study in a variety of areas such as regional planning, public administration, rural sociology, economic development, and law.

A minor in community development or community planning provides opportunities for students in other areas to better understand the application of their knowledge to specific community issues. A community development minor complements majors in both technical fields and liberal arts.

Local municipalities in New England are turning to full-time professional administrators to assume responsibility for the day-to-day administration, management, and planning activities that were previously carried out by part-time town officials. Officials at the New Hampshire Municipal Association estimated that New Hampshire needs, each year, at least twenty-five new graduates in community and public administration to fill local government professional needs. In addition to professional administration or planning positions in local or regional government, employment opportunities are also available with public agencies and organizations at the state, national, and international levels.

Students interested in the challenges of community development should consult with Albert B. Manalo, program coordinator and chairperson of the Department of Resource Economics and Development, 309 James Hall, (603) 862-3917.

Required Courses

CD 415, Community Development Perspectives
CD 508, Applied Community Development
CD 614, Fundamentals of Planning
CD 777, Topics in Community Planning
CD 794, Community Planning Internship,
or CD 793, Community Administration Internship
CMN 500, Public Speaking
EREC 411, Environmental and Resource Economics Perspectives
EREC 525, Statistical Methods and Applications
EREC 606, Land Economic Perspectives: Uses, Policies, and Taxes
EREC 627, Community Economics
EREC 775, Research Methods
TOUR 705, Ecotourism: Managing for the Environment
or TOUR 767, Social Impact Assessment
MATH 420, Finite Mathematics
MGT 580, Introduction to Organizational Behavior
MGT 712, Managing Change and Conflict in Organizations
POLT 503, State and Local Government and Politics

Dairy Management

(For descriptions of courses, see page 133.)

The dairy management program, offered by the Department of Animal and Nutritional Sciences, is designed to provide students with solid training in areas important to the successful management of a dairy enterprise, for employment in related agribusinesses (e.g., pharmaceutical and feed industries), or for those wishing to pursue additional training leading to the M.S. or Ph.D. degree in dairy science or its related disciplines. Dairy management students receive training in areas such as nutrition, reproduction, diseases, genetics, lactation physiology, forages, agribusiness finance, personnel management, computer science, and public relations. In addition, junior and senior students enrolled in this program will be given complete responsibility for managing the UNH teaching herd with other students, thereby acquiring actual management experience along with their basic subject matter training. The UNH Teaching and Research Center, a modern dairy facility, houses approximately one hundred milking cows plus a similar number of nonlactating animals.

In addition to the University's general education requirements, a typical dairy management student will take the following courses:

First Year

ANSC 408 (optional), 409, 410, 430; BIOL 411; CHEM 403-404; ENGL 401; EREC 411

Second Year

ANSC 432, 511, 512, 650; CS 401; PBIO 421; EREC 504

Summer Internship

ANSC 600

Third Year

ANSC 609, 612, 530, 650, 701, 715

Fourth Year

ANSC 698, 708, 710, 724, 727, 728, 743; MGT 580 or 713

Students interested in pursuing graduate studies take MATH 424B, CHEM 545-546, BCHM 658-659 and MICR 503 in lieu of PBIO 421 and CS 401.

Environmental and Resource Economics

(For descriptions of courses, see page 165.)

This program offers training in environmental and resource economics, including public resource policy, resource management, natural resource and environmental economics, and community economics and finance. The curriculum emphasizes applied economics in the context of public policy. Training is also available in agricultural economics, including agribusiness, small business management, food marketing, agricultural policy, and world food supplies.

Students majoring in environmental and resource economics will normally concentrate in one of the following three areas: environmental and natural resource economics, agricultural economics, or community economics. In addition, students must satisfy general education requirements, which lead to a broad university education. Majors interested in the economic or business aspects of agriculture and natural resources will be expected to take courses in the biology departments.

Students majoring in any of the social science, life science, and agriculture departments of the University may find it to their advantage to elect courses or a minor in environmental and resource economics or agribusiness. By doing so, their basic training can be supplemented in a specific area of interest, such as resource development and natural resource policy for social science majors, farm management and agricultural marketing for agricultural majors, and community economics and finance for students interested in local government and development.

Required Courses
All of the following
CD 614, Fundamentals of Planning
ECON 401, Principles of Economics (Macro)
ECON 605, Intermediate Microeconomic Analysis
ECON 611, Intermediate Macroeconomic Analysis, *or* ECON 635, Money and Banking
EREC 411, Environmental and Resource Economics Perspectives
EREC 504, Business Management for Natural Resource Firms
EREC 525, Statistical Methods and Applications
EREC 775, Research Methods
MATH 420, Finite Mathematics, or MATH 424B, Calculus for the Life Sciences
At least five of the following, of which two must be 700 level
EREC 501, Agricultural and Natural Resource Product Marketing
EREC 572, Introduction to Natural Resource Economics
EREC 606, Land Economic Perspectives: Uses, Policies, and Taxes
EREC 611, Marine Resource Economics
EREC 627, Community Economics
EREC 633, Economics of Travel and Tourism
EREC 676, Economics of Water Use and Quality Management
EREC 708, Environmental Economics
EREC 715, Linear Programming and Quantitative Methods
EREC 756, Rural and Regional Economic Development

Students who major in environmental and resource economics are qualified for a wide variety of opportunities upon graduation. Private business, public institutions, and government agencies currently have a strong demand for specialists trained in natural resource development; land and water use policy; natural resource and small business management; agricultural, fisheries, and forestry marketing; and community development. In many cases, students may wish to improve their qualifications by pursuing more specialized graduate studies in one or more of the above areas.

Departmental Honors

Honors in environmental and resource economics will be awarded to students who complete 16 credits of honors courses in environmental and resource economics (including a minimum of four credits of a senior research project), and who maintain a minimum grade-point average of 3.20 in the major. Students interested in the environmental and resource economics honors program should contact the environmental and resource economics coordinator in James Hall for more information.

Students interested in a major or minor in environmental and resource economics should contact Alberto B. Manalo, 309 James Hall, (603) 862-3917.

Environmental Conservation

(For descriptions of courses, see page 204.)

The program in environmental conservation provides a broad background for understanding environmental and resource problems and their solutions. Development of policies and planning are essential to resolving environmental problems and require a foundation in biology as well as government and economics.

Students must choose a 32-credit option (environmental affairs or environmental science) or develop a concentration that is related to specific career goals (for example, in the areas of environmental education, ecology, or conservation biology). Students choosing the latter route incorporate a minor or equivalent into their concentration. In addition to courses in the options or concentrations, a student must complete the 18 core courses. Courses in the EC program major must be completed with a grade of C- or better.

Students interested in the Environmental Conservation major should consult with Mimi Larsen Becker, program coordinator.

