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 Kaufert Laboratory of Forest Products and Wood Science, Hodson Hall, and the Engineering and Fisheries Laboratory 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 Kaufert Laboratory. The Department of Fisheries and Wildlife office; Entomology, Fisheries, and Wildlife Library; labs; lecture rooms; and faculty facilities are in Hodson Hall and the Engineering and Fisheries Laboratory. Adjacent to college facilities is the regional headquarters of the USDA U.S. Forest Service Research Forest Experiment Station.

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 Kaufert Laboratory).

The CNR Student Services Office, 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, 135 Natural Resources Administration Building, 2003 Upper Buford Circle, St. Paul, MN 55018 (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.

\[
\text{AAR (ACT Aptitude Rating, for students who have taken the ACT):} \\
\text{HSR percentile + \((2 \times \text{ACT composite score})\) = 110} \\
\text{SAR (SAT Aptitude Rating, for students who have taken the SAT):} \\
\text{HSR percentile + \((\text{SAT verbal} \div 10 \times \text{SAT math} \div 10)\) = 171}
\]

Note: The AAR and SAR scores shown above were for fall 2000 admission. Students should call the Office of Admissions (612-625-2008) for the latest admission criteria.

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. Most students find they must transfer before their junior year to meet residence and upper division course requirements of CNR.

Credits earned through special examination or the College of Continuing Education 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:
- fisheries and wildlife (with specializations in fisheries, wildlife, and conservation biology);
- forest resources (with tracks in forest management and forest science);
- 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);
- recreation resource management;
- urban forestry; and
- 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, wildlife conservation, water resource science, or conservation biology, and the master of forestry (M.F.), are offered through the Graduate School in cooperation with CNR. For information, contact the appropriate director of graduate studies: 135 NRAB (612-624-6768) for forestry or 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 links 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 minors designed to enhance the major programs of not only CNR students, but also students whose major programs are unrelated to natural resources. The minors are fisheries and wildlife, forest resources, urban forestry, and paper science and engineering. Students may apply for a minor in any University department or program. 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 may participate in honors at both the lower division (freshman/sophomore) and upper division (junior/senior) level. At the lower division level, students participate in specially designed honors courses and honors colloquia focusing on current issues in their chosen field. 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. Upper division honors 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 3003H—Honors Colloquium. 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 cumulative GPA of at least 3.30, with at least 60 semester credits completed (After admission, students must achieve a GPA of at least 3.50 in their last 60 semester credits.)

Application Procedure for Upper Division Applicants—Students must complete an upper division honors application and include a faculty mentor’s letter of 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.
To be eligible for the CNR Dean’s List, a Dean’s List—
more information.

accepts CLEP scores at the 75th percentile or higher for obtained from the CNR Student Services Office. CNR of subject examinations for credit. Information may be humanities examinations prepared by the College College Level Examination Program (CLEP)—
Policies

Students also receive recognition during commencement.

College Level Examination Program (CLEP)—
Students may earn credit for the CLEP social science and College of

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 consider an alternative or substitution in an academic policy or curricular requirement, provided the basic spirit of the policy or requirement is maintained. A student may petition for a departure from normal procedure. Students must receive major adviser/departmental recommendation before the petition is routed to the Student Scholastic Standing Committee.

Repeating Courses—Students may repeat a course in which a grade of D+ or lower is earned. The most recent passing grade and credits count in the GPA and credit totals. 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.

Graduation With Distinction or With Honors—(See the Policies section of the catalog.)

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 may be 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 cumulative GPA of at least 2.00. Forest resources and urban forestry students must also have completed the following courses with a grade of at least C-: Biol 1009 or Biol 1001, Chem 1011 or Chem 1021, and precalculus or college algebra. Fisheries and wildlife students must have completed the following courses with a grade of at least C-: Biol 1009, Biol 2022, Biol 2012, and Biol 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 Biol 1009 or Biol 1001, and FR 3104 or Biol 3407. 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 cumulative GPA of at least 2.00, complete the Itasca Session, FR 4218, FR 4262, FR 4411, and FR 4431 and other prerequisites. This is a four and one-half 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 department 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 Kaufert Laboratory (612-624-7459).

