# College of Natural Resources

This is the College of Natural Resources section of the 1999-2000 Undergraduate Catalog of the University of Minnesota.

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The mission of the College of Natural Resources (CNR) is to foster a quality environment by contributing to the management, protection, and sustainable use of our natural resources through teaching, research, and outreach.

Facilities—CNR is based in six buildings on the St. Paul campus and one building on the Minneapolis campus. The Natural Resources Administration Building, Green Hall, the Kauert Laboratory of Forest Products and Wood Science, Hodson Hall, the Engineering and Fisheries Laboratory, and the Natural Resources Science Building are on the St. Paul campus; the Bell Museum of Natural History is on the Minneapolis campus.

The Dean's Office, Student Services Office, Graduate Studies Office, Natural Resources and Environmental Studies Program Office, Forestry Library, and CNR computer lab are located in the Natural Resources Administration Building. The Department of Forest Resources, Remote Sensing Lab, and some Department of Fisheries and Wildlife faculty and graduate student offices are located in Green Hall.

The Department of Wood and Paper Science is in the Kauert Laboratory. The Department of Fisheries and Wildlife office, the Entomology, Fisheries, and Wildlife Library, laboratories, and lecture and faculty facilities are in Hodson Hall and the Engineering and Fisheries Laboratory. Adjacent to college facilities is the regional headquarters of the North Central Research Station of the U.S. Forest Service.

CNR uses several field centers for its programs: The University's Lake Itasca Forestry and Biological Station is located in Itasca State Park in north central Minnesota. Fisheries and Wildlife, Forest Resources, Natural Resources and Environmental Studies, and Urban Forestry majors spend a three-week summer term at the station.

CNR's Cloquet Forestry Center includes more than 3,700 acres of virgin and second-growth forest in a major forest products manufacturing area of northeastern Minnesota. Forest Resources students complete a five-week field forestry session at the Center in their senior year.

The 300-acre John H. Allison Forest, about 10 miles from the St. Paul campus, is available for field laboratory work throughout the year.

CNR's undergraduate curricula are organized within four departments: fisheries and wildlife (200 Hodson Hall); forest resources (115 Green Hall); an interdisciplinary program called natural resources and environmental studies (135 Natural Resources Administration Building); and wood and paper science (203 Kauert Laboratory).

The CNR Student Services Offices, 135 Natural Resources Administration Building, provides admission, registration, advising, career services, and other assistance to all undergraduates. Call (612)624-6768 or visit the CNR Web site at <www.cnr.umn.edu>.

Admission

Undergraduates seeking admission to CNR should apply through the Office of Admissions, 240 Williamson Hall, 231 Pillsbury Drive S.E., Minneapolis, MN 55455 (612/625-2008). Prospective students are encouraged to call or visit the CNR Student Services Office in 135 Natural Resources Administration Building, 2003 Upper Buford Circle, St. Paul, MN 55108 (612/624-6768) for additional information regarding admission, honors program, careers, or scholarships.

Freshman Admission—High school graduates must submit scores from the Scholastic Aptitude Test (SAT) or American College Test (ACT) along with their high school rank percentile (HSR).

The formulas below show how to calculate the ACT or SAT “Aptitude Rating” using a student’s high school rank percentile and ACT or SAT test scores. If the Aptitude Rating falls at or above the number indicated for the college that a student plans to enter, the student will be admitted automatically, provided the student also has completed the high school preparation requirements. If the Aptitude Rating falls below the number indicated, the application will be reviewed through the University’s individual review process.

AAR (ACT Aptitude Rating, for students who have taken the ACT):

\[
\text{HSR percentile} + (2 \times \text{ACT composite score}) = 110
\]

SAR (SAT Aptitude Rating, for students who have taken the SAT):

\[
\text{HSR percentile} + (\text{SAT verbal} + 10 + \text{SAT math} + 10) = 170
\]

Students seeking admission will be expected to have completed the University’s high school course preparation requirements. See “Freshman Admission” in the General Information section of this catalog.

Applicants who attain at least the minimum score and meet course requirements will be admitted routinely. Others will be considered on an individual basis, taking into account factors such as high school performance and educational objectives.

Transfer Admission—Appropriate credits earned at other accredited colleges and universities or within other units of the University may be applied toward CNR programs. Students seeking admission will be expected to have completed any University's high school course preparation requirements. See “Freshman Admission” in the General Information section of this catalog.

Credits earned through special examination or University College may transfer to CNR. The minimum GPA for transfer admission is 2.00.

Degrees/Majors

Bachelor of Science (B.S.)

The major curricula of CNR all lead to B.S. majors. CNR offers six major curricula: (1) fisheries and wildlife (with specializations in fisheries, wildlife, and conservation biology); (2) forest resources (with tracks in forest management and forest science); (3) natural resources and environmental studies (with concentrations in
environmental assessment and monitoring; environmental education; planning, policy and law; resource conservation and environmental management; and water and soil resources; (4) recreation resource management; (5) urban forestry; and (6) wood and paper science (with specializations in forest products marketing, forest products production management, paper science and engineering, and residential building science and technology. Because the first year of coursework is somewhat similar, students may transfer between curricula at the end of their freshman year with little or no credit loss.

Graduate Degrees—The master of science (M.S.) and the doctor of philosophy (Ph.D.) in forestry, fisheries, or wildlife conservation, water resource science, conservation biology, and the master of forestry (M.F.) degrees are offered through the Graduate School in cooperation with CNR. For detailed information, contact the appropriate director of graduate studies: 135 NRAB (612/624-6768) for forestry and wood and paper science; 200 Hodson Hall (612/624-3600) for fisheries and wildlife. Or consult the Graduate School Catalog. The CNR Web site at <www.cnr.umn.edu> also leads to departments and graduate programs. Interested students should apply for admission through the Graduate School, 306 Johnston Hall, 101 Pleasant Street S.E., Minneapolis, MN 55455 (612/625-3014).

Minors

CNR offers four minor concentrations designed to enhance the major programs of current natural resources students as well as those whose major programs are unrelated to natural resources. CNR minors include fisheries and wildlife, forest resources, urban forestry, and paper science and engineering. Students may apply for a minor in any University department or program that offers such an option. Upon graduation, the minor is listed on the transcript with degree and major. For assistance in planning a minor, contact the CNR Student Services Office, 135 Natural Resources Administration Building, (612/624-6768). Detailed minor requirements are described in the CNR Degree Programs section of this catalog.

Honors

CNR students have the opportunity to participate in honors at both the lower division (freshman/sophomore) and upper division (junior/senior) levels. At the lower division level, students participate in specially designed honors courses and honors colloquia focusing on current issues in their chosen field of study. Completion of the lower division honors program is recognized by a certificate and by designation on a student’s transcript. The heart of the upper division honors program is a research project supervised by a faculty mentor. Students also participate in an honors seminar designed to expose them to science topics in their field. The upper division honors experience culminates in a senior thesis, oral presentation of the research project, and recognition at the college graduation ceremony.

Qualifications for Freshman Applicants

• admission to CNR
• completion of fewer than 30 semester credits of college coursework
• top 10 percent of high school graduating class or ACT composite score of 28 or combined SAT score (verbal + math) of 1260 (1200 if SAT was taken before April 1, 1995)

Application Procedure for Freshman Applicants—Applicants must complete the Scholarships and Honors Programs for Freshmen application form (available from the Office of Admissions) before June 1 of the year they enter the University.

Qualifications for Lower Division Non-Freshman and Transfer Applicants

• admission to CNR
• completion of between 31 and 60 semester credits of college coursework
• cumulative GPA of 3.30
• completion of CNR lower division honors application form

(Current CNR students are eligible to apply for lower division honors if they meet the qualifications for transfer applicants.)

Application Procedure for Non-Freshman and Transfer Applicants—Applicants must complete the CNR lower division honors application form available through the CNR Student Services Office. (Students with 50-60 semester credits should apply directly to the upper division program when eligible.)

Completion of Lower Division Honors Program—Completion of at least two honors colloquia. At least one colloquium must be a section of NRES 3000. CNR honors students are eligible for registration in colloquia offered through the College of Liberal Arts honors program (HCol designated courses), other University honors programs, and transfer institutions.

Completion of at least two honors courses with a grade of B or better.

Completion of 60 semester credits with a cumulative GPA of at least 3.30.

Qualifications for Upper Division Applicants

A minimum cumulative GPA of 3.30, with at least 60 semester credits completed (After admission, students must achieve a cumulative GPA of 3.50 to graduate with honors.)

Application Procedure for Upper Division Applicants—Students must complete an upper division honors application with a faculty mentor’s recommendation. The application may be obtained from the CNR Student Services Office.

Completion of Upper Division Honors Program—Research Project—Students conduct research and acquire new information about the topic under investigation. Students are encouraged to submit their results for publication in a professional journal, if warranted.

Honors Seminar—Honors program students participate in one honors seminar within their department. Seminars typically focus on problem analyses and research reports concerning selected topics.

Graduation with Honors—Participation in the honors program is required for graduation with the traditional honors designations cum laude, magna cum laude, and summa cum laude. Candidates for graduation with honors must complete the following:

• At least 40 credits in upper division courses (3xxx, 4xxx, or 5xxx) at the University of Minnesota, Twin Cities campus.

• Two semesters (two credits/semester) of directed research with the results reported in an acceptable honors thesis and as an oral seminar. Students may use research they conducted while participating in the Undergraduate Research Opportunities Program if approved by the departmental honors program coordinator. Courses are FW 4801, 4802; FR 4801, 4802; NRES 4801, 4802; and WPS 4801, 4802.
• One semester (1 cr) of honors seminar according to the
student’s chosen curriculum: FW 4200, FR 4200,
NRES 4200, WPS 4200.
• The last 60 credits of A-F registration (including
transfer coursework) with the minimum GPAs
specified below.
  Transcripts of students graduating with honors show
one of the following:
  Cum laude (minimum 3.50 GPA);
  Magna cum laude (minimum 3.66 GPA);
  Summa cum laude (minimum 3.75 GPA).
  Students also receive the appropriate recognition during
decommencement.

Policies

College Level Examination Program (CLEP)—
Students may earn credit for the CLEP social science and
humanities examinations prepared by the College
Entrance Examination Board. CLEP also offers a number of
subject examinations for credit. Information may be
obtained from the CNR Student Services Office. CNR
accepts CLEP scores at the 75th percentile or higher for
exemption from up to 8 credits in a selected number of
courses. Contact the CNR Student Services Office for
more information.

Dean’s List—To be eligible for the CNR Dean’s List,
students must be a current CNR student and have
completed 12 credits with at least a 3.67 GPA. Dean’s
List recipients receive a letter from the dean recognizing
their academic accomplishments and are recognized in the
Honors and Recognition area of the Natural Resources
Administration Building. There is a transcript notation for
each term a student is on the Dean’s List.

Extra Credit—Students may register for 1 to 3 extra
credits in some courses with the instructor’s approval.
The extra work is mutually agreed upon by the student
and the instructor and conducted independently of class.
Contact the CNR Student Services Office for more
information.

Grading—All required courses, in the major must be
taken A-F.

Honor System—Under an honor system adopted on the
St. Paul campus, students accept responsibility for the
supervision of student behavior during examinations and
pledge not to give or receive aid. A student or faculty
member who observes an act of dishonesty may report the
incident to the college Honor Case Commission, a
committee of the Student-Faculty Board. For more
information about how the honor system works, contact
the CNR Student Services Office.

Independent Study—With instructor approval, students
may take regularly offered courses through independent
study without attending class. Contact the CNR Student
Services Office for more information.

Policy Waivers—Occasionally it may be to the
educational advantage of both the student and the
department to waive an academic policy or curricular
requirement, provided the basic spirit of the regulation is
maintained. A student may petition for a departure from
normal procedure. Students must first receive major
adviser/departmental recommendation before the petition
is routed to the Student Scholastic Standing Committee.

Repeating Courses—Students may repeat a course even
if a passing grade was received. The grade received for
the course the second time becomes the permanent grade.
The original grade and credits are not included in the
student’s cumulative number of completed credits or
GPA. It is the student’s responsibility to report any
repeated courses to the CNR Student Services Office.

Special Examinations for Credit—Students who believe
their knowledge of a subject is equal to that required to
complete a particular course may request to take an
examination for credit. If the Student Scholastic Standing
Committee and the department approve, arrangements
can be made with an appropriate instructor to take an
examination. Usually no grade is assigned. A fee is
assessed for each examination. Credit by special
examination is not granted for language or mathematics
courses taken in high school.

Suspension—To appeal a suspension (see “Probation”
under the Policies section of this catalog), a student must
obtain a Petition for Reinstatement from the CNR Student
Services Office. The petition must be completed and
turned in to the Student Scholastic Standing Committee,
along with any supporting documents. The final decision
rests with the Student Scholastic Standing Committee,
which informs the student of its decision in writing.

Graduation Requirements

To receive the B.S. degree, CNR students must meet the
following requirements.
• Complete the prescribed curriculum as specified in the
  student’s degree program.
• Achieve a cumulative GPA of at least 2.00, with
  grades of C- or better in each course in the major.
• Satisfy liberal education requirements.
• Satisfy residence and other general University
  requirements.
• Officially apply for graduation.
• Meet all financial obligations to the University.