The following eighteen courses are required of all majors
NR 400, Professional Perspectives in Natural Resources
NR 401, Introduction to Natural Resources
PBIO 412, Introductory Botany
ZOOL 412, Principles of Zoology

Ecology Electives: Check all courses for prerequisites. Choose one of the following
BIOL 541, General Ecology
NR 425, Field Dendrology
NR 433, Wildlife Ecology
NR 660, NZ: Biodiversity and Ecology
PBIO 566, Systematic Botany
ZOOL/PBIO 503, Intro to Marine Biology

A second course should be selected from the following
EREC 411, Environmental and Resource Economics Perspectives
NR 527, Forest Ecology
NR 661, NZ: Ecosystem Management and Restoration Ecology
NR 765, Community Ecology
PBIO 724, Freshwater Algal Ecology
PBIO/ZOOL 725, Marine Ecology
PBIO 742, Physiological Ecology

CHEM 403, General Chemistry

Economics Elective: Choose one of the following
ECON 605, Intermediate Microeconomic Analysis
ECON 607, Ecological Economics
ECON 645, International Economics
ECON 668, Economic Development
ECON 669, Women and Economic Development
ECON 670, Economics of Energy
ECON 707, Economic Growth and Environmental Quality
EREC 606, Land Economics Perspective: Uses, Policies, and Taxes
EREC 611, Marine Resource Economics
EREC 627, Community Economics and Finance
EREC 676, Economics of Water Use and Quality Management
EREC 708, Environmental Economics
NR 643, Economics of Forestry

NR 602, Natural Resources and Environmental Policy

NR 701, Ecological Values and Ethics, *or* PHIL 755, Environmental Ethics, *or* HIST 618, American Environmental History
NR 504, Freshwater Resources

NR 501, Introduction to Soil Sciences

One communication skills course
AOE 650, CMN 500, NR 725, THDA 520, 583, 621, 622, 624

One writing skills course
ENGL 501, 503, 519, 529

One statistical skills course
BIOL 528, PSYC 402, SOC 502, or equivalent

NR 637, Practicum in Environmental Conservation, 4 credits. The practicum is a student-initiated independent project involving field work on an actual conservation activity, off campus, during the senior year. There is a 100-hour minimum time commitment which may be public service or for pay.

NR 775, Natural Resources Senior Project

General Science Certification

See pages 33 and 78.

Minor in Environmental Conservation

A minor in environmental conservation is available to students outside of the environmental conservation major. This minor consists of five courses or 20 credits. The following are the categories and/or specific courses required:

Required
1. Any one of the following: PBIO 412, ZOOL 412, BIOL 411, BIOL 412. Note that BIOL 411/412 is usually restricted to students in the College of Life Sciences and Agriculture. The recommended courses are PBIO 412 or ZOOL 412.

2. NR 435, Contemporary Conservation Issues and Environmental Awareness.

3. One course in ecology. Some possibilities include, but are not limited to: BIOL 541, NR 433, NR 527, NR 660 (NZ)

4. One intermediate level course (600-level or higher) in ecological economics, resource economics, or environmental policy. Examples are NR 662, Environmental Policy, Planning and Economics in New Zealand's Political Context; NR 720, International Environmental Politics and Policies for the 21st Century; ECON 607, Ecological Economics; EREC 606/611/627 or 676. (The prerequisite for the EREC or ECON 607 courses is an introductory course in micro economics, such as EREC 411.)
5. One of the following: NR 504, Freshwater Resources; NR 501, Introduction to Soil Sciences; NR 502, The Endangered Forest; or NR 750, Applied Environmental Philosophy; NR 661, Ecosystem Management and Restoration Ecology in New Zealand.

For additional information please contact Dr. Mimi Larsen Becker, Department of Natural Resources, James Hall.

Environmental Conservation Off-Campus Programs

The environmental conservation program offers two programs which provide an option to spend a semester abroad. The *Geocommons Program* offers 12 credits in international sustainable communities (NR 680, 681, 682) by providing semester experiences in communities that are striving for sustainability in India and France. Emphasis is on the human dimensions of community-building, ecological design, and a sense of place (coordinator: Dr. Robert Eckert).

The *UNH-EcoQuest New Zealand Program* provides highly motivated students with the opportunity to engage in a unique multidisciplinary, research-oriented field study program. Four fully integrated courses (NR 660, 661, 662, and 663 for 16 credit hours) focus on the ecological, resource management, conservation and sustainability issues important to the natural environment, economy, and culture of New Zealand over a full semester. Alternatively, students can participate in a summer session five-week two-course intensive (NR 660, 662 for eight credit hours). Students engaged in this learning community will examine unique ecosystems, watershed scale restoration, and undertake a problem-solving, hands-on integrated approach to resource management investigations which incorporate cultural, economic, and policy dimensions of the New Zealand environment. The UNH EcoQuest New Zealand Program coordinator is Dr. Kimberly Babbitt.

Forestry

(For descriptions of courses, see page 204.)

Forestry is the art and science of managing and understanding the natural and human dimensions of forests and forest use. The forestry program is designed to provide graduating professionals with a sound technical preparation and a broad general education. The forest management and forest science options of the forestry major leading to the bachelor of science in forestry degree (B.S.F.) are accredited by the Society of American Foresters (SAF). The SAF is recognized by the Council on Postsecondary Accreditation and the U.S. Department of Education as the accrediting body for forestry in the United States.

Professional foresters are employed by private industry, public agencies, public interest firms, groups, educational institutions, research organizations, and consulting firms. Foresters manage forests, provide for wildlife habitat and forest recreation, protect water and soil resources, and assure a sustainable supply of forest products. Some graduates work toward natural resource protection and the improvement of environmental quality.

Forestry education at UNH focuses on ecosystem management for diversity, productivity and health, based on multidisciplinary collaboration. There are opportunities in international forestry. Many students enter graduate school for advanced training in forest biology or forest management.

Technical, administrative, and managerial skills are required of all professional foresters. This program provides a foundation in scientific knowledge, as well as technical and managerial skills, with elective freedom to cultivate special abilities and interests.

Students majoring in forestry must complete 130 credits of classroom work and 4 credits of field training. University general education requirements are included in this total.

Besides these formal courses, all forestry majors are required to have at least one summer of forestry work experience (NR 599). While students are responsible for their own summer work, placement assistance is available from the faculty.

In the junior year, students must choose to concentrate in either of the following options (and must earn 24 credits within that concentration to graduate):

Forest Management Option

This option is designed for students who intend to plan a career in forest resource management. Requirements: NR 753, Decision Sciences in Natural Resource Management; NR 754, Wood Products Manufacture and Marketing; RMP 711, Recreation Resource Management; one course in administration, 500 level or higher; two courses (8 credits) in advanced forestry, wildlife, hydrology, soils, resource management, urban forestry, recreation, or administration.