Fisheries and Wildlife Field Trip—Fisheries and wildlife majors are eligible to participate in a field trip during 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. In addition, CNR offers a 3 credit class over winter break, NRES 3206—The Natural History of Costa Rica.
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 call 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 department faculty. A series of special employment seminars are provided by the Career Services Office on topics such as resume writing, interviewing, initiating internship job searches, and summer/seasonal intern hiring updates. Each major also requires for incoming students an orientation class 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, or campus level. Within each department, several committees (including curriculum committees) have student representatives. Students serve on CNR committees and on CNR’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. Finally, CNR student senators are elected to serve on the executive committee of the Minnesota Student Association and the Senate.

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, Xi Sigma Pi Honor Society, Water Resources Students in Action, and Student Society of Arboriculture.

Directory

(area code 612)

CNR Administration
Dean’s Office
235 Natural Resources Administration Building
624-1234

Student Services
135 Natural Resources Administration Building
624-6768

Career Services
135 Natural Resources Administration Building
624-6768

Admissions/Prospective Student Services
135 Natural Resources Administration Building
624-6768

Departments
Fisheries and Wildlife
200 Hodson Hall
624-3600

Forest Resources
115 Green Hall
624-3400

Natural Resources and Environmental Studies
135 Natural Resources Administration Building
624-6768

Wood and Paper Science
207 Kaufert Lab
625-5200

Cloquet Forestry Center
Cloquet, MN 55720
218-879-0850
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 on the following pages. 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**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>EngC 1013</td>
<td>University Writing and Critical Reading, Emphasis on Environment (4 cr)</td>
</tr>
<tr>
<td>or Rhet 1101</td>
<td>Writing to Inform, Convince, and Persuade (4 cr)</td>
</tr>
<tr>
<td>Rhet 1223</td>
<td>Oral Presentations in Professional Settings (3 cr)</td>
</tr>
<tr>
<td>or Spch 1101</td>
<td>Introduction to Public Speaking (3 cr)</td>
</tr>
<tr>
<td>Rhet 3562</td>
<td>Technical and Professional Writing (4 cr)</td>
</tr>
<tr>
<td>or EngC 3027</td>
<td>Advanced Expository Writing (4 cr)</td>
</tr>
</tbody>
</table>

**Mathematical Thinking**

<table>
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<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Math 1271</td>
<td>Calculus I (4 cr)</td>
</tr>
<tr>
<td>and Math 1272</td>
<td>Calculus II (4 cr)</td>
</tr>
<tr>
<td>or Math 1131</td>
<td>Finite Mathematics (3 cr)</td>
</tr>
<tr>
<td>and Math 1142</td>
<td>Short Calculus (4 cr)</td>
</tr>
<tr>
<td>FW 4001</td>
<td>Biometry (4 cr)</td>
</tr>
<tr>
<td>or Stat 5021</td>
<td>Statistical Analysis (4 cr)</td>
</tr>
</tbody>
</table>

**Physical, Chemical, and Biological Sciences**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biol 2012</td>
<td>General Zoology (4 cr)</td>
</tr>
<tr>
<td>Chem 1021</td>
<td>Chemical Principles I (4 cr)</td>
</tr>
<tr>
<td>Chem 1022</td>
<td>Chemical Principles II (4 cr)</td>
</tr>
<tr>
<td>GCB 3022</td>
<td>Genetics (3 cr)</td>
</tr>
<tr>
<td>or Biol 4003</td>
<td>Genetics (3 cr)</td>
</tr>
</tbody>
</table>

Select one of the following groups:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biol 1009</td>
<td>General Biology (4 cr)</td>
</tr>
<tr>
<td>and Biol 2022</td>
<td>General Botany (3 cr)</td>
</tr>
<tr>
<td>or Biol 1001</td>
<td>Intro Biol I: Evolutionary and Ecological Perspectives (4 cr)</td>
</tr>
<tr>
<td>and Biol 1002</td>
<td>Intro Biol II: Molecular, Cellular, and Developmental Perspectives (5 cr)</td>
</tr>
</tbody>
</table>

Select one of the following groups:

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Phys 1101</td>
<td>Fundamental Physics I (4 cr)</td>
</tr>
<tr>
<td>and Phys 1102</td>
<td>Fundamental Physics II (4 cr)</td>
</tr>
<tr>
<td>or Phys 1001</td>
<td>The Physical World—Energy and Its Impact on the Environment (4 cr)</td>
</tr>
<tr>
<td>and Geo 1001</td>
<td>The Dynamic Earth: Introduction to Geology (4 cr)</td>
</tr>
<tr>
<td>or Geo 1019</td>
<td>Our Changing Planet (4 cr)</td>
</tr>
<tr>
<td>or Ast 1001</td>
<td>Exploring the Universe (4 cr)</td>
</tr>
<tr>
<td>or Geog 1425</td>
<td>The Atmosphere (3 cr)</td>
</tr>
<tr>
<td>and Geog 1426</td>
<td>The Atmosphere Lab (1 cr)</td>
</tr>
<tr>
<td>or Phys 1201</td>
<td>General Physics I (5 cr)</td>
</tr>
<tr>
<td>and Phys 1202</td>
<td>General Physics II (5 cr)</td>
</tr>
</tbody>
</table>

**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**

<table>
<thead>
<tr>
<th>Course</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biol 3407</td>
<td>Ecology (3 cr)</td>
</tr>
<tr>
<td>FW 1001</td>
<td>Orientation in Fisheries, Wildlife, and Conservation Biology (1 cr)</td>
</tr>
<tr>
<td>FW 4701</td>
<td>Fisheries and Wildlife Problem Solving (2 cr)</td>
</tr>
<tr>
<td>or FW 4801H</td>
<td>Honors Research (2 cr)</td>
</tr>
<tr>
<td>and FW 4802H</td>
<td>Honors Research (2 cr)</td>
</tr>
<tr>
<td>and FW 4200H</td>
<td>Honors Seminar (1 cr)</td>
</tr>
<tr>
<td>NRES 3011W</td>
<td>Ethics, Conflict and Leadership in Resource Management (3 cr)</td>
</tr>
</tbody>
</table>
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 5003—Human Dimensions of Biological Conservation (3 cr)
- NRES 3202W—Social Change: Environmental Dispute Resolution, Leadership, and Collaborative Partnerships (3 cr)
- NRES 3241W—Natural Resources Policy and Administration (3 cr)

**Animals and Plants**

Select three of the following, including one plant and one animal course:

- EEB 4134—Introduction to Ornithology (4 cr)
- Ent 5021—Insect Taxonomy and Phylogeny (4 cr)
- Ent 5361—Aquatic Insects (3 cr)
- FR 1101—Dendrology (3 cr)
- FW 4129—Mammalogy (4 cr)
- FW 4136—Ichthyology (4 cr)
- PBio 4321—Taxonomy of Minnesota Flora (3 cr)
- PBio 4511—Plant Systematics (3 cr)

**Community and Ecosystem Ecology**

LA 5204—Landscape Ecology (3 cr)

Select one of the following:

- EEB 4014W—Ecology of Vegetation (3 cr)
- EEB 4016—Ecological Biogeography (3 cr)
- EEB 4601—Linnology (3 cr)
- EEB 4609W—Ecosystem Ecology (3 cr)
- EEB 5122—Plant Interactions with Animals and Microbes (4 cr)
- FR 5142—Tropical Forest Ecology (3 cr)

**Fisheries, Wildlife, and Conservation Biology**

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

Select one of the following:

- FW 5051—Analysis of Populations (3 cr)
- FW 5601—Fisheries Analysis (3 cr)
- FW 5603W—Habitats and Regulation of Wildlife (3 cr)
- FW 5604W—Fisheries Ecology and Management (3 cr)
- Any Itasca Summer Session field course (4 cr)
- FW 4106—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—Students should give strong consideration to courses on the list below or in any of the three areas of specialization (i.e., fisheries, wildlife, conservation biology).