Liberal Education—Students must meet the University’s
liberal education requirements, including the diversified
core and designated theme requirements. The diversified
core requirements can be met by completing the core
curriculum listed in each CNR degree program. To satisfy
the designated theme requirements, at least 3 credits are
required in each of the following areas: cultural diversity,
international perspectives, environment, and citizenship
and public ethics. The environment and international
perspectives themes are satisfied by completing the
required courses in each program. The remaining themes
may be satisfied by careful selection among core
professional and elective courses. See individual CNR
degree programs for specific courses.

Itasca Session—Forest resources, urban forestry, and
fisheries and wildlife majors are required to complete a
three-week summer field session at the Lake Itasca
Forestry and Biological Station. To attend, students must
have completed 30 semester credits and attained a
minimum cumulative GPA of 2.00. Forest resources and
urban forestry students must also have completed the
following courses with a grade of C- or better: Biol 2022,
Chem 1011 or 1021, and precalculus or college algebra.
Fisheries and wildlife students must have completed the
following courses with a grade of C- or better: Biol 1009,
2022, 2012, and 3407. NRES students are required to
complete either a field session at Itasca or complete
NRES 3051—Experience and Training in a Field Setting
(1-3 cr). To register for the field session, NRES students
must have completed at least 6 credits of biology. The
Itasca session is also open to students not enrolled in
CNR.
**Cloquet Session**—Students in the forest resources major are required to complete the Cloquet Forestry Session in their senior year. To attend, students must attain a minimum cumulative GPA of 2.00 and complete the Itasca Session and other prerequisites. This is a five-week session held in the spring during the intersession and the first part of the summer session.

**Advising**

Advising services for both current and prospective students are provided by professional advisers in the Student Services Office and by departmental faculty.

Each CNR student, with adviser assistance, is responsible for learning curricular and graduation requirements and developing a course program and timetable to meet them. All freshmen and first-year transfer students are assigned an adviser in the Student Services Office for their first year or first semester respectively. Students are then assigned a faculty adviser within their major area of study.

**Special Learning Opportunities**

**Minnesota-Idaho Student Exchange**—Forest resources students at the University may study forest harvesting in Idaho during their senior year under an exchange agreement with the University of Idaho. Minnesota students return from their study in Idaho to be awarded a B.S. from CNR.

**Forest Products Cooperative Education Program**—Students in this program alternate periods of employment in their career fields with periods of academic study. The program leads to a B.S. in wood and paper science with a specialization in paper science and engineering, forest products production management, forest products marketing, or residential building science and technology. Full-time students who have declared a major in wood and paper science and who have at least a 2.70 GPA may apply. For more information, contact Joseph Massey, head of the Department of Wood and Paper Science, 209 Kaufer Laboratory (612/624-7459).

**Fisheries and Wildlife Field Trip**—Fisheries and wildlife majors are eligible to participate in a field trip during spring break of their senior year. Selection for participation is competitive, based on previous academic performance. Students travel with a faculty member or graduate student(s) to the western United States to observe and discuss ongoing fisheries and wildlife management activities. Local natural resources agency personnel provide on-site information. Selected students register for one credit of FW 4565—Fisheries and Wildlife Ecology and Management: Field Trip during the intersession following spring semester.

**International Programs**

Two types of study abroad that can especially enhance degree work in CNR are field study and integrated classroom study. Minnesota Studies in International Development is a field study program offering coursework and grassroots internships in Ecuador, India, Kenya, or Senegal. The Student Project for Amity among Nations consists of summer overseas research on a topic of the student’s choosing, preceded by a year’s on-campus preparation and followed by project write-up in the fall; the four destinations change from year to year. The University also cosponsors two specialized options for CNR students: a tropical biology/conservation program in Costa Rica and a marine biology program in Denmark.

Integrated classroom study programs permit students to take regular university courses alongside students from the host-country. The University’s student exchanges and consortium memberships provide access to universities in many countries. Conservation and resource management curricula taught in English are available in Australia, Canada, Fiji, Finland, Ghana, the Netherlands, the Philippines, South Africa, Tanzania, and the United Kingdom. Students with sufficient language fluency may instead choose to study in Dutch (the Netherlands), Finnish (Finland), French (France), German (Germany), Italian (Italy), Korean (South Korea), Portuguese (Brazil), Spanish (Argentina, Colombia, Mexico, Spain, Uruguay), Swedish (Finland, Sweden), or Thai (Thailand).

Other Study Abroad Opportunities—CNR students need not seek credit in their major. Study abroad is encouraged for language acquisition or cultural learning. The resulting credits can often be used as electives. The University and other institutions sponsor a broad range of
intensive language and area studies programs. For more information, students should contact the Global Campus (612/626-9000).

Career Information

CNR offers assistance and advice to students seeking summer jobs and internships, as well as permanent employment after graduation. Job search assistance for all students is provided by either the Career Opportunities Coordinator in 135 Natural Resources Administration Building or by departmental faculty. A series of special employment seminars are provided by the Career Services Office on topics including resume writing, interviewing, initiating internship job searches, and summer/seasonal intern hiring updates. Each major also requires an orientation class for incoming students that provides interaction with faculty and alumni in their chosen professional field.

Student Organizations

Governance—Students may participate in governance activities at the department, college, and campus levels. Within each department, several committees (including curriculum committees) have student representatives. Students serve on CNR committees and on the college’s Student-Faculty Board, which advises the dean on student issues and concerns. Students may also participate in the St. Paul Campus Board of Colleges, which directs student activities and acts as a liaison between the student body and administration, and on the Student Center Board of Governors, which establishes programs, operation policies, and budgets for the St. Paul Student Center.

Clubs—Student clubs in CNR include the Environmental Studies Club, Forestry Club, Student Chapter of the Society of American Foresters, Recreation Resource Management Club, Forest Products Society/Student Chapter, Student Chapter of the Technical Association of the Pulp and Paper Industry (TAPPI), Student Chapter of the Paper Industry Management Association (PIMA), Student Chapter of the Institute of Packaging Professionals (IOPP), Fisheries and Wildlife Club (with an affiliated student chapter of The Wildlife Society), Minnesota Women in Natural Resources Student Organization, and Xi Sigma Pi Honor Society, Water Resources Students in Action, and Student Society of Arboriculture.
The 1998 Gourman Report ranked the fisheries and wildlife program #5 in the nation.

College of Natural Resources

Fisheries and Wildlife

Department of Fisheries and Wildlife

B. S.

The fisheries and wildlife curriculum provides students with a broad science background emphasizing biological and environmental sciences and other coursework needed for careers in fisheries, wildlife, conservation biology, and other natural resource and environmental fields. Graduates are prepared to research, plan, and implement the management, protection, and enhancement of fisheries and aquatic resources, wildlife resources, and biological diversity. Graduates find employment as fisheries and wildlife scientists and managers, naturalists, zoo biologists, environmental biologists, environmental educators, and other natural resource professionals. The program also provides students with the fundamental science background needed to enter a wide variety of graduate programs in biological and natural resource sciences as well as professional programs in veterinary medicine, environmental law, and environmental education.

Students select an area of specialization, usually by the end of the sophomore year. The areas of specialization are described below. Although no computer course is required, students are expected to be computer literate and competent using word processing, spreadsheet, and e-mail software.

Degree Requirements

To complete the degree, students must complete 128 credits. After completing a core curriculum that includes liberal education, communications, basic science, mathematics, and an orientation to the fields of fisheries, wildlife, and conservation biology, students complete additional credits in one of three areas of specialization: fisheries, wildlife, or conservation biology. Some of the core curriculum courses also fulfill diversified core and designated theme requirements.

Required Courses

Communication Skills

EngC 1012—University Writing and Critical Reading, Emphasis on Environment (4 cr)
or
Rhet 1101—Writing to Inform, Convince, and Persuade (4 cr)  
Rhet 1223—Oral Presentations in Professional Settings (3 cr)
or
Spch 1101—Introduction to Public Speaking (3 cr)  
Rhet 3562—Technical and Professional Writing (3 cr)
or
EngC 3027—Advanced Expository Writing (3 cr)

Mathematical Thinking

Math 1271—Calculus I (4 cr)
and Math 1272—Calculus II (4 cr)
or
Math 1131—Finite Mathematics (3 cr)
and Math 1142—Short Calculus (3 cr)  
FW 4001—Biometry (4 cr)
or
Stat 5021—Statistical Analysis (4 cr)

Physical, Chemical, and Biological Sciences

Chem 1021—Chemical Principles I (4 cr)  
Chem 1022—Chemical Principles II (4 cr)  
Biol 2012—General Zoology (4 cr)  
GCB 3022—Genetics (3 cr)
or
Biol 4003—Genetics (3 cr)

Select one of the following groups:
Biol 1009—General Biology (4 cr)
and Biol 2022—General Botany (3 cr)
or
Biol 1001—Intro Biol I: Evolutionary and Ecological Perspectives (4 cr)
and Biol 1002—Intro Biol II: Molecular, Cellular, and Developmental Perspectives (5 cr)

Select one of the following groups:
Phys 1101—Fundamental Physics I (4 cr)
and Phys 1102—Fundamental Physics II (4 cr)
or
Phys 1001—The Physical World-Energy and Its Impact on the Environment (4 cr)  
and Geo 1001—The Dynamic Earth: Introduction to Geology (4 cr)  
or
Geo 1019—Our Changing Planet (4 cr)  
or
Ast 1001—Exploring the Universe (4 cr)
or
Geo 1425—The Atmosphere (3 cr)
and Geo 1426—The Atmosphere Lab (1 cr)
or
Phys 1201—General Physics I (5 cr)
and Phys 1202—General Physics II (5 cr)

Social Sciences and Humanities

At least 15 credits, distributed as follows:
Social Science—at least 6 credits, including at least one economics course
Historical Perspectives—one course, at least 3 credits (can also apply to a designated theme)
Humanities—at least 6 credits, with one course in literature and one course in "other humanities"

Core Courses

FW 1001—Orientation in Fisheries, Wildlife, and Conservation Biology (1 cr)
Biol 3407—Ecology (3 cr)  
NRES 3011—Ethics, Conflict and Leadership in Resource Management (3 cr)
FW 4701—Fisheries and Wildlife Problem Solving (2 cr)
or
FW 4801—Honors Research (2 cr)
and FW 4802—Honors Research (2 cr)
and FW 4200—Honors Seminar (1 cr)

Conservation Biology Specialization

The conservation biology area of specialization is for students interested in careers dealing with a broad range of conservation issues in aquatic or terrestrial habitats. Positions typically focus on protection of endangered species and management for biodiversity. Careers as environmental educators or naturalists are also options.

Required Courses

Communications, Leadership, Policy

Choose two of the following:
FW 4003—Human Dimensions of Wildlife Management (3 cr)
NRES 3241—Natural Resources Policy and Administration (3 cr)
NRES 3202—Planning and Leadership in Natural Resource Management (3 cr)

Animals and Plants

Select one plant and one animal course:
FW 4129—Mammalogy (4 cr)
EEB 4134—Introduction to Ornithology (4 cr)
FW 4136—Ichthyology (4 cr)
Ent 5021—Insect Taxonomy and Phylogeny (4 cr)
FR 1101—Dendrology (3 cr)
PBio 4511—Plant Systematics (3 cr)
PBio 4321—Taxonomy of Minnesota Flora (3 cr)
Community and Ecosystem Ecology
LA 5204—Landscape Ecology (3 cr)

Select one of the following:
FR 5142—Tropical Forest Ecology (3 cr)
EEB 4014—Ecology of Vegetation (3 cr)
EEB 4016—Ecological Biogeography (3 cr)
EEB 4601—Limnology (3 cr)
EEB 4608—Ecosystem Ecology (3 cr)
EEB 5122—Plant Interactions with Animals and Microbes (4 cr)

Fisheries, Wildlife, and Conservation Biology
FW 2001—Introduction to Fisheries, Wildlife, and Conservation Biology (3 cr)

Select one of the following:
FW 5601—Fisheries Analysis (3 cr)
FW 5051—Analysis of Populations (3 cr)
FW 5604—Fisheries Ecology and Management (3 cr)
FW 5603—Habitats and Regulation of Wildlife (3 cr)
Any Itasca Summer Session field course (4 cr)
FW 4108—Field Methods in Research and Conservation of Vertebrate Populations (Itasca) (3 cr)
FW 4106—Important Plants in Fisheries and Wildlife Habitats (Itasca) (1 cr)

Electives—Please give strong consideration to courses on the list below or in any of the three areas of specialization (i.e., fisheries, wildlife, or conservation biology).
FW 5621—GIS for Fisheries, Wildlife, and Biological Conservation (3 cr)
or FR 4131—GIS in Natural Resource Analysis (3 cr)
NRES 3575—Wetlands Conservation (3 cr)
NRES 3001—Colloquium: Perspectives on Treaty Rights (2 cr)
NRES 3002—Colloquium: Exotic Species (2 cr)
NRES 3021—Plant Resource Management and the Environment (3 cr)
NRES 3061—Water Quality: Management of a Natural Resource (3 cr)
NRES 4211—Survey, Measurement, and Modeling in Natural Resources (3 cr)
NRES 4801—Natural Resources Interpretation (3 cr)
NRES 5002—Colloquium: Restoration of Aquatic Systems (1 cr)

Fisheries Specialization
The fisheries area of specialization is for students who wish to pursue careers in fisheries and aquatic resource science, management, and administration; fish hatchery management; and aquaculture, aquatic education, and aquatic environmental assessment. The curriculum meets the education criteria for the Certified Fisheries Professional designation established by the American Fisheries Society, the major professional organization for fisheries scientists and managers in North America.