Forest Science Option

In this option, students may specialize in specific forest sciences as background for graduate school or focus their interests in areas other than forest management. Areas of concentration include forest biology, ecology, soil science, watershed management, international forestry, and others. Students in this option are encouraged to minor in the area of their choice.

Minors

Nonforestry majors may minor in forestry by completing 20 to 22 credits of coursework approved by the forestry program faculty.

Freshman Year

BIOL 528, Applied Biostatistics I *or* equivalent
ENGL 401, Freshman English
MATH 424B, Calculus for Life Sciences
NR 400, Professional Perspectives of Natural Resources
NR 401, Introduction to Natural Resources
NR 425, Field Dendrology
NR 426, Wood Science and Technology
NR 542, Forestland Measurement and Mapping
PBIO 412, Introductory Botany
One oral communication skills course

Sophomore Year

CHEM 403, General Chemistry
EREC 411, Environmental and Resource Economics Perspectives, *or*
ECON 402, Principles of Economics (Micro)
NR 433, Wildlife Ecology
NR 501, Introduction to Soil Sciences
NR 506, Forest Entomology
NR 527, Forest Ecology
NR 544, Forest Biometrics
NR 599, Work Experience
General education elective 4, 5, 6, or 8
General education elective 4, 5, 6, or 8

Junior Year

NR 602, Natural Resources and Environmental Policy
NR 629, Silviculture
NR 643, Economics of Forestry
NR 652, Forest Resources Assessment
NR 670, Forest Fire Protection
PBIO 651, Plant Pathology
Professional option
General education elective 4, 5, 6, or 8
General education elective 4, 5, 6, or 8

Senior Year
NR 745, Forest Management
NR 775, Natural Resources Senior Project
NR 757, Photo Interpretation and Photogrammetry
Professional option
Professional option
Professional option
NR 703, Watershed Water Quality Management, *or*
NR 504, Freshwater Resources
General education elective 4, 5, 6, or 8
Students interested in the forestry program may consult with the program coordinator, Mark Ducey, James Hall.

General Science Certification
See pages 33 and 78.

General Studies

General studies provides a flexible curriculum for students with a broad, general interest in several areas of life sciences and agriculture. It cuts across departmental lines and in some respects resembles a self-designed major. General studies is not intended to be a catch-all for students from other colleges, but is designed to serve the needs of life sciences and agriculture students. Requirements for a general studies major are CHEM 403-404; BIOL 411-412 (or PBIO 412 and ZOOL 412); PHYS 401-402; and six additional courses in the college (or closely related courses approved by the adviser) two of which must be at the 600 level and two at the 700 level. These courses should be interrelated in such a way that they will help students meet their goals for employment or further study.

Freshmen who are unsure of a major should not declare general studies as a major but should remain undeclared for a semester or two (see Undeclared Status). The program is generally not available to students entering their senior year.

Genetics Program

The Genetics Program offers master's and Ph.D. degrees in genetics. Undergraduates interested in Genetics can pursue their interests within the context of any of the following B.S. degree programs: biology, animal sciences, biochemistry and molecular biology, microbiology, plant biology, and zoology. For course entries in genetics, see course descriptions under GEN, as well as relevant courses listed under the fore-listed departments and programs. Students interested in preparing for graduate work in genetics at UNH or elsewhere should contact the chairperson of the genetics program early in their undergraduate careers for advice on courses.

Medical Laboratory Science

(For descriptions of courses, see page 199.)
The Medical Laboratory Science (MLS) program is accredited by the National Accrediting Agency for Clinical Laboratory Sciences (NAACLS). The program is ideal for students who are interested in pursuing a challenging and rewarding career in analytical biomedicine. The curriculum for MLS majors provides students with a sound background knowledge in the biological and physical sciences and a quality education in specialized science theory and laboratory skills. In addition, the curriculum offers students an opportunity to become more knowledgeable in the arts, humanities, and social sciences. Students entering the MLS program can pursue a degree in one of two tracks: (1) a B.S. in MLS-Clinical Track; (2) a B.S. in MLS-Research Track. They will initially enroll in the MLS program without designating a specific MLS track. Students will be informed of the specifics of the MLS-Clinical Track and MLS-Research Track in their freshman year course, MLS 401, Introduction to Medical Laboratory Science. Also, students may obtain detailed information concerning the two MLS tracks from their academic advisers. A decision to pursue a specific MLS track must be made by the end of the junior year.

NAACLS requires that all MLS students understand the essential functions that will be required of a certified medical technologist. Requirements include: a sound intellect; good motor skills; eye-hand coordination and dexterity; effective communications skills; visual acuity to perform microscopic analyses, or read procedures, graphs, etc.; professional skills such as the ability to work independently, manage time efficiently, and comprehend, analyze and synthesize various materials, as well as have sound psychological health and stability. Contact the MLS program director for more information.

MLS-Clinical Track
Students selecting the MLS-Clinical Track spend their freshman, sophomore, and junior years and the fall semester of their senior year on the University campus. During the spring semester of the senior year, these students take clinical internship at one of the clinical affiliates. Clinical internship positions are limited. Selection to fill available positions will be based on established criteria published in the *MLS Student Handbook*, including professionalism, academic performance, interviews, and references.

Students enrolled in the MLS-Clinical Track may choose the generalist option to become certified as a medical technologist or choose to specialize in either clinical microbiology, clinical cematology, clinical immunohematology, or clinical chemistry. Students choosing the generalist option will spend 24-26 weeks at a clinical affiliate where they complete clinical courses in Advanced Clinical Microbiology (MLS 751), Advanced Clinical Hematology (MLS 752), Advanced Clinical Immunohematology (MLS 753), and Advanced Clinical Chemistry (MLS 754). Upon successful completion of this program, students are awarded the B.S. degree and are eligible to take the American Society of Clinical Pathologists (ASCP) and National Certification Agency (NCA) certification examinations. Students choosing the categorical option will spend 20-24 weeks at a clinical internship site where they complete either Clinical Microbiology Internship (MLS 761), Clinical Hematology Internship (MLS 762), Clinical Immunohematology Internship (MLS 763), or Clinical Chemistry Internship (MLS 764). Upon successful completion, students are awarded the B.S. degree and are eligible to take the ASCP and NCA categorical examinations in their specialty area.

Graduates of the MLS-Clinical Track perform various medical laboratory tests and provide the diagnostic assistance required in modern patient care. These professionals are vital members of the health care team, performing various analytical procedures in a wide variety of biomedical laboratories. Graduates are employed in hospitals, biotechnology, research, industry, education, and a variety of other health care settings. A list of essential functions necessary for work in a clinical lab is available from the MLS office.