- FR 4131—GIS in Natural Resource Analysis (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 (2 cr)
- NRES 3201W—Natural Resources Policy and Administration (3 cr)
- NRES 3575—Wetlands Conservation (3 cr)
- NRES 4211—Survey, Measurement, and Modeling in Natural Resources (3 cr)
- NRES 4811—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 5003—Human Dimensions of Biological Conservation (3 cr)
- NRES 3202W—Social Change: Environmental Dispute Resolution, Leadership, and Collaborative Partnerships (3 cr)
- NRES 3241W—Natural Resources Policy and Administration (3 cr)

**Animals and Plants**

- FW 4136—Ichthyology (4 cr)
- FW 4401W—Introduction to Fish Physiology and Behavior (4 cr)
- or Biot 3211—Animal Physiology (3 cr)
- or AnSc 2301—Systemic Physiology (4 cr)

Select one of the following:

- Ent 5021—Insect Taxonomy and Phylogeny (4 cr)
- Ent 5361—Aquatic Insects (3 cr)
- PBio 4321—Taxonomy of Minnesota Flora (3 cr)
- PBio 4511—Plant Systematics (3 cr)

**Community and Ecosystem Ecology**

EEB 4601—Linnology (3 cr)

Select one of the following:

- EEB 4607—Plankton Ecology (4 cr)
- EEB 4609W—Ecosystems Ecology (3 cr)
- EEB 5053—Ecology: Theory and Concepts (4 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 5603W—Habitats and Regulation of Wildlife (3 cr)
- or EEB 4134—Introduction to Ornithology (4 cr)
- or FW 4129—Mammalogy (4 cr)
- FW 5604W—Fisheries Ecology and Management (3 cr)

Select one of the following:

- Chem 2101—Introductory Analytical Chemistry Lecture (3 cr)
- and Chem 2111—Introductory Analytical Chemistry Lab (1 cr)
- or BioC 1012—General Principles of Biochemistry (3 cr)
- and Chem 2301—Organic Chemistry I (3 cr)
- or Chem 2301—Organic Chemistry I (3 cr)
- and Chem 2302—Organic Chemistry II (3 cr)
- or Prevét students must take the following:
- Chem 2301—Organic Chemistry I (3 cr)
- and Chem 2302—Organic Chemistry II (3 cr)
- and Chem 2311—Organic Chemistry Lab (3 cr)

Electives—Students should give strong consideration to courses on the list below or in any of the three areas of specialization (i.e., fisheries, wildlife, conservation biology).

- BioC 1012—General Principles of Biochemistry (3 cr)
- EEB 4621—Linnology Laboratory (1 cr)
- FR 4114—Forest Hydrology and Watershed Management (3 cr)
- 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)
Wildlife Specialization

The wildlife specialization is for students who wish to pursue careers in wildlife science, management, and administration; zoo biology; 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 5003—Human Dimensions of Biological Conservation (3 cr)
- NRES 3202W—Social Change: Environmental Dispute Resolution, Leadership, and Collaborative Partnerships (3 cr)
- NRES 3241W—Natural Resources Policy and Administration (3 cr)

**Animals and Plants**

- EEB 4134—Introduction to Ornithology (4 cr)
- FW 4129—Mammalogy (4 cr)
- FW 4401W—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 4601—Limmology (3 cr)
- EEB 4609W—Ecosystem Ecology (3 cr)
- EEB 5053—Ecology: Theory and Concepts (4 cr)
- FR 5142—Tropical Forest Ecology (3 cr)

Select one of the following:
- EEB 4014W—Ecology of Vegetation (3 cr)
- EEB 4016—Ecological Biogeography (3 cr)
- EEB 5122—Plant Interactions with Animals and Microbes (4 cr)
- LA 5204—Landscape Ecology (3 cr)

**Fisheries, Wildlife, and Conservation Biology**

- 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 5051—Analysis of Populations (3 cr)
- FW 5603W—Habitats and Regulation of Wildlife (3 cr)
- FW 5604W—Fisheries Ecology and Management (3 cr)

Select one of the following:
- EEB 4134—Introduction to Ornithology (4 cr)
- FW 4129—Mammalogy (4 cr)
- FW 4136—Ichthyology (4 cr)

Select one of the following:
- FW 4401W—Introduction to Fish Physiology and Behavior (4 cr)
- FW 5051—Analysis of Populations (3 cr)
- FW 5455—Sustainable Aquaculture (3 cr)
- FW 5571—Avian Conservation (3 cr)
- FW 5601—Fisheries Analysis (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 requirements 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.