Required Courses
Communications, Leadership, Policy

Select one of the following:
FW 4003—Human Dimensions of Wildlife Management (3 cr)
NRES 3241—Natural Resources Policy and Administration (3 cr)
NRES 3202—Planning and Leadership in Natural Resource Management (3 cr)

Animals and Plants
FW 4136—Ichthyology (4 cr)
FW 4401—Introduction to Fish Physiology and Behavior (4 cr)
or Biol 3211—Animal Physiology (3 cr)
or AnSc 2301—Systemic Physiology (4 cr)

Select one of the following:
PBio 1501—Minnesota Plant Life (2 cr)
PBio 4511—Plant Systematics (3 cr)
Ent 5361—Aquatic Insects (3 cr)
Ent 5021—Insect Taxonomy and Phylogeny (4 cr)

EEB 4601—Limnology (3 cr)

Select one of the following:
EEB 5052—Ecology: Theory and Concepts (4 cr)
EEB 4607—Plankton Ecology (4 cr)
EEB 4608—Ecosystems Ecology (3 cr)

Fisheries, Wildlife, Conservation Biology, and Chemistry
FW 4106—Important Plants in Fisheries and Wildlife Habitats (Itasca) (1 cr)
FW 4108—Field Methods in Research and Conservation of Vertebrate Populations (Itasca) (3 cr)
FW 5601—Fisheries Analysis (3 cr)
FW 5604—Fisheries Ecology and Management (3 cr)
FW 5603—Habitats and Regulation of Wildlife (3 cr)
or FW 4129—Mammalogy (4 cr)
or EEB 4134—Introduction to Ornithology (4 cr)

Select one of the following:
Chem 2101—Introductory Analytical Chemistry Lecture (3 cr)
and Chem 2111—Introductory Analytical Chemistry Lab (1 cr)
or Chem 2301—Organic Chemistry I (3 cr)
and Chem 2311—Organic Chemistry Lab (3 cr)

Electives—Please give strong consideration to courses on the list below or in any of the three areas of specialization (i.e., fisheries, wildlife or conservation biology).
FW 5411—Aquatic Toxicology (3 cr)
FW 5455—Sustainable Aquaculture (3 cr)
FW 5621—GIS for Fisheries, Wildlife, and Biological Conservation (3 cr)
NRES 3001—Colloquium: Perspectives on Treaty Rights (2 cr)
NRES 3002—Colloquium: Exotic Species (1 cr)
NRES 3061—Water Quality: Management of a Natural Resource (3 cr)
NRES 4211—Survey, Measurement, and Modeling in Natural Resources (3 cr)
NRES 4801—Natural Resources Interpretation (3 cr)
NRES 5002—Colloquium: Restoration of Aquatic Systems (1 cr)

Wildlife Specialization
The wildlife area of specialization is for students who wish to pursue careers in wildlife science, management, and administration; zoo biology, and terrestrial ecology, environmental assessment, and education. With proper selection of electives, students can meet the education criteria for the Certified Wildlife Biologist designation established by The Wildlife Society, the major professional organization for wildlife scientists and managers in North America.

Required Courses
Communications, Leadership, Policy

Select one of the following:
FW 4003—Human Dimensions of Wildlife Management (3 cr)
NRES 3241—Natural Resources Policy and Administration (3 cr)
NRES 3202—Planning and Leadership in Natural Resource Management (3 cr)

Animals and Plants
FW 4129—Mammalogy (4 cr)
EEB 4134—Introduction to Ornithology (4 cr)
FW 4401—Introduction to Fish Physiology and Behavior (4 cr)
or Biol 3211—Animal Physiology (3 cr)
or AnSc 2301—Systemic Physiology (4 cr)

Community and Ecosystem Ecology

Select one of the following:
EEB 5052—Ecology: Theory and Concepts (4 cr)
EEB 4601—Limnology (3 cr)
EEB 4608—Ecosystems Ecology (3 cr)
FR 5142—Tropical Forest Ecology (3 cr)
Pre-Veterinary Medicine

Students may fulfill the minimum requirements for admission to the University’s College of Veterinary Medicine and other colleges of veterinary medicine by completing a bachelor’s degree in fisheries and wildlife within any of the three areas of specialization. Although the minimum requirements for admission to colleges of veterinary medicine may be completed in three years, admission is highly competitive. Completing a bachelor’s degree in fisheries and wildlife provides students with additional academic skills and other career opportunities.

Degree Requirements

Students must complete the core curriculum, one of the three areas of specialization, and four additional courses.

Required Courses

The following courses are required in addition to the fisheries and wildlife core requirements and courses in one of three areas of specialization. These courses may be substituted for the electives in the areas of specialization. Phys 1101 and 1102 — (3 cr, 3 cr) or Phys 1201 and 1202 — (4 cr, 4 cr) or Phys 1301 and 1302— (4 cr, 4 cr) or
Chem 2301 — Organic Chemistry I (3 cr) or
Chem 2302 — Organic Chemistry II (3 cr) or
Chem 2311 — Organic Chemistry Lab I (3 cr) or
Chem 2320 — Organic Chemistry Lab II (3 cr) or
VPB 2302 — General Microbiology with Lab (4 cr) or
Biol 3001 — Biology of Microorganisms (3 cr) or
Biol 3012 — General Principles of Biochemistry (3 cr) or
Biol 3301 — Biology of Microorganisms (3 cr)

Forest Resources

B.S.

The forest resources curriculum prepares students to plan, implement, and research the management, protection, and sustainable use of forest and related resources, including timber, water, wildlife, recreation, and aesthetics. Students in the forest resources curriculum select between two tracks, forest management and forest science. Both tracks qualify students to be forest managers. However, students taking the forest management track receive more training in principles and techniques of resource management, while those taking the forest science track receive more scientific and specialized training in particular aspects of forest resources. Students should choose the forest management track or the forest science track as early in their college careers as possible.

Degree Requirements

To complete the degree, students must complete 128 credits. Students must also meet the University’s liberal education requirements; see “Liberal Education” in the CNR general information section of this catalog.

Required Courses

Communication Skills

Rhet 1101 — Writing to Inform, Convince, and Persuade (4 cr) or
EngC 1012 — University Writing and Critical Reading, Emphasis on Cultural Diversity (4 cr) or
EngC 1014 — University Writing and Critical Reading, Emphasis on Public Ethics (4 cr) or
Spch 1101 — Introduction to Public Speaking (3 cr)
Rhct 1223—Oral Presentation in a Professional Settings (3 cr)
Rhct 3562—Technical and Professional Writing (3 cr)
or EngC 3027—Advanced Expository Writing (4 cr)
or Sphc 1101—Introduction to Public Speaking (3 cr)

**Mathematical Thinking**
Math (see requirements in track sections)
Stat 3011—Statistical Analysis (3 cr)
or Stat 5021—Statistical Analysis (4 cr)

**Physical and Biological Sciences**
Biol 1009—General Biology (4 cr)
Biol 2022—General Botany (3 cr)
Chemistry (see requirements in track sections)
or “B” or better in high school physics
Soil 2125—Basic Soil Science (4 cr)

**Social Sciences and Humanities (15 cr)**
ApEc 1101—Principles of Microeconomics (3 cr)
or Econ 1101—Principles of Microeconomics (4 cr)
NRES 3261—Economics and Natural Resource Management (3 cr)
Humans—at least 6 credits including one course in literature and one course in “other humanities”
Historical Perspective—at least one course of at least 3 credits. A course fulfilling the historical perspectives may also apply toward a designated theme requirement.

**Professional Required Core Courses**
Introductory Courses:
FR 1001—Orientation and Information Systems (1 cr)
WPS 1301—Wood as a Raw Material (3 cr)

Resource Assessment:
FR 4262—Remote Sensing of Natural Resources (3 cr)
FR 4218—Assessment and Modeling of Forests (3 cr)

Management of Vegetation, Wildlife, Soil, and Water Resources:
FR 1101—Dendrology (3 cr)
FR 3104—Forest Ecology (4 cr)
FR 4411—Silviculture Systems (3 cr)
FR 4114—Forest Hydrology and Watershed Management (3 cr)
Enter 3001—Insects and Insect Management (1 cr)
and Ent 4251—Forest and Shade Tree Entomology (2 cr)
or PlPa 3003—Diseases of Forest and Shade Trees (3 cr)

FR 2001—Introduction to Fisheries, Wildlife, and Conservation Biology (3 cr) (recommended for freshmen or sophomores)
or FW 5603—Habitats and Regulation of Wildlife (3 cr)
FW 5604—Fisheries Ecology and Management (3 cr)
Geo 1001—The Dynamic Earth: An Introduction to Geology (4 cr)
NRES 3061—Water Quality: Management of a Natural Resource (3 cr)
NRES 3003—Diseases of Forest and Shade Trees (3 cr)
Soil 5711—Forest Soils (3 cr)

**Resource Policy, Management, and Planning**
FR 3251—Role of Renewable Natural Resources in Developing Countries (1 cr)
FR 5264—Advanced Forest Management Planning (2 cr)
NRES 3202—Planning and Leadership in Natural Resource Management (3 cr)
or NRES 3011—Ethics, Conflict, and Leadership in Resource Management (3 cr)
NRES 3245—Recreation Policy and Landscape-level Planning (3 cr)
NRES 4395—Natural Resources Planning (4 cr)

**Assessment and Information Systems**
FR 3601—Elements of Surveying (1 cr)
FR 4131—Geographic Information Systems for Natural Resource Analysis (3 cr)
FR 5228—Advanced Topics in Assessment and Modeling of Forests (3 cr)
FR 5412—Advanced Remote Sensing (3 cr)

**Forest Management Track**
This track is for students who wish to become directly involved in forest land management or find employment in specialized areas such as resource planning, timber harvesting, forest protection, or policy development. Graduates may also pursue graduate study to become researchers and teachers or seek advanced positions in administering and managing forest and related natural resources. This track contains a forest harvesting option that involves a year of study at the University of Idaho.

**Required Mathematics and Chemistry Courses**
Math 1142—Short Calculus (3 cr)
Chem 1011—General Principles of Chemistry (4 cr)
and BioC 1012—General Principles of Biochemistry (3 cr)
or Chem 1021—Chemical Principles I (4 cr)
and Chem 1022—Chemical Principles II (4 cr)

**Additional Forest Management Professional Courses**
FR 4431—Timber Harvesting and Road Planning (1 cr)
FR 4232—Management of Recreational Lands (4 cr)
NRES 3202—Planning and Leadership in Natural Resource Management (3 cr)
or NRES 3011—Ethics, Conflict, and Leadership in Resource Management (3 cr)

**Field Training in Assessment and Management of Forest Resources**
(Taught at Crozet Forestry Center during the Crozet Forestry Session)
FR 4615—Remote Sensing and Resource Assessment: Field Applications (2 cr)
FR 4611—Field Silviculture (3 cr)
FR 4621—Timber Harvesting and Road Planning: Field Applications (2 cr)

**Enrichment Courses**
Students select, with adviser approval, 10 additional credits of professional courses, which are grouped below by subject matter. At least 7 of the credits must be taken from courses listed below regardless of group. Students completing the Forest Harvesting Option may also choose from courses offered at the University of Idaho. Courses may not be used to fill the 10 credit enrichment requirement if they are used to satisfy other requirements.

**Managing Plant, Animal, Soil, and Water Resources**
Enter 3001—Insects and Insect Management (1 cr)
and Ent 4251—Forest and Shade Tree Entomology (2 cr)
FR 4118—Tree Biology (2 cr)
FR 5142—Tropical Forest Ecology (3 cr)
FR 5153—Forest and Wetland Hydrology (3 cr)
FW 5603—Habitats and Regulation of Wildlife (3 cr)
FW 5604—Fisheries Ecology and Management (3 cr)
Geo 1001—The Dynamic Earth: An Introduction to Geology (4 cr)
NRES 3061—Water Quality: Management of a Natural Resource (3 cr)
PlPa 3003—Diseases of Forest and Shade Trees (3 cr)
Soil 5711—Forest Soils (3 cr)

**Resource Policy, Management, and Planning**
FR 3251—Role of Renewable Natural Resources in Developing Countries (1 cr)
FR 5264—Advanced Forest Management Planning (2 cr)
NRES 3202—Planning and Leadership in Natural Resource Management (3 cr)
or NRES 3011—Ethics, Conflict, and Leadership in Resource Management (3 cr)
NRES 3245—Recreation Policy and Landscape-level Planning (3 cr)
NRES 4395—Natural Resources Planning (4 cr)

**Assessment and Information Systems**
FR 3601—Elements of Surveying (1 cr)
FR 4131—Geographic Information Systems for Natural Resource Analysis (3 cr)
FR 5228—Advanced Topics in Assessment and Modeling of Forests (3 cr)
FR 5412—Advanced Remote Sensing (3 cr)

**Forest Harvesting Option in the Forest Management Track**
Students interested in forest harvesting and its relation to other forest management topics may complete the forest harvesting option within the forest management track. This option provides training for careers in logging-engineering firms, forest products companies, consulting, or public agencies. Graduates may design and layout timber sales and forest roads, administer timber sales, and manage wood procurement systems. Students spend their first three years at the University of Minnesota and their senior year at the University of Idaho. Students interested in this option must consult Professor Charlie Blinn.