All students participating in clinical courses must purchase liability insurance and show evidence of selected immunizations. Internship fees will be charged by the clinical affiliate in some instances.

MLS-Research Track
The curriculum for this track focuses on providing students with a quality education in the fundamentals of biomedical laboratory science and laboratory skills in addition to a broad-based university general education. This track is appropriate for students desiring employment in a wide variety of biomedical research laboratories in universities, medical schools, diagnostic product companies, biotechnology companies, hospitals, government agencies, etc. Students seeking a degree in this track are qualified to pursue advanced education in the biomedical fields.

Students intending to pursue advanced degrees should consult with their academic advisers as early as possible so that appropriate academic plans can be established. Graduates of this track are qualified to seek postgraduation clinical internship if they wish to attain certification as a medical technologist or a specialist.

Students pursuing a degree in the MLS-Research Track follow the same curriculum as the curriculum required for the MLS-Clinical Track with the exception of taking a semester of additional courses in a related area, such as:

PBIO 754, Laboratory in Biochemistry and Molecular Biology of Nucleic Acids	5
MICR 702, Infectious Disease and Health	5
MICR 706, Virology	3
MICR 752, Mammalian Cell Culture	5
GEN 753, Cytogenetics	4
MLS 796, Biomedical Research Internship	Var
MLS and other courses (consult with academic advisers)	

Research track students do not take a clinical internship in their senior year.

MLS-Clinical Track: Academic Requirement

Students pursuing a degree in the MLS-Clinical Track must obtain a grade of C or better in all MLS courses. These students must also have achieved a minimum 2.50 cumulative grade-point average (GPA) at the time of application for clinical internship (junior year), and must maintain that minimum until the internship begins. A personal interview at the clinical affiliate is required. This interview evaluates a student's understanding of the profession, communication skills, maturity, self-confidence, and supervisory potential. Students must demonstrate these attributes to participate in the clinical courses.

MLS-Research Track: Academic Requirement

The students in the MLS-Research Track must meet the UNH requirements for the bachelor of science degree.

Career Mobility Program

This option is designed to make the B.S. degree in MLS available to certified laboratory assistants, medical laboratory technicians, military-trained laboratory personnel, and other individuals with at least two years of full-time recent experience in a clinical laboratory. This may be done on a full- or part-time basis by taking required courses at UNH or other accredited institutions. Students may challenge MLS clinical course requirements through credit by examination. Written and practical examinations are available in the areas of clinical microbiology, clinical hematology, clinical immunohematology, clinical chemistry, and urinalysis/body fluids. Students interested in the option should contact the MLS program director.

MLS Minor

Students may obtain a minor in MLS by successfully completing three MLS core courses and two additional approved electives for a minimum of 20 credits. Students interested in the MLS minor should consult the MLS program director.

MLS Fast Track

This program is designed for students with a B.S. degree in a life science who wish to become eligible for certification as a medical technologist. The student must have a clinical sponsor, such as Path Lab, Inc., which will provide clinical training. Students will take MLS theory classes in hematology, clinical chemistry, immunohematology, urinalysis and body fluids, mycology and parasitology, and laboratory management, as well as any prerequisites or background courses required for the program. Courses are taken through the Division of Continuing Education, and no degree is conferred at completion. Contact the MLS program director for more information.

Required Courses

ANSC 511, Anatomy and Physiology
BIOL 411/412, Principles of Biology I and II
BIOL 604, Genetics
CHEM 403-404, General Chemistry
CHEM 545/6 Organic Chemistry
BCHM 658/9 Biochemistry
MICR 503, General Microbiology
MICR 602, Pathogenic Microbiology
MICR 705, Immunology
MATH 424B, Calculus for Life Sciences,
or BIOL 528, Applied Biostatistics I
MLS 500 Introduction to Laboratory Methods
MLS 602, MLS Seminars
MLS 610, Laboratory Management
MLS 650A, Phlebotomy
MLS 650B, Phlebotomy Internship
MLS 651, Clinical Serology
MLS 652, Clinical Hematology
MLS 653, Immunohematology
MLS 654, Clinical Chemistry
MLS 655, Urinalysis/Body Fluid
MLS 720, Mycology/Parasitology

Microbiology

(For descriptions of courses, see page 200.)

Microbiology explores the world of organisms too small to be seen with the unaided eye. The primary emphasis in the Department of Microbiology is on prokaryotes (bacteria and archaea) and viruses. The curriculum provides basic familiarity with microorganisms, their interactions with other life forms (including humans), and their roles in natural systems and processes.

Baccalaureate degree holders in microbiology secure positions in industry (food and beverage, pharmaceutical, bioproducts, etc.); in city, state, and federal agencies (public health, environmental quality, regulatory, etc.); or in universities or research institutes.

The Department of Microbiology offers programs of study leading to the bachelor of science degree. Microbiology is widely recognized as being both a basic life science and a highly pragmatic applied science. The curriculum within the microbiology program is intended to accommodate the diverse needs of potential students. It provides solid training for individuals intending to enter the workforce or to pursue graduate education in the biological sciences, biomedicine, or biotechnology. It also provides for entry into professional programs such as dentistry, human medicine, or, with little additional preparation, veterinary medicine. The curriculum is appropriate for students planning to enter the workforce immediately upon graduation, as research technicians, applied scientists, or in sales or marketing positions in the life sciences or biotechnological industry. The curriculum is also appropriate for transfer students and those planning to pursue a degree in business, including the M.B.A., for careers in managing diagnostic laboratories or in hospital administration.

Other microbiology-related courses offered in the following departments may be taken with an adviser's permission: animal sciences, biochemistry and molecular biology, plant biology, civil engineering, zoology, or medical laboratory science. Courses in these areas are reviewed periodically by the microbiology faculty to ascertain their suitability for microbiology majors.

Special Projects in Microbiology (MICR 795) is available by special permission and allows students the opportunity to conduct semi-independent research projects in conjunction with departmental faculty. Up to 4 credits of Problems in Microbiology may be applied to major requirements, although students may enroll for additional hours. Students must receive a minimum grade of C in major requirements taught in the Col-

lege of Life Sciences and Agriculture (e.g., microbiology, biology, or biochemistry). A passing grade in major requirements taught outside the College of Life Sciences and Agriculture (e.g., chemistry, math, or physics) is acceptable.

Students planning to attend graduate or postgraduate professional school or to apply for certification as registered microbiologists through the American Society for Microbiology are strongly advised to take a course in quantitative analysis (CHEM 517-518).

Individuals considering a major in microbiology are strongly encouraged to enroll in MICR 503 and organic chemistry in their sophomore year. Requirements in the biology core curriculum may be deferred until the subsequent year, if necessary.