- BioC 1012—General Principles of Biochemistry (3 cr)
- Chem 2301—Organic Chemistry I (3 cr)
- Chem 2302—Organic Chemistry II (3 cr)
- Phys 1101 and Phys 1102 (4 cr, 4 cr)
- or Phys 1201 and Phys 1202 (5 cr, 5 cr)
- or Biol 3301—Biology of Microorganisms (5 cr)
Forest Resources

Department of 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 aesthetic resources. Students select between two tracks: forest management and forest science. Students taking the forest management track receive more training in principles and techniques of resource management; students 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 as possible in their college careers.

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)
Rhet 1223—Oral Presentation in a Professional Settings (3 cr)
or Spch 1101—Introduction to Public Speaking (3 cr)
Rhet 3562—Technical and Professional Writing (4 cr)
or EngC 3027—Adventurous Expository Writing (4 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)
or Soil 1125—The Soil Resource (4 cr)

Social Sciences and Humanities (15 cr)
ApEc 1101—Principles of Microeconomics (3 cr)
or Econ 1101—Principles of Microeconomics (4 cr)
NRES 3261W—Economics and Natural Resource Management (3 cr)
Humansities—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 4218—Assessment and Modeling of Forests (3 cr)
FR 4262—Remote Sensing of Natural Resources (3 cr)

Managing Plant, Animal, Soil, and Water Resources:
Ent 3001—Insects and Insect Management (1 cr)
or Ent 4251—Forest and Shade Tree Entomology (2 cr)
or PL 3003—Diseases of Forest and Shade Trees (3 cr)
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)
FW 2001—Introduction to Fisheries, Wildlife, and Conservation Biology (3 cr)
(or FW 5603W—Habitats and Regulation of Wildlife (3 cr)
(recommended for juniors or seniors)

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

Economics, Management, Policy and Planning:
FR 4471—Forest Management and Planning (3 cr)
NRES 3214W—Natural Resource Policy and Administration (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. The track contains a forest harvesting option that involves a year of study at the University of Idaho.

Required Courses

Mathematics and Chemistry
Chem 1011—General Principles of Chemistry (4 cr)
or Chem 1021—Chemical Principles I (4 cr)
and Chem 1022—Chemical Principles II (4 cr)
Math 1142—Short Calculus (4 cr)

Forest Management Professional Courses
FR 4232W—Management of Recreational Lands (4 cr)
FR 4431—Timber Harvesting and Road Planning (1 cr)
NRES 3202W—Social Change: Environmental Dispute Resolution, Leadership, and Collaborative Partnerships (3 cr)
or NRES 3011W—Ethics, Conflict, and Leadership in Resource Management (3 cr)

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

Enrichment Courses
Students select, with adviser approval, 10 additional credits in professional courses, which are grouped below by subject matter. At least 7 of the credits must be 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 used to satisfy other requirements may not be used to fill the 10-credit enrichment requirement.

Managing Plant, Animal, Soil, and Water Resources
Ent 3001—Insects and Insect Management (1 cr)
or 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 5603W—Habitats and Regulation of Wildlife (3 cr)
FW 5604W—Fisheries Ecology and Management (3 cr)
Geo 1001—The Dynamic Earth: An Introduction to Geology (4 cr)
NRES 3061W—Water Quality: Management of a Natural Resource (3 cr)
Pipa 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 3202W—Social Change: Environmental Dispute Resolution, Leadership, and Collaborative Partnerships (3 cr)
or
NRES 3011W—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. It 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, or 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 the option must consult Professor Charlie Blinn.

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

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

Courses Omitted from 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)
FR 4232—Management of Recreational Lands (4 cr)
FR 4471—Forest Management and Planning (3 cr)
NRES 3202W—Social Change: Environmental Dispute Resolution, Leadership, and Collaborative Partnerships (3 cr)
or
NRES 3011W—Ethics, Conflict, and Leadership in Resource Management (3 cr)
Pipa 3003—Diseases of Forest and Shade Trees (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 Courses
Mathematics and Chemistry
Chem 1021—Chemical Principles I (4 cr)
Chem 1022—Chemical Principles II (4 cr)
Math 1271—Calculus I (4 cr)
Math 1272—Calculus II (4 cr)