Course requirements for this option are those in the general forest management track with the following exceptions.
Gourman Report.

Closed and ranked #7 in the nation by the 1998 Gourman Report.

Natural Resources
Management was ranked #7 in the nation by the 1998 Gourman Report.

Forest Resources

Natural Resources and Environmental Studies

Required Courses
14 semester credits of forest harvesting courses taught at the University of Idaho. A current list of these courses can be obtained from Professor Blinn.

Course Requirements Omitted in Forest Harvesting Option (students are encouraged to consider these in selecting their 10 additional professional courses and their free electives):
- Ent 3001—Insects and Insect Management (1 cr)
- and Ent 4251—Forest and Shade Tree Entomology (2 cr)
- PIPa 3033—Diseases of Forest and Shade Trees (3 cr)
- FR 4471—Forest Management and Planning (3 cr)
- FR 4232—Management of Recreational Lands (4 cr)
- NRES 3202—Planning and Leadership in Natural Resource Management (3 cr)
  or NRES 3011—Ethics, Conflict, and Leadership in Resource Management (3 cr)

Forest Science Track
This track is for students who wish to learn the fundamentals of forest resource management while gaining depth in a basic or applied science related to forest resources. Graduates might pursue careers as forest managers, but are more likely to enter graduate school followed by careers in research, teaching, and technical support for managers and administrators. Areas of specialization include quantitative methods, economics and policy, forest ecology, silviculture, watershed management/water resources, and resource protection.

Admission to the forest science track requires approval by a faculty committee and a GPA of 3.20 or above for those in college and a high school rank in the upper tenth percentile for those entering as freshmen.

Students interested in the forest science track develop an individualized program with an adviser and submit the program for approval to a faculty committee.

Required Mathematics and Chemistry Courses
- Math 1271—Calculus I (4 cr)
- Math 1272—Calculus II (4 cr)
- Chem 1021—Chemical Principles I (4 cr)
- Chem 1022—Chemical Principles II (4 cr)

Additional Forest Science Professional and Scientific Courses
Students must take 20 credits of professional and scientific courses, at least 15 credits of which must be in sciences. These courses must be selected in consultation with an adviser, and adviser approval is required.

Field Sessions
One or two field sessions (three weeks at Lake Itasca Forestry and Biological Station, five weeks at Cloquet Forestry Center).

Forest Resources

Minor Requirements
The forest resources minor (17 cr) helps students in natural resources and other areas gain deeper understanding of the scientific foundations of forestry, the management of forest resources, and the importance of forest resources to society. Students select from an array of courses in forest assessment, forest biology and management, and forest economics and policy. Students may include a three-week hands-on field session in Itasca State Park as part of their minor. Students interested in the minor should contact the CNR Student Services Office.

Minor Core Courses (10-11 cr)
- FR 1101—Dendrology (3 cr)
  or FR 2101—Forest Plants (Itasca) (1 cr)
  and FR 2102—Forest Ecology: Field Experience (Itasca) (2 cr)
  and FR 2104—Forest Measurement Techniques (Itasca) (1 cr)
- FR 3104—Forest Ecology (4 cr)
- FR 4411—Silvicultural Systems (3 cr)

Additional Required Courses (7 cr)
Forest Policy, Management, and Planning
Select at least one from the following:
- NRES 3241—Natural Resource Policy and Administration (3 cr)
- NRES 3261—Economics and Natural Resource Management (3 cr)
- NRES 4232—Management of Recreational Lands (3 cr)
- FR 4501—Urban Forest Management (3 cr)
- FR 4471—Forest Management and Planning (3 cr)

Resource Assessment
- FR 4218—Assessment and Modeling of Forests (3 cr)
- FR 4131—Geographic Information Systems for Natural Resource Analysis (3 cr)
- FR 4262—Remote Sensing of Natural Resources (3 cr)

Biography and Management of Vegetation, Wildlife, Water, and Soil Resources
- FR 2101—Forest Plants (Itasca) (1 cr)
  and FR 2102—Forest Ecology: Field Experience (Itasca) (2 cr)
  and FR 2104—Forest Measurement Techniques (Itasca) (1 cr)
- FR 3501—Arboriculture (3 cr)
- FR 4114—Forest Hydrology and Watershed Management (3 cr)
- FR 4431—Timber Harvesting and Road Planning (1 cr)
- FR 5142—Tropical Forest Ecology (3 cr)
- Ent 3001—Insects and Insect Management (1 cr)
  and Ent 4251—Forest and Shade Tree Entomology (2 cr)
- PIPa 3003—Diseases of Forest and Shade Trees (3 cr)

NRES 4703—Agroforestry: Role in Watershed Management (3 cr)

Natural Resources and Environmental Studies

B.S.
The natural resources and environmental studies curriculum is for students interested in an interdisciplinary major focusing on the use, management, and protection of natural resources and the environment. Students have flexibility in designing their study program to achieve one or more of the following objectives:

- Learn about the interaction between natural resources and modern society, including the social and environmental roles that natural resources play nationally and internationally.
- Prepare for careers in public and private organizations that plan the use and management of natural resources and protection of the environment.
- Prepare for positions in fields such as environmental education, environmental assessment, resource inventory, natural resource planning, environmental protection, sustainable development, policy analysis, water resources, waste management, and natural resource management.
- Prepare for graduate study.

All students complete the core curriculum of required courses listed on the following page. In addition, students choose an area of concentration. Areas of concentration include environmental assessment and monitoring; environmental education; planning, policy, and law; resource conservation and environmental management; and water and soil resources. Courses must be selected in collaboration with an adviser. Students must complete a Concentration Contract in consultation with their faculty adviser.

Degree Requirements
To complete the degree, students must complete 120 credits.
Required Courses

Communication Skills
Rhet 1101—Writing to Inform, Convince, and Persuade (4 cr)
or
Rhet 1102—Writing on Issues of Science and Technology (4 cr)
or
EngC 1011—University Writing and Critical Reading (4 cr)
or
EngC 1012—University Writing and Critical Reading, Emphasis on Cultural Diversity (4 cr)
or
EngC 1014—University Writing and Critical Reading, Emphasis on Public Ethics (4 cr)
Rhet 1223—Oral Presentation in Professional Setting (3 cr)
or
Sphc 1101—Introduction to Public Speaking (3 cr)
Rhet 3562—Technical and Professional Writing (3 cr)
or
EngC 3027—Advanced Expository Writing (4 cr)

Mathematical Thinking
Mathematics: (see area of concentration for specific requirements)
Stat 3011—Introduction to Statistical Analysis (4 cr)
or
Stat 5021—Statistical Analysis (4 cr)

Physical and Biological Sciences
Biol 1001—Introductory Biology I: Evolutionary and Ecological Perspectives (4 cr)
or
Biol 1009—General Biology (4 cr)
Biol 2022—General Botany* (3 cr)
or
Biol 2012—General Zoology* (4 cr)
* Required in the resource conservation and environmental management concentration
Chemistry (see area of concentration for specific requirements)
Physics (see area of concentration for specific requirements)
Geo 1001—The Dynamic Earth: An Introduction to Geology (4 cr)
Soil 2125—Basic Soil Science (4 cr)

Social Sciences and Humanities (15 cr)
Social Science (at least 6 cr). Complete one of the microeconomics courses below plus one additional social science course (see area of concentration for specific requirements).
ApEc 1101—Principles of Microeconomics (3 cr)
or
Econ 1001—Principles of Microeconomics (4 cr)
To fulfill the other social science requirement, consider completing
NRES 3261—Economics and Natural Resource Management (3 cr)
or
NRES 3241—Natural Resource Policy and Administration (3 cr)
* Historical Perspective (at least one course of at least 3 cr). A course fulfilling the historical perspectives requirement may also apply toward a designated theme requirement.

CNR Core Courses
NRES 1001—Orientation and Information Systems (1 cr)
NRES 1201—Conservation of Natural Resources (3 cr)
NRES 3000 or 3001 or 3002 or 5001—Colloquium (choose one)
(1-2 cr)
FR 3104—Forest Ecology (4 cr)
or
Biol 3407—Ecology (3 cr)
NRES 3001—Water Quality: Management of a Natural Resource (3 cr)
or
FR 4114—Forest Hydrology and Watershed Management (3 cr)
FW 2001—Introduction to Fisheries, Wildlife, and Conservation Biology (3 cr)
NRES 3021—Plant Resource Management and the Environment (3 cr)
or
FR 4411—Silviculture Systems (3 cr)
NRES 4211—Survey, Measurement, and Modeling in Natural Resources (3 cr)
NRES 3051—Experience and Training in a Field Setting (1-3 cr)
or
Field Session (3-4 cr) (see concentration for recommended field session)
NRES 4195—Problem Solving in Natural Resources and Environmental Studies (4 cr)
or
NRES 4295—GIS for Problem Solving in Environmental Science and Management (4 cr)

Environmental Assessment and Monitoring Concentration
The environmental assessment and monitoring concentration focuses on development of skills for assessing the extent and character of various natural and environmental resources with techniques such as geographic information systems, remote sensing, and quantitative sampling, analysis, and modeling.

Required Courses

General Education and Professional Course Requirements
Math 1142—Short Calculus (3 cr)
or
Math 1271—Calculus I (4 cr)
and
Math 1272—Calculus II (4 cr)
Chem 1021—Chemistry Principles I (4 cr)
or
Chem 1022—Chemistry Principles II (4 cr)
or
Chem 1011—General Principles of Chemistry (4 cr)
or
BioC 1012—General Principles of Biochemistry (3 cr)
or
“B” or better in high school physics
FR 4131—Geographical Information Systems for Natural Resource Analysis (3 cr)
FR 4262—Remote Sensing of Natural Resources (3 cr)
NRES 4295—GIS for Problem Solving in Environmental Science and Management (4 cr)
FR 2101, 2102, 2104—Forest Plants; Forest Ecology; Field Experience; and Forest Measurement Techniques (Itasca) (4 cr)
or
NRES 3051—Experience and Training in a Field Setting (1-3 cr)
or
FR 1101—Dendrology (3 cr)
or
EEB 4014—Ecology of Vegetation (3 cr)
or
PBio 4321—Taxonomy of Minnesota Flora (3 cr)

Additional Required Professional Courses (12 cr)
(Courses taken from this list may not be counted toward fulfilling both core and concentration requirements)
CSci 1113—Introduction to Programming (3 cr)
EEB 4014—Ecology of Vegetation (3 cr)
FR 2101, 2102, 2104—Forest Plants; Forest Ecology; Field Experience; and Forest Measurement Techniques (Itasca) (4 cr)
FR 1101—Dendrology (3 cr)
FR 3601—Elements of Surveying (1 cr)
FR 4114—Forest Hydrology and Watershed Management (3 cr)
FR 4218—Assessment and Modeling of Forests (3 cr)
FR 5228—Advanced Topics in Assessment and Modeling of Forests (3 cr)
FR 5412—Advanced Remote Sensing (3 cr)
FW 5603—Habitats and Regulation of Wildlife (3 cr)
FW 5604—Fisheries Ecology and Management (3 cr)
FW 5621—Geographic Information Systems for Fisheries, Wildlife and Biological Conservation (3 cr)
GeoG 3511—Introduction to Cartography (3 cr)
GeoG 5562—Geographic Information Science and Analytical Cartography (3 cr)
GeoG 5563—Advanced Geographic Information Science (3 cr)
NRES 1041—Natural Resources as Raw Materials (3 cr)
NRES 3051—Experience and Training in a Field Setting (1-3 cr)
or
NRES 3205—Field Ecology in NRES (4 cr)
NRES 3061—Water Quality: Management of a Natural Resource (3 cr)
NRES 3241—Natural Resource Policy and Administration (3 cr)
NRES 3245—Recreation Policy and Landscape-level Planning (3 cr)
NRES 3261—Economics and Natural Resources Management (3 cr)
PBio 4321—Taxonomy of Minnesota Flora (3 cr)
Soil 4021—Environmental Impact Statements (3 cr)
Soil 4511—Field Study of Soils (1 cr)
Soil 5555—Wetlands Soils (3 cr)
Environmental Education Concentration

The environmental education concentration focuses on skills and knowledge for working in a variety of communication and education fields associated with natural resources and the environment. Emphasis is on environmental issues at local, regional, and global levels; the human dimensions of environmental education; and “best practices” for diverse audiences and for teaching and learning in nonformal settings.