Students may obtain a minor in microbiology by successfully completing MICR 503 and four additional departmental courses totaling a minimum of 20 credits at the 600 or 700 level. Students must receive a minimum grade of C in major requirements taught in the College of Life Sciences and Agriculture (e.g., microbiology, biology, or biochemistry). BCHM 658/659 may be substituted for one of these courses. A maximum of 4 credits of Problems in Microbiology may be applied to the minor.

Microbiology Curriculum

The microbiology curriculum is satisfied by Group I and Group II course requirements. All Group I courses are required. One course from each of the three categories comprising Group II requirements is also required. The microbiology major B.S. degree requirement is eight microbiology courses totaling a minimum of 32 credit hours at a grade of C or above.

Group I Requirements

BIOL 411-412, Principles of Biology[1]
BCHM 658, with lab BCHM 659,
or BCHM 751-752, Principles of BCHM with BCHM 755 (lab)
CHEM 403-404, General Chemistry
CHEM 651, Organic Chemistry and co-requisite lab
or CHEM 545[2]
PHYS 401-402, Introduction to Physics[3]
MATH, 424B, Calculus for Life Science,
or MATH 425 and BIOL 528,
or equivalent statistics[3]
BIOL 604, Principles of Genetics[3]
MICR 503, General Microbiology
MICR 602, Pathogenic Microbiology
MICR 704, Genetics of Prokaryotic Microbes
MICR 717, Microbial Physiology
A microbial ecology course (this requirement may be fulfilled by taking either MICR 707, MICR 713, or MICR 719)

Group II Requirements

(One microbiology course from each of three categories: general, medical, and ecological.)

General

MICR 603, Bacteriology of Food (UNHM)
MICR 710, Electron Microscopy and Microbial Cytology (and 712, Laboratory)
MICR 711, Genomics and Bioinformatics
MICR 718, Ethics and Issues in Microbiology
MICR 751, Cell Culture

Medical

MICR 702, Infectious Disease and Health
MICR 706, Virology (and 708, Laboratory)
MICR 714, Water Pollution Microbiology
MICR 705, Immunology

Ecological

MICR 707, Marine Microbiology
MICR 713, Microbes and the Environment
MICR 719, Prokaryote Biodiversity
MICR 766, Plant-Microbe Interactions
NR 706, Soil Microbiology

Electives

(These cannot be taken to fulfill the microbiology major requirement.)
MICR 504, Brewing and Industrial Microbiology Applications (UNHM)

MICR 600, Field Experience
MLS 720, Clinical Mycology-Parasitology
PBIO 721, The Microscopic Algae
PBIO 752, Mycology
MICR 790, Laboratory Teaching Experiences
MICR 795, Problems in Microbiology[4]

[1]For students transferring into the Microbiology major, the equivalent of two semesters of a laboratory biological science may be accepted with microbiology faculty approval.
[2]Premedical and other pre-health should take one year of organic chemistry.
[3]Classes recommended for the major.
[4]A maximum of four credits of MICR 795 may be applied to the major.

Departmental Honors

Honors in microbiology will be awarded to students who complete 16 credits of honors courses in microbiology (including a minimum of four credits in a senior research project), and who maintain a minimum grade-point average of 3.20 in the major. Students interested in the microbiology honors program should apply to the department before their junior year.

Students wishing to declare a major or minor in microbiology or to be admitted to the microbiology honors program should consult the departmental chair.

Nutritional Sciences

(For descriptions of courses, see Animal Sciences, page 133 and page 210.)

The science of nutrition is the study of nutrients in food and the body's handling of these nutrients. As an applied science, nutrition is based on biochemistry and physiology but can also include anthropology, economics, genetics, microbiology, pathology, animal sciences, and zoology. Consequently, the nutritionist often cooperates with workers in many different fields. The nutrition program at UNH is designed to permit specialized study in human and/or animal nutrition.

Two curricula are offered to meet the educational needs of students with differing professional aspirations.

Basic Science Curriculum

This curriculum provides students with a solid science background in biology, chemistry, physiology, nutrition, biochemistry, and physics. Upon graduation, students are well prepared for technically oriented jobs in science. This curriculum is also excellent preparation for students planning further education in graduate school or professional schools of medicine and dentistry. Students in this curriculum are required to complete the biology core curriculum: NUTR 400, 750; ANSC 511 and 512; MICR 503; BCHM 658/659; and 12 additional credits from recommended courses in nutrition.

Dietetics Curriculum

Approved by the American Dietetics Association (ADA), the dietetics curriculum prepares students to apply for a post-graduate dietetic internship. Completing this internship and passing the ADA examination are essential for becoming a registered dietitian (RD), requisite for employment opportunities in clinical dietetics and community nutrition. Required courses for this curriculum are NUTR 400, 401, 405, 473, 476, 503, 504, 510, 550, 650, 720, 750, 773, 775, and 780; ANSC 511 and 512; CHEM 403-404, and 545-546; ENGL 401; DCE 491; MICR 501 or 503; BCHM 658/659; SOC 500 or PSYC 401; MGT 580; HMP 710; and either PSYC 402, SOC 502, BIOL 528, or HHS 540.

Plant Biology

(For descriptions of courses, see page 216.)

Plant biology is the study of plants at the population, organismal, cellular, and molecular level; and the investigation of the uses of plants for food, fiber, recreational, and ornamental purposes. Offerings in marine and freshwater plant biology also are provided and are facilitated by the Jackson Es-

tuarine Laboratory and two marine laboratories where the plant biology faculty maintains an active involvement in teaching and research. The Department of Plant Biology offers three baccalaureate degrees: bachelor of science in plant biology, bachelor of science in environmental horticulture, and bachelor of arts in plant biology. See also programs listed under biology major and marine sciences.

B.S. in Plant Biology

This degree is for students intending to seek employment in agricultural, pharmaceutical, and biotechnology industries; to work in governmental agencies, environmental groups, and consulting firms; to teach secondary education; or to undertake graduate studies in preparation for advanced research and teaching positions. Students interested in university teaching and/or research, and governmental and industrial research, should plan to complete an advanced degree in the field.

Students are required to take the core courses, which include the biology core curriculum, and five plant biology elective courses.