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

Minor Requirements
The forest resources minor (17 credits) 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
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 group:
FR 4232W—Management of Recreational Lands (3 cr)
FR 4471—Forest Management and Planning (3 cr)
FR 4501—Urban Forest Management (3 cr)
NRES 3241W—Natural Resource Policy and Administration (3 cr)
NRES 3261W—Economics and Natural Resource Management (3 cr)

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

Biology and Management of Vegetation, Wildlife, Water, and Soil Resources
Ent 3001—Insects and Insect Management (1 cr)
and Ent 4251—Forest and Shade Tree Entomology (2 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)
FR 3501—Arboriculture (3 cr)
FR 4114—Forest Hydrology and Watershed Management (3 cr)
FR 4351—Timber Harvesting and Road Planning (1 cr)
FR 5142—Tropical Forest Ecology (3 cr)
NRES 4703—Agroforestry: Role in Watershed Management (3 cr)
Pipa 3003—Diseases of Forest and Shade Trees (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 enrolled in this major 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 below. 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 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)
Rhet 3562—Technical and Professional Writing (4 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)
or Soil 1125—The Soil Resource (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 1101—Principles of Microeconomics (4 cr)
To fulfill the other social science requirement, consider completing
NRES 3261W—Economics and Natural Resource Management
or NRES 3241W—Natural Resource Policy and Administration
or NRES 3001—Orientation and Information Systems (1 cr)
NRES 1201—Conservation of Natural Resources (3 cr)
NRES 3000 or NRES 3001 or NRES 3002 or NRES 5001—Colloquium (choose one) (1-2 cr)
NRES 3021—Plant Resource Management and the Environment (3 cr)
or FR 4411—Silviculture Systems (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 3061W—Water Quality: Management of a Natural Resource (3 cr)
or FR 4114—Forest Hydrology and Watershed Management (3 cr)**
NRES 4195W—Problem Solving in Natural Resources and Environmental Studies (4 cr)
or NRES 4295W—GIS for Problem Solving in Environmental Science and Management (4 cr)
NRES 4211—Survey, Measurement, and Modeling in Natural Resources (3 cr)
*Water and Soil Resources-Water Quality Track, and Hydrology Track must complete WRS 5001—Introduction to Field Research in Water Resources.
**Both NRES 3061W and FR 4114 are required in the Water and Soil Resources-Water Quality Track.

Environmental Assessment and Monitoring Concentration
The environmental assessment and monitoring concentration focuses on 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 Courses
Chem 1021—Chemistry Principles I (4 cr)
and Chem 1022—Chemistry Principles II (4 cr)
or Chem 1011—General Principles of Chemistry (4 cr)
and BioC 1012—General Principles of Biochemistry (3 cr)
FR 2101, FR 2102, FR 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)
and FR 1101—Dendrology (3 cr)
or EEB 4014W—Ecology of Vegetation (3 cr)
or PBio 4321—Taxonomy of Minnesota Flora (3 cr)
FR 4131—Geographical Information Systems for Natural Resource Analysis (3 cr)
FR 4262—Remote Sensing of Natural Resources (3 cr)
Math 1124—Short Calculus (4 cr)
or Math 1271—Calculus I (4 cr)
and Math 1272—Calculus II (4 cr)
NRES 4295W—GIS for Problem Solving in Environmental Science and Management (4 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 informal settings.

Required Courses

General Education and Professional Courses

- Chem 1011—General Principles of Chemistry (4 cr)
- BioC 1012—General Principles of Biochemistry (3 cr)
- FR 5403—Fundamentals of Natural Resource Education (2 cr)
- Math 1142—Short Calculus (4 cr)
- Math 1271—Calculus I (4 cr)
- Math 1272—Calculus II (4 cr)
- NRES 1041W—Natural Resources as Raw Materials (3 cr)
- NRES 3241W—Natural Resource Policy and Administration (3 cr)
- NRES 3241W—Natural Resource Policy and Administration (3 cr)
- NRES 3245—Recreation Policy and Landscape-level Planning (3 cr)
- NRES 4811—Natural Resources Interpretation (3 cr)
- Phys 1001—The Physical World—Energy and Its Impact on the Environment (4 cr)
- ApEc 4611—Resource Development and Environmental Economics (3 cr)
- CI 5140—Reflective Teaching and Professional Ethics (3 cr)
- CI 5502—Special Topics: Outdoor Science Education (1-8 cr)
- CI 5533—Studies in Science Education (4 cr)
- CI 5537—Special Topics: Science Education (1-8 cr)
- CI 5747—Global and Environmental Education: Content and Practice (3 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)
- 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 3261W—Economics and Natural Resource Management (3 cr)
- NRES 3575—Wetlands Conservation (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)
- 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. Emphasis is 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 must select a subspecialty, either in planning or in policy and law.
Required Courses