Required Courses

*General Education and Professional Course Requirements*

Math 1142—Short Calculus (3 cr)

or Math 1271—Calculus I (4 cr)

and Math 1272—Calculus II (4 cr)

Chem 1011—General Principles of Chemistry (4 cr)

or BioC 1012—General Principles of Biochemistry (3 cr)

Phys 1001—The Physical World - Energy and Its Impact on the Environment (4 cr)

or “B” or better in high school physics

NRES 1041—Natural Resources as Raw Materials (3 cr)

NRES 3202—Planning and Leadership in Natural Resource Management (3 cr)

or NRES 3011—Ethics, Conflict, and Leadership in Resource Management (3 cr)

NRES 3241—Natural Resource Policy and Administration (3 cr)

or NRES 3245—Recreation Policy and Landscape-level Planning (3 cr)

NRES 4811—Natural Resources Interpretation (3 cr)

FR 5403—Fundamentals of Natural Resource Education (3 cr)

NRES 3051—Experience and Training in a Field Setting (1-3 cr)

or NRES 3205—Field Ecology in NRES (4 cr)

or FR 2101, 2102, 2103—Forest Plants; Forest Ecology; Field Experience; and Forest Measurement Techniques (Iiusca) (4 cr)

Additional Required Professional Courses (15 cr)

Agro 4103—World Food Problems (3 cr)

ApEc 4611—Resource Development and Environmental Economics (3 cr)

Anth 3041—Ecological Anthropology (3 cr)

CI 5747—Global and Environmental Education: Content and Practice (3 cr)

CI 5537—Special Topics: Science Education (1-8 cr)

CI 5502—Special Topics: Outdoor Science Education (1-8 cr)

CI 5140—Reflective Teaching and Professional Ethics (3 cr)

CI 5533—Studies in Science Education (4 cr)

DHA 4482—Residential Environmental Quality (3 cr)

EEB 3361—Visions of Nature: The Natural World and Political Thought (3 cr)

FR 3251—Role of Renewable Natural Resources in Developing Countries (1 cr)

NRES 3261—Economics and Natural Resource Management (3 cr)

NRES 3575—Wetlands Conservation (3 cr)

Hort 5071—Restoration and Reclamation Ecology (3 cr)

LA 3501—Environmental Design and Its Biological and Physical Context (3 cr)

LA 5204—Landscape Ecology (3 cr)

NRES 4101—Conservation of Plant Biodiversity (3 cr)

Pol 3872—Global Environmental Cooperation (3 cr)

Rec 5301—Wilderness and Adventure Education (3 cr)

Rec 5311—Programming Outdoor and Environmental Education (3 cr)

Rhet 3383—In Search of Nature (3 cr)

Soil 5601—Principles of Waste Management (3 cr)

Spch 5451—Intercultural Communication Processes (3 cr)

Planning, Policy, and Law Concentration

The planning, policy, and law concentration focuses on planning and management activities, with emphases on environmental, social, and cultural factors. Application areas encompass watershed, landscape, and site planning, and address issues of development, resource protection, land use, and regulation at local, state, and national levels. Students are urged to select either a subspecialty in planning or one in policy and law.

Required Courses

*General Education and Professional Course Requirements*

Math 1142—Short Calculus (3 cr)

or Math 1271—Calculus I (4 cr)

and Math 1272—Calculus II (4 cr)

Chem 1011—General Principles of Chemistry (4 cr)

or BioC 1012—General Principles of Biochemistry (3 cr)

Pol 1001—American Democracy in a Changing World (4 cr)

LA 1401—The Designed Environment (3 cr)

NRES 1041—Natural Resources as Raw Materials (3 cr)

NRES 3011—Ethics, Conflict, and Leadership in Natural Resource Management (3 cr)

or NRES 3202—Planning and Leadership in Natural Resource Management (3 cr)

or NRES 3051—Experience and Training in a Field Setting (1-3 cr)

or NRES 3205—Field Ecology in NRES (4 cr)

or FR 2101, 2102, 2103—Forest Plants; Forest Ecology; Field Experience; and Forest Measurement Techniques (Iiusca) (4 cr ea)
Students must decide which track they want to follow: the planning track or the policy and law track.

**Planning Track in the Planning, Policy, and Law Concentration**

**Additional Required Professional Courses**
- FR 1101—Dendrology (3 cr)
- FR 4131—Geographical Information Systems for Natural Resources Analysis (3 cr)
  or
  FW 5621—GIS for Fisheries, Wildlife, and Biological Conservation (3 cr)
- NRES 3245—Recreation Policy and Landscape-level Planning (3 cr)

Select 12 credits from the three groups listed below. At least one course must be chosen from each group.

**Social Context for Planning**
- FR 4232—Management of Recreational Lands (4 cr)
- ApEc 5321—Regional Economic Analysis (3 cr)
- PA 5034—Community Analysis and Planning Techniques (1.5 cr)
- PA 5251—Strategic Planning and Management (1.5 cr)
- PA 5252—Strategic Tactics in Project Planning and Management (3 cr)

**Biological/Physical Context for Planning**
- FR 4262—Remote Sensing for Natural Resources (3 cr)
- Hort 5071—Restoration and Reclamation Ecology (3 cr)
- LA 3501—Environmental Design and Its Biological and Physical Context (3 cr)
- LA 5204—Landscape Ecology (3 cr)
- LA 5241—Environmental Planning (4 cr)
- Soil 4021—Environmental Impact Statements (3 cr)

**Ways of Understanding and Mitigating Natural Resource Conflict**
- NRES 3241—Natural Resource Policy and Administration (3 cr)
- NRES 3261—Economics and Natural Resources Management (3 cr)
- FR 4259—Analysis of Outdoor Recreation Behavior (3 cr)
- Geog 3355—Environmental Quality (4 cr)
- Geog 5724—Meanings of Place (3 cr)
- ApEc 4311—Tourism Development Principles, Processes and Policies (3 cr)
- Rhet 3266—Group Process, Team Building, and Leadership (3 cr)
- PA 5011—Organizational Analysis, Management and Design (3 cr)

**Policy and Law Track in the Planning, Policy, and Law Concentration**

**Additional Required Professional Courses (6 cr)**
- NRES 3241—Natural Resource Policy and Administration (3 cr)
- NRES 3261—Economics and Natural Resources Management (3 cr)

Select 12 credits from the three groups listed below. At least one course must be chosen from each group.

**Policy Analysis**
- Pol 3085—Quantitative Analysis in Political Science (3 cr)
- ApEc 3311—Introduction to Policy Analysis (3 cr)
- ApEc 5651—Economics of Natural Resource and Environmental Policy (3 cr)
- PA 5002—Introduction to Policy Analysis (1.5 cr)
- PA 5013—Law and Urban Land Use (3 cr)

**Policy and Economics**
- ApEc 3001—Applied Micro: Consumers and Markets (3 cr)
- ApEc 3006—Applied Macro: Government and the Economy (3 cr)
- ApEc 5611—Land and Water Economics (3 cr)
- ApEc 4311—Tourism Development Principles, Processes, and Policies (3 cr)
- NRES 3245—Recreation Policy and Landscape-level Planning (3 cr)

**Implications of Policy on Natural Resources Planning and Management**
- PA 5012—The Politics of Public Affairs (3 cr)
- Anth 3041—Ecological Anthropology (3 cr)
- Geog 5724—Meanings of Place (3 cr)
- Pol 3441—Politics of Environmental Protection (3 cr)
- Pol 3872—Global Environmental Cooperation (3 cr)
- Pol 4483—Grassroots Politics (3 cr)

FR 3251—Role of Renewable Natural Resources in Developing Countries (1 cr)
FR 5146—Dynamics of Global Change (3 cr)
Geog 3361—Land Use, Landscapes and the Law (3 cr)

**Resource Conservation and Environmental Management Concentration**

The resource conservation and environmental management concentration focuses on developing broad understanding of resource conservation and environmental management. Emphasis is on understanding the linkages between society and the environment and acquiring the leadership and management skills relevant to environmental management at local, state, and national levels.

**Required Courses**

**General Education and Professional Course Requirements**
- Math 1142—Short Calculus (3 cr)
  or
  Math 1271—Calculus I (4 cr)
  and
  Math 1272—Calculus II (4 cr)
- Biol 2102—General Zoology (4 cr)
- Biol 2102—General Botany (3 cr)
- Chem 1021 and 1022—Chemistry Principles I and II (4 cr ea)
  or
  Chem 1011—General Principles of Chemistry (4 cr)
  and
  BioC 1012—General Principles of Biochemistry (3 cr)
- Phys 1001—The Physical World - Energy and Its Impact on the Environment (4 cr)
  or
  “B” or better in high school physics
- NRES 1041—Natural Resources as Raw Materials (3 cr)
- NRES 3011—Ethics, Conflict, and Leadership in Natural Resource Management (3 cr)
- NRES 3051—Experience and Training in a Field Setting (1-3 cr)
  or
  NRES 3205—Field Ecology in NRES (3 cr)
  or
  FR 2101, 2102, 2103—Forest Plants; Forest Ecology: Field Experience; and Forest Measurement Techniques (Itasca) (4 cr ea)
- NRES 3241—Natural Resource Policy and Administration (3 cr)
- NRES 3245—Recreation Policy and Landscape-level Planning (3 cr)
- NRES 3261—Economics and Natural Resources Management (3 cr)

**Additional Required Professional Courses**
At least 15 credits required from the following list. With adviser approval, up to 4 credits not included in the list below may be substituted.

- Agro 3203—Environment, Global Food Production and the Citizen (3 cr)
- ApEc 1102—Macroeconomics (3 cr)
  or
  Econ 1102—Macroeconomics (4 cr)
- ApEc 5611—Land and Water Economics (3 cr)
- CE 5591—Environmental Law for Engineers (3 cr)
- EEB 4601—Linnology (3 cr)
- FR 3251—Role of Renewable Natural Resources in Developing Countries (1 cr)
- FR 3601—Elements of Surveying (1 cr)
- FR 4131—GIS for Natural Resource Analysis (3 cr)
- FR 4232—Management of Recreational Lands (4 cr)
- FR 4262—Remote Sensing of Natural Resources (3 cr)
- FR 4461—Water Quality: The International Dimension (3 cr)
- FW 5411—Aquatic Toxicology (3 cr)
- FW 5455—Sustainable Aquaculture (3 cr)
- FW 5571—Avian Conservation and Management (3 cr)
- FW 5603—Habitats and Regulation of Wildlife (3 cr)
- FW 5604—Fisheries Ecology and Management (3 cr)
- FW 5621—GIS for Fisheries, Wildlife and Biological Conservation (3 cr)
- Geo 5108—Principles of Environmental Geology (3 cr)
- Geog 3361—Land Use, Landscapes, and the Law (3 cr)
- Hort 5071—Landscape and Reclamation Ecology (3 cr)
- LA 5204—Landscape Ecology (3 cr)
- NRES 3202—Planning and Leadership in Natural Resource Management (3 cr)
- NRES 3575—Wetlands Conservation (3 cr)
Natural Resources and Environmental Studies

Recreation Resource Management

Cloquet. State Park and located in Itasca research stations students at two of Natural Resources available to College experiences are Unique opportunities for hands-on learning experiences are available to College of Natural Resources students at two University field research stations located in Itasca State Park and Cloquet.

NRES 4101—Conservation of Plant Biodiversity (3 cr)
NRES 5703—Agroforestry: Role in Watershed Management
PA 5013—Law and Urban Land Use (3 cr)
PA 5212—Managing Urban Growth and Change (3 cr)
PA 5251—Strategic Planning and Management (1.5 cr)
PIPa 3002—Air Pollution, People and Plants: The Science and the Ethics (3 cr)
Pol 3441—Politics of Environmental Protection (3 cr)
Pol 3872—Global Environment Cooperation (3 cr)
Pol 4523—Politics of the Regulatory Process (3 cr)
Pol 5872—Global Environmental Politics (3 cr)
PubH 5200—Environmental Health (2 cr)
PubH 5173—Hazard-Related Exposure to Physical Agents in the Environment (4 cr)
Soil 3221—Soil Conservation and Land-Use Management (3 cr)
Soil 4021—Environmental Impact Statements (3 cr)
Soil 4511—Field Study of Soils (1 cr)
Soil 5601—Principles of Waste Management (3 cr)
Soil 4601—Soils and Pollution (3 cr)

For students interested in waste management, the following courses are highly recommended. Not all courses are available every year. For more information about solid waste management course offerings, consult with an adviser in the CNR Student Services Office.

SoW 6003—Legal, Regulatory, and Policy Framework of Solid Waste Management (3 cr)
SoW 6005—Applied Economics of Solid Waste (2 cr)
SoW 6007—Solid Waste Management Seminar (1 cr)

Water and Soil Resources Concentration

The water and soil resources concentration focuses on the management of water and soil resources to achieve a balance between management practices and resulting water or soil quality. The concentration emphasizes informed decision making; ecological approaches to water resource management; water movement, storage, and hydrologic cycles; prevention of soil erosion, land degradation, and resulting impacts on off-site resources.