Core Courses	Credits
BIOL 411, Principles of Biology I	4
BIOL 412, Principles of Biology II	4
CHEM 403, General Chemistry I	4
CHEM 404, General Chemistry II	4
MATH 424B, Calculus for Life Sciences	4
MICR 503, General Microbiology	5
BIOL 541, General Ecology	4
BIOL 528, Applied Biostatistics I	4
CHEM 545/546, Organic Chemistry and Laboratory	5
BCHM 658/659, General Biochemistry and Laboratory	5
PHYS 401, Introduction to Physics I	4
PHYS 402, Introduction to Physics II	4
BIOL 604, Principles of Genetics	4
PBIO 401, Plant Biology Orientation	1
PBIO 701/702, Plant Physiology and Laboratory	5
PBIO 758, Plant Anatomy	5
PBIO 774, Plant Biotechnology and Genetic Engineering	3
PBIO 566, Systematic Botany *or* PBIO 668, Summer Flora of New Hampshire	4

Plant Biology Electives

Five additional courses must be selected from those listed below under categories 1-5. No more than three courses from any one category can be used to fulfill the requirement. It is strongly recommended that students choose courses from as many of the categories as possible to obtain a broad background in plant biology. Core courses cannot be used to fulfill elective requirements. PBIO 795, Investigations in Plant Biology can be used once to fulfill one of the five electives, if taken for 3 or more credits. PBIO 796, Special Topics in Plant Biology can be used to fulfill elective requirements, if taken for 3 or more credits and preapproved by adviser.

Category 1: Systematics, Ecology, and Evolution
PBIO 566, 625, 668, 717, 719, 721, 722, 723, 724, 747, 752,761; INCO 595, Tropical Ecology and Conservation Biology; NR 713, 764, 765

Category 2: Marine and Freshwater Plant Biology
PBIO 503, 625, 717, 719, 721, 722, 723, 724, 725, 727/729, 747

Category 3: Plant Structure and Physiology
NR 713; PBIO 601, 709, 711, 713, 714/715, 727/729, 775

Category 4: Environmental Horticulture
NR 506; PBIO 546, 547, 565, 572, 582, 650, 651, 652, 655, 678, 689, 706/708, 720, 726; ZOOL 530

Category 5: Plant Genetics, Cell Biology, and Biotechnology
BCHM 771; GEN 702, 705; PBIO 751, 753, 754, 766, 772, 775

B.S. in Environmental Horticulture

This program offers a flexible curriculum for students interested in a multifaceted view of plant agriculture that also embraces issues of environmental stewardship, food safety, international development, and other topics of broad public concern. A degree in environmental horticulture will prepare students for careers managing greenhouses, nurseries, farms, and golf courses; in teaching; in consulting and applied research; in practicing journalism; in working for park and highway planning commissions; in working in sales or brokerage aspects of wholesale and retail marketing; and in finding employment in food- and feed-processing firms.

Students are required to take the core courses, support courses, and 20 credits of elective courses.

Core Courses	Credits
PBIO 401, Plant Biology Orientation	1
PBIO 412, Introductory Botany	4
PBIO 421, Concepts of Plant Growth	4
PBIO 501, Basic Biochemistry	3
or BCHM 658/659 General Biochemistry	5
PBIO 546, Plants, Soils, and the Environment	4
PBIO 547, Environmental Horticulture	4
PBIO 572, Plant Propagation	4
PBIO 566, Systematic Botany	4
PBIO 600, Field Experience (Horticulture Related)	4
PBIO 701, Plant Physiology	3
PBIO 612, Plant Genetics and Reproduction	4
or BIOL 604, Principles of Genetics	4
PBIO 651, Plant Pathology	4
PBIO 726, Integrated Pest Management	4
PBIO 797, Senior Seminar	1

Electives
A minimum of 20 credits (including at least 12 credits at 600 or 700 level)
Students are offered some flexibility in selection of electives, although these electives should be related to horticulture and selected in consultation with an adviser.

Support courses required from other departments

BIOL 528, Applied Biostatistics I	4
CHEM 403, General Chemistry I	4
CHEM 404, General Chemistry II	4
ZOOL 530, Principles of Applied Entomology	4
Economics Perspectives	4

B.A. in Plant Biology

Students must complete a minimum of 40 semester credits in the major. The curriculum provides a broad background in the liberal arts and plant biology. Students may enter this program as freshmen or transfer into it from other liberal arts or science programs. This program is of particular interest to students who intend to utilize their plant biology training in public relations, teaching, or other related careers in combination with a liberal arts background. The program allows students to obtain minors in other fields such as English, history and philosophy of science, international affairs, education, art, etc., to create an interdisciplinary program, or to pursue a double major.

Requirements	Credits
PBIO 401, Plant Biology Orientation	1
PBIO 412, Introductory Botany (waived if previous credit received for BIOL 411-412 or equivalent)	4
ZOOL 412, Principles of Zoology	4
PBIO 501, Basic Biochemistry	3
or CHEM 545/546, Organic Chemistry and Laboratory	5
BIOL 541, General Ecology	4
PBIO 566, Systematic Botany	4
or PBIO 668, Summer Flora of New Hampshire	4
or PBIO 721, Microscopic Algae	4
or PBIO 722, Marine Phycology	4
BIOL 604, Principles of Genetics or	4
PBIO 612, Plant Genetics and Reproduction	4
PBIO 701/702, Plant Physiology and Laboratory	5

Upper Level Plant Biology Categories Electives
12 credits minimum
Select courses from several of the five plant biology categories (see B.S. program). PBIO 758 and 774 are also recommended.

General Education
Required: Group 3, CHEM 403-404, General Chemistry
Recommended: Group 2, BIOL 528, Applied Biostatistics I
Group 8, PHIL 424, Science, Technology, & Society; or HUMA 651, Humanities and Science: The Nature of Scientific Creativity

Other B.A. Requirements
Foreign Language (equivalent to one year of college language).

General Science Certification
See pages 33 and 78.

Minors
The Department of Plant Biology offers two departmental minors: a minor in plant biology and a minor in environmental horticulture. These minors are available to all students and are designed to provide a flexible and broad selection of courses to complement any other major area of study.

The specific requirements of the minor in plant biology include PBIO 401, PBIO 412 or equivalent, and a minimum of 15 credits from the following list of courses: PBIO 566, 601, 625, 651, 668, 701/702, 709, 711, 713, 717, 719, 721, 722, 723, 724, 725, 727, 729, 747, 751, 752, 753, 754, 758, 761, 766, 772, 774/775, 795 (maximum of 4 cr.), 796.

The requirements for the environmental horticulture minor are PBIO 401, PBIO 421, and a minimum of 15 credits from the following list of courses: PBIO 546, 547, 557, 565, 566, 572, 582, 612, 650, 651, 652, 655, 678, 689, 701/702, 720; HT 263.

For selection of specific courses, students should see the department chair or their adviser.

Departmental Honors
Honors in plant biology or environmental horticulture will be awarded to students who complete 16 credits of honors courses in plant biology courses (including a minimum of four credits in a senior honors thesis project), and maintain a minimum grade-point average of 3.20 (overall average and in major coursework). Students wishing to apply to the departmental honors program should consult with Professor Garrett Crow.