General Education and Professional Courses
Chem 1011—General Principles of Chemistry (4 cr)
or BioC 1012—General Principles of Biochemistry (3 cr)
Math 1142—Short Calculus (4 cr)
or Math 1271—Calculus I (4 cr)
and Math 1272—Calculus II (4 cr)
NRES 1041W—Natural Resources as Raw Materials (3 cr)
or NRES 3011W—Ethics, Conflict, and Leadership in Natural Resource Management (3 cr)
or NRES 3202W—Social Change: Environmental Dispute Resolution, Leadership, and Collaborative Partnerships (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, FR 2102, FR 2104—Forest Plants; Forest Ecology; Field Experience; and Forest Measurement Techniques (Istaca) (4 cr)
Pol 1001—American Democracy in a Changing World (4 cr)

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

Required Courses

Additional Professional Courses
FR 1101—Dendrology (3 cr)
FR 4232W—Management of Recreational Lands (4 cr)
FR 4259—Analysis of Outdoor Recreation Behavior (3 cr)
FR 4262—Remote Sensing for Natural Resources (3 cr)
FR 5146—Dynamics of Global Change (3 cr)
Geog 3361—Land Use, Landscapes and the Law (3 cr)
Geog 5724—Meanings of Place (3 cr)
PA 5012—The Politics of Public Affairs (3 cr)
Pol 3441—Politics of Environmental Protection (3 cr)
Pol 3872—Global Environmental Cooperation (3 cr)
Pol 4483—Grassroots Politics (3 cr)

Resource Conservation and Environmental Management Concentration

This 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 level.

Required Courses

General Education and Professional Courses
Biol 2012—General Zoology (4 cr)
Biol 2022—General Botany (3 cr)
or 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)
Math 1142—Short Calculus (4 cr)
or Math 1271—Calculus I (4 cr)
and Math 1272—Calculus II (4 cr)
NRES 1041W—Natural Resources as Raw Materials (3 cr)
NRES 3011W—Ethics, Conflict, and Leadership in Natural Resource Management (3 cr)
NRES 3205—Field Ecology in NRES (4 cr)
or FR 2101, FR 2102, FR 2104—Forest Plants; Forest Ecology; Field Experience; and Forest Measurement Techniques (Istaca) (4 cr)
or FR 4259—Analysis of Outdoor Recreation Behavior (3 cr)
or FR 4262—Remote Sensing for Natural Resources (3 cr)
FR 4232W—Management of Recreational Lands (4 cr)
FR 4259—Analysis of Outdoor Recreation Behavior (3 cr)
FR 4262—Remote Sensing for Natural Resources (3 cr)
FR 5146—Dynamics of Global Change (3 cr)
Geog 3361—Land Use, Landscapes and the Law (3 cr)
Geog 5724—Meanings of Place (3 cr)
PA 5012—The Politics of Public Affairs (3 cr)
Pol 3441—Politics of Environmental Protection (3 cr)
Pol 3872—Global Environmental Cooperation (3 cr)
Pol 4483—Grassroots Politics (3 cr)

Degree Programs

College of Natural Resources

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

**Water and Soil Resources Concentration**

This concentration focuses on the management of water and soil resources to achieve a balance between management practices and resulting water or soil quality. The emphasis is on 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**

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 Courses**

- **Chem 1021/1022—Chemical Principles I and II (4 cr ea)**
- **Chem 2101—Introduction to Analytical Chemistry**
- **Chem 2111—Introduction to Analytical Chemistry Lab**
- **CE 4541—Environmental Water Chemistry**
- **CE 4601—Linnology**
- **FR 4141—Forest Hydrology and Watershed Management**
- **Math 1142—Short Calculus**
- **Math 1271—Calculus I (4 cr)**
- **Math 1272—Calculus II (4 cr)**
- **NRES 3061W—Water Quality: Management of a Natural Resource**
- **Phys 1011—The Physical World—Energy and Its Impact on the Environment**
- **Phys 1011—Fundamental Physics**
- **WRS 5001—Introduction to Field Research in Water Resources**
- **WRS 5101—Water Resources: Individuals and Institutions**
- **WRS 3241—Natural Resource Policy and Administration**