Students must select one of three available tracks: the water quality track, the hydrology track, or the soil and water conservation track.

Water Quality Track in the Water and Soil Resources Concentration

Students completing the water quality track will be prepared for careers in national, state, and local government; consulting; or industry. They might begin their careers as a water quality technician in a watershed district or other governmental unit, or in a private organization.

Required Courses

General Education and Professional Course Requirements
Math 1142—Short Calculus (3 cr)
or
Math 1271—Calculus I (4 cr)
and
Math 1272—Calculus II (4 cr)
Chem 1021/1022—Chemical Principles I and II (4 cr ea)
Chem 2101—Introduction to Analytical Chemistry Lecture (3 cr)
and
Chem 2111—Introduction to Analytical Chemistry Lab (2 cr)
or
CE 4541—Environmental Water Chemistry (4 cr)
or
Phys 1011—Fundamental Physics (4 cr)
EEB 4601—Limnology (3 cr)
FR 4114—Forest Hydrology and Watershed Management (3 cr)
NRES 3061—Water Quality: Management of a Natural Resource (3 cr)
WRS 5001—Field Methods in Water Resources (3 cr)
WRS 5101—Water Resources: Individuals and Institutions (3 cr)
or
NRES 3241—Natural Resource Policy and Administration (3 cr)
In consultation with your adviser, select 12 credits from the following list:
AgEt 4223—Hydrology and Water Quality (3 cr)
EEB 4605—Limnology Laboratory (1 cr)
EEB 4607—Plankton Ecology (4 cr)
EEB 4609—Ecosystem Ecology (3 cr)
Ent 5361—Aquatic Insects (3 cr)
FR 4461—Water Quality: The International Dimension (3 cr)
FR 4131—GIS for Natural Resource Management (3 cr)
FR 5153—Forest and Wetland Hydrology (3 cr)
FW 5411—Aquatic Toxicology (3 cr)
FW 5604—Fisheries Ecology and Management (3 cr)
NRES 3261—Economics and Natural Resource Management (3 cr)
NRES 5002—Colloquium—Restoration of Aquatic Ecosystems (1 cr)
NRES 5575—Wetlands Conservation (3 cr)
Soil 5555—Wetland Soils (2 cr)

Hydrology Track in the Water and Soil Resources Concentration

Students completing the hydrology track are eligible for state and federal certification as hydrologists. They can serve as a hydrologist or water resource technician in a watershed district or other governmental unit, or in a private organization.

Required Courses

General Education and Professional Course Requirements
Chem 1021/1022—Chemical Principles I and II (4 cr ea)
or
Chem 1011—General Principles of Chemistry (4 cr)
and
BioC 1012—General Principles of Biochemistry (4 cr)
Math 1271/1272—Calculus I and II (4 cr ea)
Math 2243—Linear Algebra and Differential Equations (3 cr)
Physics 1101/1102—General Physics I and II (5 cr ea)
or
Physics 1101/1102—Fundamental Physics I and II (4 cr ea)
CE 3502—Fluid Mechanics (3 cr)
Geo 5701—General Hydrogeology
FR 4114—Forest Hydrology and Watershed Management (3 cr)
NRES 3061—Water Quality: Management of a Natural Resource (3 cr)
or
CE 4541—Environmental Water Chemistry (4 cr)
WRS 5001—Field Methods in Water Resources (3 cr)
WRS 5101—Water Resources: Individuals and Institutions (3 cr)
or
NRES 3241—Natural Resource Policy and Administration (3 cr)
Choose three of the following:
CE 4501—Hydrologic Design (4 cr)
CE 4512—Open Channel Hydraulics (3 cr)
FR 5153—Forest and Wetland Hydrology (3 cr)
Geo 4601—Limmology (3 cr)
Geo 4701—Geomorphology (3-4 cr)
Soil 5232—Soil Physics: Transport Properties and Processes (3 cr)
Soil 5555—Wetland Soils (2-3 cr)

Soil and Water Conservation Track in the Water and Soil Resources Concentration

Students completing the soil and water conservation track meet the requirements for certification as a soil conservationist with the USDA Natural Resource Conservation Service. They can serve as a soil and water conservationist in a watershed district or other governmental unit, or in a private organization.

Required Courses

General Education and Professional Course Requirements
Math 1142—Short Calculus (3 cr)
or
Math 1271—Calculus I (4 cr)
and
Math 1272—Calculus II (4 cr)
Chem 1021/1022—Chemical Principles I and II (4 cr ea)
Chem 2101—Introduction to Analytical Chemistry Lecture (3 cr)
and
Chem 2111—Introduction to Analytical Chemistry Lab (2 cr)
or
CE 4541—Environmental Water Chemistry (4 cr)
or
Phys 1011—Fundamental Physics (4 cr)
Ethics 4601—Limnology (3 cr)
FR 4114—Forest Hydrology and Watershed Management (3 cr)
NRES 3061—Water Quality: Management of a Natural Resource (3 cr)
WRS 5001—Field Methods in Water Resources (3 cr)
WRS 5101—Water Resources: Individuals and Institutions (3 cr)
or
NRES 3241—Natural Resource Policy and Administration (3 cr)
In consultation with your adviser, select 12 credits from the following list:
AgEt 4223—Hydrology and Water Quality (3 cr)
Recreation Resource Management

Department of Forest Resources

B.S.
The recreation resource management curriculum prepares students for careers in planning or managing the use of recreational land and water, and for graduate study. The curriculum emphasizes natural and managed nonurban areas; administration of natural resources-oriented recreation programs in public and private sectors; social science aspects of natural resources use; and skills in communication, planning, and management.

Graduates may become directly involved in recreation resource management and play specialized supporting roles in areas such as planning and public relations. Some find employment in fields such as environmental education and interpretation. Students pursuing graduate study may develop careers in teaching or research or seek advanced positions in recreation resource management and administration.

Degree Requirements
To complete the degree, students must complete 128 credits. Students must also complete the University’s liberal education requirements; see “Liberal Education” in the CNR general information section of this catalog.

Required Courses

Communication Skills (9-10 cr)
- Rhet 1101—Writing to Inform, Convince and Persuade (4 cr)
- or EngC 1013—University Writing and Critical Reading, Emphasis on the Environment (4 cr)
- Students who are exempt from Rhet 1101 or are in an honors program should elect to take Rhet 1152—Writing on Issues of Science and Technology (3 cr)
- Rhet 1223—Oral Presentations in Professional Settings (3 cr)
- or Spch 1101—Introduction to Public Speaking (3 cr)
- Rhet 3562—Technical and Professional Writing (3 cr)
- or EngC 3027—Advanced Expository Writing (4 cr)

Mathematical Thinking (7 cr)
- Math 1142—Short Calculus (3 cr)
- or Math 1271—Calculus I (4 cr)
- and Math 1272—Calculus II (4 cr)
- Stat 3011—Introduction to Statistical Analysis (4 cr)
- or Stat 5021—Statistical Analysis (4 cr)

Physical, Biological and Earth Sciences (19 cr)
- Biol 1009—General Biology (4 cr)
- Biol 2022—General Botany (3 cr)
- Chem 1011—General Principles of Chemistry (4 cr)
- or BioC 1012 General Principles of Biochemistry (3 cr)
- Geol 1001—The Dynamic Earth: An Introduction to Geology (4 cr)
- Soil 1125—The Soil Resource (4 cr)
- or Soil 2125—Basic Soil Science (4 cr)

Social Sciences and Humanities
History and Social Sciences (12-14 cr):
- ApEc 1101—Principles of Microeconomics (3 cr)
- ApEc 1102—Principles of Macroeconomics (3 cr)
- or NRES 3261—Economics and Natural Resources Management (3 cr)

Select one of the following four groups:
- Psy 1001—Introduction to Psychology (4 cr)
- or Psy 3201—Introduction to Social Psychology (4 cr)
- or Soc 1001—Introduction to Sociology (3 cr)
- and Soc 3711—Principles of Social Organization (3 cr)
- or Soc 1001—Introduction to Sociology (3 cr)
- and Soc 3411—Understanding Formal Organizations (3 cr)
- or Soc 1001—Introduction to Sociology (3 cr)
- and Soc 3721—Principles of Social Psychology (5 cr)

Humanities—One course in literature and LA 1401—The Designed Environment (3 cr) (total 7 cr)

Historical Perspective—At least one course of at least 3 credits. A course that fulfills the historical perspective requirements may also apply toward a designated theme.

Required Professional Courses

Introductory and General
- FR 1001—Orientation and Information Systems (1 cr)
- or NRES 1001—Orientation and Information Systems (1 cr)

Resource Assessment
- NRES 4211—Survey, Measurements and Modeling in Natural Resources (3 cr)
- FR 4131—GIS for Natural Resources Analysis (3 cr)

Management of Vegetation, Wildlife, Soil, and Water Resources
- FR 1101—Dendrology (3 cr)
- FR 3104—Forest Ecology (4 cr)
- or EEB 3001—Ecology and Society (3 cr)
- or Biol 3407—Ecology (3 cr)
- FR 4114—Forest Hydrology and Watershed Management (3 cr)
- or NRES 3061—Water Quality: Management of a Natural Resource (3 cr)
- NRES 3021—Plant Resource Management and the Environment (3 cr)
- or FR 4411—Silviculture Systems (3 cr)
- FW 2001—Introduction to Fisheries, Wildlife, and Conservation Biology (3 cr)
- or NRES 4101—Conservation of Plant Biodiversity (3 cr)

Policy, Management, and Planning
- FR 4232—Management of Recreational Lands (4 cr)
- NRES 3245—Recreation Policy and Landscape-level Planning (3 cr)
- FR 4259—Analysis of Outdoor Recreation Behavior (3 cr)
- NRES 3011—Ethics, Conflict and Leadership in Resource Management (3 cr)
- NRES 3202—Planning and Leadership in Natural Resource Management (3 cr)
- NRES 4195—Problem Solving in Natural Resources and Environmental Studies (4 cr)
- Rec 3551—Administration and Finance of Leisure Services (4 cr)
- or Rec 5191—Commercial Recreation and Tourism (3 cr)

Other Required Professional Courses
Choose one course from each of the three groups:

Social and Managerial Sciences
- ApEc 4311—Tourism Development Principles, Processes, Policies (3 cr)
- Anth 3041—Ecological Anthropology (3 cr)
- Geog 5724—The Meaning of Place (3 cr)
- Rhet 3266—Group Process, Team Building and Leadership (3 cr)
- Geog 3361—Land Use, Landscapes, and the Law (3 cr)
- NRES 3241—Natural Resource Policy and Administration (3 cr)

Recreation Programming and Management Services
- NRES 4811—Natural Resources Interpretation and Communication (3 cr)
- Rec 5301—Wilderness and Adventure Education (3 cr)
- Rec 5311—Programming Outdoor and Environmental Education (3 cr)
- Rec 5801—Legal Aspects of Sport and Recreation (3 cr)
Management of Vegetation, Soil, and Water Resources
LA 5204—Landscape Ecology (3 cr)
Hort 4021—Landscape Design, Implementation, and Management I (4 cr)
FR 4262—Remote Sensing of Natural Resources (3 cr)
FR 2101—Forest Plants (Itasca) (1 cr)
and FR 2102—Forest Ecology: Field Experience (Itasca) (2 cr)
and FR 2104—Forest Measurement Techniques (Itasca) (1 cr)
Free Electives (8-13 cr): Students should meet with their adviser when choosing these courses.

Urban Forestry

Department of Forest Resources
B.S.
The urban forestry curriculum prepares students for careers in planning and managing vegetation and natural resources in or near urban communities, and for direct involvement in resource management or for specialized supporting roles in areas such as urban planning and environmental education.

Urban forests include areas along streets and in parks, private lands, greenbelts, and open spaces. Urban foresters help communities plan, design, or protect urban and peri-urban forests; supervise tree selection and planting; and design insect control/disease protection and plant health care programs.

Principle employers for graduates in urban forestry include city governments, private tree care and arborcultural consulting companies, state and federal forestry agencies, nurseries, and utility companies.
Graduates may also be qualified for traditional forestry positions, including those in the federal government.

Degree Requirements
To complete the degree, students must complete 128 credits. Those students going into consulting or private business concentrate professional electives in the forest health and cultural practices of urban forestry. Students interested in managing the urban landscape will concentrate on electives in the management and administration areas.
Students must also complete the University’s liberal education requirements; see “Liberal Education” in the CNR general information section of this catalog.