Soil Science

(For descriptions of courses, see page 204.)
Soil scientists are concerned with proper management of our soil resources, in rural and urban environments, and with the essential role of soil in sustainable resource management. Soil scientists are needed as members of interdisciplinary teams engaged in a variety of natural resource and environmental quality issues.

Career opportunities are excellent for graduates of the soil science program. There is a growing awareness that planning, design, and construction of public and private facilities must be compatible with the soil upon which these facilities are placed. Thus, urbanization of the Northeast has created a demand for soil scientists competent to advise on soil considerations during planning and development stages. Soils expertise is in demand for identification of areas in need of protection. Soil scientists often play important roles in toxic waste remediation, aquifer protection, and site selection for hazardous waste disposal or storage. There is also a growing role for soil scientists with supplemental training in environmental chemistry who wish to work with plant scientists and foresters in developing sustainable systems for food and fiber production, or with planners in developing landscape management plans.

Students in the soil science program are given a strong analytical background for studying physical, chemical, and biological properties of soils, as well as their classification and management. Graduates are well prepared for further study in graduate school, and professional certification is available through the ARCPACS, a federal certifying board.

Core Courses

A. Soil Science courses
NR 501, Introduction to Soil Sciences
NR 609, Soils and Community Planning
NR 611, Soils and Environmental Quality
NR 706, Soil Microbiology
NR 716, Wetland Delineation
NR 732, Chemistry of Soils
NR 733, Chemical Analysis of Soil

B. Natural Resources courses
NR 400, Prof. Perspectives in Natural Resources
NR 401, Introduction to Natural Resources
NR 527, Forest Ecology,
or BIOL 541, General Ecology
NR 602, Natural Resources and Environmental Policy
NR 775, Natural Resources Senior Project

C. Support courses
PBIO 412, Introductory Botany
BIOL 528, Applied Biostatistics I
CHEM 403-404, General Chemistry
ESCI 512, Principles of Mineralogy
ESCI 561, Surficial Processes
EREC 411, Environmental and Resource Economics Perspectives
PHYS 401 (or 407), Introduction to Physics I
One course in chemistry beyond CHEM 403-404.
One course in mathematics (MATH 424B, or 425)
One writing course beyond ENGL 401 (ENGL 501, 502, 503, 519, 529, DCE 596)

Students interested in the soil science major should consult with Elizabeth Rochette.

General Science Certification
See pages 33 and 78.

Tourism Planning and Development

(For descriptions of courses, see page 231.)
Tourism creates immense economic activity, totaling more than $4 trillion dollars of world spending activity. Tourism is also an integral part of New England's economy. Experience has shown that the public and private sectors of the tourism industry benefit substantially from proper planning. Those locations with the best planned and managed tourism developments are likely to be the most successful tourist destinations from the standpoint of providing both high-quality tourist experiences and bringing substantial economic benefits with minimal disruptions to the social and natural environment. In response to these needs, the Department of Resource Economics and Development offers a bachelor of science degree in tourism planning and development from regional and international perspectives.

The tourism planning and development curriculum provides students with the skills and knowledge necessary to plan, develop, and manage natural, cultural, and financial resources in an environmentally responsible manner. The program utilizes an interdisciplinary approach to provide students with a strong liberal education supplemented by a broad professional understanding of tourism planning and its role in local, state, national, global economic, and social development. Students study both the social and environmental sciences in order to better understand the complexity of natural and social systems. The program emphasizes the practical application of planning and economic theory to the planning for the development of tourism resources.

Curriculum Structure
All majors must complete a core curriculum and choose one of two concentrations: international development or regional tourism planning.

Core Courses
The core curriculum is composed of the following courses:

CD 415, Community Development Perspectives
CD 614, Fundamentals of Planning
CD 777, Topics in Community Planning
EREC 411, Environmental and Resource Economics Perspectives
EREC 501, Agricultural and Natural Resource Product Marketing
EREC 525, Statistical Methods and Applications
EREC 775, Research Methods
TOUR 400, Introduction to Tourism
TOUR 615, Tourism Planning and Development
TOUR 633, Economics of Travel and Tourism
TOUR 560, Special Topics (8 credits)
TOUR 700, Marketing Places
TOUR 705, Ecotourism: Managing for the Environment,
or TOUR 767, Social Impact Assessment
TOUR 794, Tourism Internship

TOUR 794 involves a 14-to-16 week, full-time, supervised internship, and enables students to meet and work in association with representatives from the public and private sectors of the tourism industry.

International Tourism Development Concentration

This concentration area prepares students to work in the dynamic and challenging environment of international tourism development. Depending on interests, language skills, and international experiences, students may expect to find employment in settings such as national tourism offices, international tourism organizations, national and foreign consults, and multinational tourism destination resorts. In addition to the required core courses, students who pursue the international tourism development concentration must complete the following requirements: TOUR 792, International Experience; two TOUR electives; competency in a foreign language (i.e., functional reading, writing, and speaking ability equivalent to the third-year second-semester level); and two additional electives that will enhance students' career opportunities in the international area.

Regional Tourism Planning Concentration

This concentration area prepares students to obtain professional roles in planning in the public or private sectors of the tourism industry. Depending on interests and technical skills, students may expect to find employment in settings such as local and regional economic development organizations, chamber of commerce offices, convention and visitor bureaus, state and federal offices of tourism development, local and regional planning commissions, and resort communities. In addition to the required core courses, students who pursue the regional tourism planning concentration must complete the following requirements: TOUR 798, Independent Study in Tourism; two TOUR electives; and all the requirements for a minor in community planning.

New England Regional Student Program

The B.S. in tourism planning and development program is one of the specialized curricula recognized by the New England Board of Higher Education and participates in the New England Regional Student Program. Under this program, students from the state of Rhode Island, Connecticut, Massachusetts, Vermont, and Maine receive some preferential admission consideration and, if admitted, pay the UNH in-state tuition rate plus 50 percent. Students who are interested in the Tourism Planning and Development Program should contact Robert A. Robertson, 309 James Hall, (603) 862-2711.

Water Resources Management

(For descriptions of courses, see page 231.)

There is a critical need for individuals who understand how changes in land use affect water quantity and quality. The B.S. degree program in water resources management is designed to educate students in the principles of land management, biology, chemistry, water quality, and hydrology specifically as they relate to the management of water resources. The program stresses an interdisciplinary approach to resource management, including environmental, economic, social, and political considerations. Hands-on field experience is expected and research projects are encouraged.

This degree program is designed for students who intend to pursue advanced degree work in environmental studies or careers in government, in public or private utilities that manage land and water resources, in private consulting firms that offer water resource management services, and in any of a wide variety of not-for-profit organizations that address land and water resource issues.

The program is divided into three interacting parts: general education, core requirements, and an area of specialization or exploration. The core program provides a foundation in both physical and social sciences. The area of specialization or exploration allows students to pursue a minor or double major, or to survey a variety of courses relevant to water resources management. This allows students to tailor their education to meet individual areas of interest.