Required Courses

Communication Skills
Rhet 1101—Writing to Inform, Convince, and Persuade (4 cr)
or EngC 1012—University Writing and Critical Reading, Emphasis on Cultural Diversity (4 cr)
or EngC 1014—University Writing and Critical Reading, Emphasis on Public Ethics (4 cr)
Rhet 1223—Oral Presentation in Professional Setting (3 cr)
or Spch 1101—Introduction to Public Speaking (3 cr)
Rhet 3562—Technical and Professional Writing (3 cr)
or EngC 3027—Advanced Expository Writing (4 cr)
Rhet 3266—Group Process, Team Building and Leadership (3 cr)

Mathematical Thinking
Math 1142—Short Calculus (3 cr)
or Math 1271—Calculus I (4 cr)
and Math 1272 Calculus II (4 cr)
Stat 3011—Introduction to Statistical Analysis (3 cr)
or Stat 5021—Statistical Analysis (4 cr)

Physical and Biological Sciences
Biol 1009—General Biology (4 cr)
Biol 2022—General Botany (3 cr)
Chem 1011—General Principles of Chemistry (4 cr)
and BioC 1012—General Principles of Biochemistry (3 cr)
or Chem 1021—Chemical Principles I (4 cr)
and Chem 1022—Chemical Principles II (4 cr)
Soil 1125—The Soil Resource (4 cr)
or Soil 2125—Basic Soil Science (4 cr)
or Phys 1101—Fundamental Physics I (4 cr)
or “B” or better in high school physics

Social Sciences and Humanities
Social science (6 cr)
ApEc 1101—Principles of Microeconomics (3 cr)
or Econ 1101—Principles of Microeconomics (4 cr)
Pol 1001—American Democracy in a Changing World (4 cr)
Humanities—at least 6 cr, including one course in literature and one course in “other humanities”

Historical Perspective—At least one course of at least 3 credits. A course that fulfills the historical perspectives requirement may also apply toward a designated theme.

Required Professional Core Courses

Introduction
FR 1001—Orientation and Information Systems (1 cr)

Resource Assessment
NRES 4211—Survey, Measurements and Modeling in Natural Resources (3 cr)
FR 4131—GIS for Natural Resources Analysis (3 cr)

Field Training in the Assessment and Biology of Forests
FR 2101—Forest Plants (1 cr, Itasca)
FR 2102—Forest Ecology Field Experience (2 cr, Itasca)
FR 2104—Forest Measurement Techniques (1 cr, Itasca)

Management of Vegetation, Wildlife, Soil, and Water Resources
FR 1101—Dendrology (3 cr)
or Hort—1012 Woody Plant Materials (3 cr)
FR 3104—Forest Ecology (4 cr)
FR 3501—Arboriculture (3 cr)
FR 4411—Silviculture Systems (3 cr)
FR 4114—Forest Hydrology and Watershed Management (3 cr)
or NRES—3061 Water Quality: Management of a Natural Resource (3 cr)
FR 4118—Tree Biology (2 cr)
FR 4501—Urban Forest Management (3 cr)
Ent 3001—Insects and Insect Management (1 cr)
and Ent 4251—Forest and Shade Tree Entomology (2 cr)
PPla 3005—Diseases of Forest and Shade Trees (3 cr)

Economics, Management, and Policy
FR 4232—Management of Recreational Lands (4 cr)
NRES 3241—Natural Resource Policy and Administration (3 cr)
NRES 3261—Economics and Natural Resources Management (3 cr)
UrbS 3001—Introduction to Urban Studies: The Complexity of Metropolitan Life (3 cr)

Additional Required Professional Courses
Select from the following groups with adviser approval; at least 9 cr must be taken from one of the groups:

Forest Health and Cultural Practices
FW 2001—Introduction to Fisheries, Wildlife, and Conservation Biology (3 cr)
FW 5603—Habitats and Regulation of Wildlife (3 cr)
Hort 1001—Plant Propagation (4 cr)
Hort 3005—Environmental Effects on Horticultural Crop (2 cr)
Hort 4021—Landscape Design, Implementation, and Management I (4 cr)
Hort 4041—Nursery Production and Management I (3 cr)
Soil 3416—Plant Nutrients in the Environment (3 cr)
WPS 1301—Wood as a Raw Material (3 cr)

Management and Administration
ApEc 5321—Regional Economic Analysis (3 cr)
Anth 3041—Ecological Anthropology (3 cr)
Geog 3371—Introduction to Urban Geography (3 cr)
FR 4262—Remote Sensing of Natural Resources (3 cr)
FR 4131—Geographic Information Systems in Natural Resource Analysis (3 cr)
LA 1401—The Designed Environment (3 cr)
Minor Requirements
The urban forestry minor (16 credits) enables students in programs such as education, landscape architecture, horticultural sciences, natural resources, and related areas to understand the science and practice underlying the management of urban and community forests. The minor incorporates fundamental science, arboriculture, forest health, and resource management coursework. Students interested in this minor should contact the CNR Student Services Office.

Minor Core (6 cr)
FR 3501—Forestarcture (3 cr)
or FR 4501—Urban Forest Management (3 cr)
PPla 3003—Diseases of Forest and Shade Trees (3 cr)
or Ent 3001—Insects and Insect Management (1 cr)
and Ent 4251—Forest and Shade Tree Entomology (2 cr)

Additional Required Courses
Select at least 10 credits from the following list:
FR 3104—Forest Ecology (4 cr)
or FR 2101—Forest Plants (Itasca) (1 cr)
and FR 2102—Forest Ecology: Field Experience (Itasca) (2 cr)
and FR 2104—Forest Management Techniques (Itasca) (1 cr)
FR 4118—Tree Biology (2 cr)
FR 4232—Management of Recreational Lands (4 cr)
Hort 1012—Woody Plant Materials (3 cr)
NRES 4211—Survey, Measurements, and Modeling in Natural Resources (3 cr)

Wood and Paper Science

Department of Wood and Paper Science

B.S.
The wood and paper science program is for students interested in careers in developing, producing, marketing, and using the many products that flow from forests: paper, wood-based panels, lumber, and furniture as well as chemicals from wood. Coursework emphasizes chemical, physical, and mechanical properties of wood and the newest technologies for converting raw material into products. Students choose from four areas of specialization described below.

Students must also complete the University’s liberal education requirements, including the diversified core and designated theme requirements. The environment and international perspectives themes are satisfied automatically in the forest products marketing specialization by completing the required courses. For more information, see “Liberal Education” in the CNR general information section of this catalog.

Forest Products Marketing Specialization
The marketing specialization is for students interested in the marketing, sales, and distribution of forest products. Technical emphasis is on the physical-mechanical nature of wood-based building materials, including lumber, plywood, fiberboard, particleboard, and a wide range of new and emerging composite products. Coursework focuses on marketing principles and analysis, management science, computer applications, and economics. Career opportunities include purchasing and selling of forest products at wholesale and retail levels, technical sales, product promotion, and specialized marketing research. For more information, contact Joe Massey, Head, Department of Wood and Paper Science at (612) 624-7459 or jmassey@forestry.umn.edu.

Degree Requirements
To complete the degree, students must complete 128 credits.

Required Courses

Communication Skills
Rhet 1101—Writing to Inform, Convince, and Persuade (4 cr)
or Rhet 1102—Writing on Issues of Science and Technology (4 cr)
or EngC 1011—University Writing and Critical Reading (4 cr)
or EngC 1012—University Writing and Critical Reading, Emphasis on Cultural Diversity (4 cr)
or EngC 1014—University Writing and Critical Reading, Emphasis on Public Ethics (4 cr)

Rhet 1223—Oral Presentation in Professional Setting (3 cr)
or Spch 1101—Introduction to Public Speaking (3 cr)
or Rhet 3562—Technical and Professional Writing (3 cr)
or EngC 3027—Advanced Expository Writing (4 cr)

Mathematical Thinking
Math 1142—Short Calculus (3 cr)
Stat 3011—Introduction to Statistical Analysis (4 cr)

Physical and Biological Sciences
Biol 1001—Introduction to Biology I: Evolutionary and Ecological Perspectives (4 cr)
or Biol 1009—General Biology (4 cr)
or Chem 1021/1022—Chemistry Principles I and II (4 cr ea)
or Chem 1011—General Principles of Chemistry (4 cr)
and BioC 1012—General Principles of Biochemistry (3 cr)

Phys 1101—Fundamental Physics I (4 cr)
Phys 1102—Fundamental Physics II (4 cr)

Social Sciences and Humanities
ApEc 1101—Principles of Microeconomics (3 cr)
or Econ 1101—Principles of Microeconomics (4 cr)
or ApEc 1102—Principles of Macroeconomics (3 cr)
or Econ 1102—Principles of Macroeconomics (4 cr)

Humanities—at least 6 cr, including one course in literature and one course in “other humanities.”

Historical Perspective—At least one course of at least 3 cr. A course fulfilling the historical perspectives requirement may also apply toward a designated theme requirement.

Wood and Paper Science

WPS 1001—Wood and Paper Science Professional Orientation (1 cr)
WPS 1301—Wood as a Raw Material (3 cr)
WPS 1303—Wood Structure and Identification (1 cr)
WPS 3301—Wood Industry Tours (1 cr)
WPS 3305—Fundamentals of Lumber Grading (1 cr)

WPS 3312—Building Materials Estimating (1 cr)
WPS 3332—Introduction to Residential Construction (2 cr)
WPS 4301—Statics and Engineering Mechanics (3 cr)
WPS 4303—Wood Deterioration and Preservation (3 cr)
WPS 4304—Wood Drying (2 cr)
WPS 4307—Wood-Base Panel Technology (3 cr)
WPS 4309—Wood-Fluid Relationships (2 cr)
WPS 4355—Mechanics and Structural Design with Wood Products (3 cr)
WPS 4401—Forest Products Marketing (4 cr)

Marketing/Business
Acct 2050—Introduction to Financial Reporting (4 cr)
Acct 3001—Introduction to Management Accounting (4 cr)
Fina 3001—Finance Fundamentals (2 cr)
BlLaw 3058—The Law of Contracts and Agency (4 cr)
Mgmt 3001—Fundamentals of Management (2 cr)
Mktg 3001—Principles of Marketing (2 cr)
Mktg 3010—Marketing Research (4 cr)
Mktg 4030—Selling and Sales Management (4 cr)
Wood and Paper Science

The College of Natural Resources has an 11 to 1 student-faculty ratio, ensuring personal attention from world-class instructors.

Additional Required Courses
NRES 1041—Natural Resources as Raw Materials (3 cr)
CSci 1101—Introduction to Computers and Problem Solving (3 cr)

Suggested Electives
Jour 1001—Introduction to Mass Communication (3 cr)
Jour 3201—Principles of Advertising (3 cr)
Mgmt 4002—Managerial Psychology (4 cr)
Mktg 4020—Advanced Logistics and Supply Chain Management (2 cr)
Mktg 4040—Buyer Behavior (4 cr)
Mktg 4050—Integrated Marketing Communications (4 cr)
Mktg 4060—Marketing and Distribution Channels (4 cr)
Mktg 4070—International Marketing (2 cr)

Special Learning Opportunities
Work experience in the form of summer jobs, internships, and formal work cooperatives are viewed as integral components of the student’s total education in the marketing specialization. Job opportunities are posted and companies with employment opportunities may schedule interview days in the department. All students enrolled in the specialization are encouraged to participate in this outside employment program. Course credit is given to participation in outside professional employment through enrollment in the department course, WPS 3396—Industrial Internship. Students should consult with their adviser for more information.

In addition to the above, the department course WPS 3301—Wood Industry Tours, consists of a systematic examination of industry facilities in the region. Conducted during spring break, the course takes the students off-campus to visit production facilities and meet with leaders in today’s wood and paper science profession.

Paper Science and Engineering Specialization
The paper science and engineering specialization provides in-depth training in the basic sciences and engineering in addition to wood and fiber science, pulp and paper and related sciences, and engineering involved in the manufacture, use and application of pulping and papermaking processes. Graduates find careers in process engineering, manufacturing operations, technical sales and services, marketing, plant management, corporate management, and research and development. For more information, contact Joe Massey, Head, Department of Wood and Paper Science at (612) 624-7459 or jmassey@forestry.umn.edu.

Degree Requirements
To complete the degree, students must complete at least 131 credits. Students must also complete the University’s liberal education requirements, see “Liberal Education” in the CNR general information section of this catalog.

Required Courses
Communication Skills
Rhet 1101—Writing to Inform, Convince, and Persuade (4 cr)
or
EnfC 1101—University Writing and Critical Reading (4 cr)
Rhet 3562—Technical and Professional Writing (3 cr)
or
EnfC 3027—Advanced Expository Writing (4 cr)

Mathematical Thinking
Math 1271—Calculus I (4 cr)
Math 1272—Calculus II (4 cr)
Math 2245—Linear Algebra and Differential Equations (4 cr)
Math 2263—Multivariable Calculus (4 cr)

Physical and Biological Sciences
Biol 1009—General Biology (4 cr)
Chem 1021—Chemical Principles I (4 cr)
Chem 1022—Chemical Principles II (4 cr)
Chem 2301—Organic Chemistry I (3 cr)
Chem 2302—Organic Chemistry II (3 cr)

Chem 2311—Organic Chemistry Lab (3 cr)
Chem 3501—Physical Chemistry I (3 cr)
Phys 1301—Introductory Physics I (4 cr)
Phys 1302—Introductory Physics II (4 cr)

Social Sciences and Humanities (15 cr)
ApEc 1101—Principles of Microeconomics (3 cr)
NRES 3241—Natural Resource Policy and Administration (3 cr)

Historical Perspective—At least one course in literature and one course in “other humanities.”