In addition to formal courses, all water resources management majors are required to participate in a relevant work experience or internship (NR 599) and a senior project (NR 775). Students are responsible for identifying appropriate work experiences, although assistance is available from the faculty. Students may also choose to do a senior thesis (NR 799).

For additional information, please contact Carl H. Bolster, Department of Natural Resources, (603) 862-5006.

Water Resources Management Degree Requirements

BIOL 411/412, Principles of Biology
BIOL 528, Applied Biostatistics I
BIOL 541, General Ecology
CD 614, Fundamentals of Planning
CHEM 403-404, General Chemistry
ENGL 401, Freshman English
ENGL 501, Introduction to Creative Nonfiction
ESCI 401, Principles of Geology I
ESCI 705, Principles of Hydrology
EREC 411, Environmental and Resource Economics Perspective
EREC 676, Economics of Water Use and Quality Management
MATH 424B, Calculus for Life Sciences

NR 400, Professional Perspectives in Natural Resources
NR 401, Introduction to Natural Resources

NR 602, Natural Resources and Environmental Policy
NR 775, Natural Resources Senior Project

PHYS 401, Introduction to Physics I
or PHYS 407, General Physics I
PHYS 402, Introduction to Physics II
or PHYS 408, General Physics II

NR 501, Introduction to Soil Sciences
NR 504, Freshwater Resources
NR 599, Work Experience
NR 604, Watershed Hydrology
NR 700, Critical Analysis of Water Resources Literature
NR 703, Watershed Water Quality Management
NR 721, Ecology of Polluted Waters

One additional course in writing and public speaking.

Each student must take a combination of courses, devised by the student and his or her adviser, that suitably defines a coherent area of professional specialization. Each student must accumulate a total of at least 128 credit hours.

Wildlife Management

(For descriptions of courses, see page 204.)

The wildlife curriculum is for students interested in the ecology, conservation, and management of wild animals. It is designed to provide a knowledge of wildlife species and their various forest, field, and wetland habitats. Students are prepared for employment with public and private agencies in wildlife management, or for continued study at the graduate level.

Fieldwork is carried out during the academic year on local and regional wildlife areas. Each year, a two-week field session is held during June for all students who have completed the sophomore year. Majors are assisted and encouraged to obtain summer employment related to their career objectives.

The degree earned is a bachelor of science with a major in wildlife management. The program is administered in the Department of Natural Resources.

In addition to the normal University fees and tuition, wildlife students are required to meet special fee charges in connection with regularly planned field laboratory sessions.

Freshman Year
BIOL 411, Principles of Biology I
BIOL 412, Principles of Biology II
ENGL 401, Freshman English
MATH 424B, Calculus for Life Sciences,
or MATH 420, Finite Mathematics
NR 400, Professional Perspectives in Natural Resources
NR 401, Introduction to Natural Resources
NR 425, Field Dendrology
NR 433, Wildlife Ecology
Elective, physical science or General Education elective

Sophomore Year
BIOL 528, Applied Biostatistics I
CHEM 403, General Chemistry
CHEM 404, General Chemistry
ENGL 501, Introduction to Creative Nonfiction,
or ENGL 503, or 519
EREC 411, Environmental and Resource Economics Perspectives
NR 527, Forest Ecology,
or BIOL 541, General Ecology
NR 542, Forestland Measurement and Mapping (2-week summer course)
NR 655, Vertebrate Biology
ZOOL 542, Ornithology,
or ZOOL 712, Mammalogy,
or Elective

Junior Year
NR 602, Natural Resources and Environmental Policy
NR 615, Wildlife Habitats
NR 737, Wildlife Population Dynamics
ZOOL 625, Principles of Animal Physiology
ZOOL 690, Evolution
ZOOL 710, Ichthyology,
or ZOOL 713, Animal Behavior,
or ZOOL 733, Behavioral Ecology
Elective

Senior Year
NR 629, Silviculture or equivalent
NR 636, Wildlife Techniques
NR 738, Wildlife Policy and Management
NR 775, Natural Resources Senior Project
Elective
Elective
Elective

*Electives should be used to satisfy remaining general education requirements and the wildlife major requirements in the areas of policy and administration, communication skills, and physical sciences (one course in each area-pertinent courses are listed in the detailed wildlife curricular guidelines available from the department).

Students interested in the wildlife management major may consult with the program coordinator, Peter Pekins, James Hall.

General Science Certification
See pages 33 and 78.

Zoology

(For descriptions of courses, see page 232.)
The Department of Zoology has a primary responsibility for undergraduate and graduate instruction in fundamental aspects of animal biology, including the principles of form, function, development, and diversity produced by animal evolution. The teaching program provides a broad coverage of basic biological processes in invertebrate and vertebrate animals at the cellular, organismic, population, and community levels. Students receive background for a variety of professional positions in the public and private sector, and for graduate programs in the biological sciences including health-related fields. The department offers the bachelor of arts, bachelor of science, master of science, and doctor of philosophy degrees. Zoology faculty contribute significantly to the biology core curriculum, marine biology minor, genetics program, University Honors Program, Ocean Projects and Undergraduate Research Opportunity programs, and courses at the Shoals Marine Laboratory.

There is a strong teaching and research emphasis on ecological and physiological processes in aquatic animals or ecosystems. This focus is enhanced by the geographical location of the University and the availability of facilities for aquatic research. The University's location and facilities provide unique opportunities for the study of aquatic and terrestrial animals due to its access to the seacoast and the lakes region of New Hampshire, and the presence of two coastal marine laboratories, as well as estuarine and freshwater laboratories.

The zoology major builds from the common background of the biology core curriculum, with ample time for third- and fourth-year students to concentrate in specialized disciplines such as marine and freshwater biology, behavior, cell and developmental biology, ecology, evolution, fisheries, physiology, and neurobiology. Zoology majors must complete 32 credits from courses in the biological sciences approved by the department with a 2.00 average. Students must receive a minimum grade of C- in major requirements taught in the College of Life Sciences and Agriculture (e.g., zoology, microbiology, biology, biochemistry). A passing grade in major requirements taught outside the College of Life Sciences and Agriculture (e.g., chemistry, mathematics, physics) is acceptable. Minimum requirements for the B.S. in zoology are as follows: completion of the biology core courses and required courses in animal morphology, physiology and development, plus advanced electives in zoology and other biological sciences. The B.A. in Zoology has a foreign language requirement in lieu of one advanced elective. B.A. students also have somewhat more flexibility when choosing courses from the biology core.

Students who are interested in a zoology major should consult the department's undergraduate adviser or chair.

General Science Certification
See pages 33 and 78.