Basic Engineering
ChEn 4001—Material and Energy Balances (4 cr)
ME 3321—Thermodynamics (4 cr)
ME 3322—Heat Transfer and Fluid Flow (4 cr)
CE 4502—Water and Wastewater Treatment (3 cr)

Wood and Paper Science
WPS 1001—Wood and Paper Science Profession Orientation (1 cr)
WPS 1301—Wood as a Raw Material (3 cr)
WPS 3396—Industrial Internship (1 cr)
WPS 4301—Statics and Engineering Mechanics (3 cr)
WPS 4302—Wood Chemistry (3 cr)
WPS 4305—Pulp and Paper Technology (3 cr)
WPS 4306—Analysis of Production Systems (2 cr)
WPS 4313—Pulp and Paper Process Unit Operations (3 cr)
WPS 4314—Papermaking Processes and Engineering Lab (3 cr)
WPS 4318—Pulp and Paper Process Simulation and Control (3 cr)
WPS 4322—Biological and Environmental Science of Paper (2 cr)
WPS 4321—Material Science of Paper (3 cr)
WPS 4359—Surface, Colloids, and Coating Processes (4 cr)
WPS 4362—Pulping and Bleaching (3 cr)
WPS 4364—Process Engineering Design (2 cr)

Additional Required Courses
CSci 1107—Introduction to Fortran (3 cr)
or
CSci 1113—Introduction to C/C++ (4 cr)
Stat 5021—Statistical Analysis (4 cr)

Special Learning Opportunities
Work experience in the form of summer jobs, internships, and formal work cooperatives are viewed as integral components of the student’s total education in paper science and engineering. Companies with employment opportunities schedule interview days in the department. All students enrolled in the specialization are eligible to sign up for these interviews. Course credit is given to participation in outside professional employment through enrollment in the department course, WPS 3396—Industrial Internship. Students should consult with their adviser for more information.

In addition to the above, the department course WPS 3301—Wood Industry Tours, consists of a systematic examination of industry facilities in the region. Conducted during spring break, the course takes the students off-campus to visit production facilities and meet with leaders in today’s wood and paper science profession.

Minor Requirements
Students must complete 14 credits from the following:
WPS 4302—Wood Chemistry (3 cr)
WPS 4305—Pulp and Paper Technology (3 cr)
WPS 4313—Pulp and Paper Process Unit Operations (4 cr)
WPS 4314—Papermaking Processes and Process Engineering Laboratory (3 cr)
WPS 4321—Material Science of Paper (3 cr)
WPS 4322—Biological and Environmental Science of Paper (2 cr)
WPS 4359—Surface, Colloids, and Coating Processes (4 cr)
WPS 4362—Pulping and Bleaching (3 cr)
Forest Products Production Management Specialization

The production management specialization is for students interested in manufacturing, production management, product development, or industrial engineering careers in industries that manufacture lumber, panel products, millwork, furniture, or other wood products. In addition to a strong wood science background, students gain knowledge in industrial engineering, labor management, and economics. For more information, contact Joe Massey, Head, Department of Wood and Paper Science at (612) 624-7459 or jmassey@forestry.umn.edu.

Degree Requirements

To complete the degree, students must complete 128 credits. Students must also complete the University’s liberal education requirements, including the diversified core and designated theme requirements. The environment and international perspectives themes are satisfied automatically by completing required courses in the forest products production management specialization. For more information, see “Liberal Education” in the CNR general information section of this catalog.

Required Courses

Communication Skills
Rhet 1101—Writing to Inform, Convince, and Persuade (4 cr)
or Rhet 1102—Writing on Issues of Science and Technology (4 cr)
or EngC 1011—University Writing and Critical Reading (4 cr)
or EngC 1012—University Writing and Critical Reading Emphasis on Cultural Diversity (4 cr)
or EngC 1014—University Writing and Critical Reading, Emphasis on Public Ethics (4 cr)
Rhet 1233—Oral Presentation in Professional Setting (3 cr)
or Spch 1101—Introduction to Public Speaking (3 cr)
Rhet 3562—Technical and Professional Writing (3 cr)
or EngC 3027—Advanced Expository Writing (4 cr)

Mathematical Thinking
Math 1271—Calculus I (4 cr)
Math 1272—Calculus II (4 cr)
Stat 3021—Introduction to Probability and Statistics (3 cr)

Physical and Biological Sciences
Biol 1001—Introductory Biology I: Evolutionary and Ecological Perspectives (4 cr)
or Biol 1009—General Biology (4 cr)
Chem 1021/1022—Chemistry Principles I and II (4 cr ea)
or Chem 1011—General Principles of Chemistry (4 cr)
and BioC 1012—General Principles of Biochemistry (3 cr)
Phys 1101—Fundamental Physics I (4 cr)
Phys 1102—Fundamental Physics II (4 cr)

Social Sciences and Humanities
ApEc 1101—Principles of Microeconomics (3 cr)
or Econ 1101—Principles of Microeconomics (4 cr)
Psy 1001—Introduction to Psychology (4 cr)
Humanities—at least 6 cr, including one course in literature and one course in “other humanities.”

Historical Perspective—At least one course of at least 3 credits. A course fulfilling the historical perspectives requirement may also apply toward a designated theme requirement.

Wood and Paper Science
WPS 1001—Wood and Paper Science Profession Orientation (1 cr)
WPS 1301—Wood as a Raw Material (3 cr)
WPS 1303—Wood Structure and Identification (1 cr)
WPS 3301—Wood Industry Tours (1 cr)
WPS 3305—Fundamentals of Lumber Grading (1 cr)
WPS 4301—Statics and Engineering Mechanics (3 cr)
WPS 4303—Wood Deterioration and Preservation (3 cr)
WPS 4304—Wood Drying (2 cr)
WPS 4306—Analysis of Production Systems (2 cr)
WPS 4307—Wood-Base Panel Technology (3 cr)
WPS 4308—Wood Machining (2 cr)
WPS 4309—Wood-Fluid Relationships (2 cr)
WPS 4355—Mechanics and Structural Design with Wood Products (3 cr)
WPS 4401—Forest Products Marketing (4 cr)

Industrial Engineering/Operations Management
OMS 3001—Introduction to Operations Management (2 cr)
OMS 3056—Production and Inventory Management (4 cr)
IR 3021—Human Resource Management and Industrial Relations (2 cr)
IEOR 4521—Statistics, Quality, and Reliability (4 cr)
IEOR 5531—Engineering Optimization I (4 cr)
IEOR 5551—Production Planning and Control (4 cr)
IEOR 5552—Design and Analysis of Manufacturing Systems (4 cr)

Additional Required Courses
NRES 1041—Natural Resources as Raw Materials (3 cr)
CSci 1101—Introduction to Computers and Problem Solving (3 cr)

Suggested Electives
IEOR 3541—Project Management (4 cr)
IEOR 5553—Simulation of Manufacturing Systems (4 cr)
IR 3071—Collective Bargaining and Labor Relations (4 cr)
Acct 2050—Introduction to Financial Reporting (4 cr)
Mgmt 3001—Fundamentals of Management (2 cr)

Special Learning Opportunities

Work experience in the form of summer jobs, internships, and formal work cooperatives are viewed as integral components of the student’s total education in the production management specialization. Opportunities for outside employment are posted and students and strongly encouraged to consider participation. Course credit is given to participation in outside professional employment through enrollment in the department course, WPS 3396—Industrial Internship. Students should consult with their adviser for more information.

In addition to the above, the department course WPS 3301—Wood Industry Tours, consists of a systematic examination of industry facilities in the region. Conducted during spring break, the course takes the
Wood and Paper Science

students off-campus to visit production facilities and meet with leaders in today’s wood and paper science profession.

Residential Building Science and Technology Specialization

The residential building science and technology specialization is for students interested in the complex building science issues around the design, construction, and operation of residential buildings. It focuses on critical issues of building performance, including energy efficiency, building durability, and indoor air quality. The program emphasizes applied building science and provides a broad core of disciplines relating to wood-based materials. A complementary core comprises courses in business communication, management, and marketing. For more information, contact Joe Massey, Head, Department of Wood and Paper Science at (612) 624-7459 or jmassey@forestry.umn.edu.

Degree Requirements

To complete the degree, students must complete 128 credits. Students must also complete the University’s liberal education requirements, including the diversified core and designated theme requirements. The environment and international perspectives themes are satisfied automatically by completing required courses in the forest products residential building science and technology specialization. For more information, see “Liberal Education” in the CNR general information section of this catalog.

Required Courses

Communication Skills
Rhet 1101—Writing to Inform, Convince, and Persuade (4 cr)
or Rhet 1102—Writing on Issues of Science and Technology (4 cr)
or EngC 1011—University Writing and Critical Reading (4 cr)
or EngC 1012—University Writing and Critical Reading Emphasis on Cultural Diversity (4 cr)
or EngC 1014—University Writing and Critical Reading, Emphasis on Public Ethics (4 cr)
Rhet 1223—Oral Presentation in Professional Setting (3 cr)
or Spch 1101—Introduction to Public Speaking (3 cr)
or Rhet 3562—Technical and Professional Writing (3 cr)
or EngC 3027—Advanced Expository Writing (4 cr)

Mathematical Thinking
Math 1271—Calculus I (4 cr)
Math 1272—Calculus II (4 cr)
Stat 3021—Introduction to Probability and Statistics (3 cr)

Physical and Biological Sciences
Biol 1001—Introductory Biology I: Evolutionary and Ecological Perspectives (4 cr)
or Biol 1009—General Biology (4 cr)
Chem 1021/1022—Chemistry Principles I and II (4 cr ea)
or Chem 1011—General Principles of Chemistry (4 cr)
and BioC 1012—General Principles of Biochemistry (3 cr)
Phys 1101—Fundamentals of Physics I (4 cr)
Phys 1102—Fundamentals of Physics II (4 cr)

Social Sciences and Humanities
ApEc 1101—Principles of Microeconomics (3 cr)
or Econ 1101—Principles of Microeconomics (4 cr)
ApEc 1102—Principles of Macroeconomics (3 cr)
or Econ 1102—Principles of Macroeconomics (4 cr)
Psy 1001—Introduction to Psychology (4 cr)

Humanities—at least 6 cr, including one course in literature and one course in “other humanities.”
Arch 1401—The Designed Environment (3 cr)

Historical Perspective—At least one course of at least 3 cr. A course fulfilling the historical perspectives requirement may also apply toward a designated theme requirement.

Wood and Paper Science

WPS 1001—Wood and Paper Science Profession Orientation (1 cr)
WPS 1301—Wood as a Raw Material (3 cr)
WPS 3301—Wood Industry Tours (1 cr)
WPS 3312—Fundamentals of Lumber Grading (1 cr)
WPS 3331—Building Estimating (1 cr)
WPS 3332—Introduction to Residential Construction (2 cr)
WPS 4309—Wood-Fluid Relationships (2 cr)
WPS 4301—Statics and Engineering Mechanics (3 cr)
WPS 4307—Wood-Base Panel Technology (3 cr)
WPS 4355—Mechanics and Structural Design with Wood Products (3 cr)
WPS 4333—Systems Approach to Residential Construction (2 cr)
WPS 4334—Advanced Residential Building Science (3 cr)
WPS 4335—Building Testing and Diagnostics (2 cr)
WPS 4303—Wood Deterioration and Preservation (3 cr)

Supporting Courses

Arch 5501—Environment and Material Forces in Architecture (3 cr)
CE 3402—Introduction to Construction Materials (3 cr)
CE 4101—Project Management (3 cr)
DHA 2402—Residential Technology (3 cr)
DHA 2403—Housing and Community (3 cr)
IEOR 5531—Engineering Optimization I (4 cr)
IR 3021—Human Resource Management and Industry Relations (2 cr)
Mktg 3001—Principles of Marketing (2 cr)
OMS 3001—Introduction to Operations Management (2 cr)

Additional Required Courses

NRES 1041 Natural Resources as Raw Materials (3 cr)
CSci 1101—Introduction to Computers and Problem Solving (3 cr)

Suggested Electives

BLaw 3058—Law of Contracts and Agency (3 cr)
OMS 3059—Quality Management (4 cr)
PubH 5200—Topics in Environmental Health (2 cr)
WPS 4401—Forest Products Marketing (4 cr)

Special Learning Opportunities

Work experience in the form of summer jobs, internships, and formal work cooperatives are viewed as integral components of the student’s total education in the residential building science and technology specialization. Job opportunities in this specialization are posted and students are strongly encouraged to participate. Course credit is given to participation in outside professional employment through enrollment in the department course, WPS 3396—Industrial Internship. Students should consult with their adviser for more information.

In addition to the above, the department course WPS 3301—Wood Industry Tours, consists of a systematic examination of industry facilities in the region. Conducted during spring break, the course takes the students off-campus to visit production facilities and meet with leaders in today’s wood and paper science profession.