In consultation with your adviser, select 12 credits from the following list:

- **EEB 4605—Linnology Laboratory**
- **EEB 4607—Plankton Ecology**
- **EEB 4609W—Ecosystem Ecology**
- **Ent 5361—Aquatic Insects**
- **FR 4131—GIS for Natural Resource Management**
- **FR 4461—Water Quality: The International Dimension**
- **FR 5153—Forest and Wetland Hydrology**
- **FW 5411—Aquatic Toxicology**
- **FW 5604W—Fisheries Ecology and Management**
- **NRES 3241—Natural Resource Policy and Administration**

**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 Courses**

- **CE 3502—Fluid Mechanics**
- **Chem 1021/1022—Chemical Principles I and II (4 cr ea)**
- **Chem 1011—General Principles of Chemistry**
- **Chem 1011—General Principles of Biochemistry (4 cr)**
- **FR 4141—Forest Hydrology and Watershed Management**
- **Geo 5701—General Hydrogeology**
- **Math 1271/1272—Calculus I and II (4 cr ea)**
- **Math 2243—Linear Algebra and Differential Equations**
- **NRES 3061W—Water Quality: Management of a Natural Resource**
- **NRES 4101—Conservation of Plant Biodiversity (4 cr)**
- **Phys 1201/1202—General Physics I and II (5 cr ea)**
- **Phys 1101/1102—Fundamental Physics I and II (4 cr ea)**
- **WRS 5001—Introduction to Field Research in Water Resources**

**WRS 5101—Water Resources: Individuals and Institutions**

**NRES 3241—Natural Resource Policy and Administration**

**WRS 5001—Introduction to Field Research in Water Resources**

**Geo 2004—Water and Society**

Choose three of the following:

- **CE 4501—Hydrologic Design**
- **CE 4512—Open Channel Hydraulics**
- **FR 5153—Forest and Wetland Hydrology**
- **Geo 4601—Linnology**
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 non-urban 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

Communications Skills
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 taking freshman composition must 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 (4 cr)
or
EngC 3027—Advanced Expository Writing (4 cr)

Mathematical Thinking
Math 1142—Short Calculus (4 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

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 (4 cr)

Geo 1001—The Dynamic Earth: An Introduction to Geology (4 cr)
Geo 1002—Geologic and Geographical Surveys (3 cr)

or
“B” or better in high school physics

Soil 1125—The Soil Resource (4 cr)
Soil 2125—Basic Soil Science (4 cr)

Social Sciences and Humanities

ApEc 1101—Principles of Microeconomics (3 cr)
ApEc 1102—Principles of Macroeconomics (3 cr)
or
NRES 3261W—Economics and Natural Resources Management (3 cr)

Select one of the following four groups:

Psychology—One course in literature and one course in “other humanities” (at least 6 cr)

Psych 1001—Introduction to Psychology (4 cr)
or
Psych 3201—Introduction to Social Psychology (4 cr)
or
Soc 1001—Introduction to Sociology (3 cr)
or
Soc 1002—An Introduction to Sociology (3 cr)
or
Soc 3711—Principles of Social Organization (3 cr)
or
Soc 3701—Introduction to Sociology (3 cr)
or
Soc 3411—Understanding Formal Organizations (3 cr)
or
Soc 3101—Introduction to Sociology (3 cr)
or
Soc 3721—Principles of Social Psychology (3 cr)

Humanities—one course in literature and one course in “other humanities” (at least 6 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.

Professional Courses

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

Resource Assessment
FR 4131—GIS for Natural Resources Analysis (3 cr)
LA 3501—Environmental Design and Its Biological and Physical Context (3 cr)

NRES 4211—Survey, Measurements and Modeling in Natural Resources (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 4144—Forest Hydrology and Watershed Management (3 cr)
or
NRES 3061W—Water Quality: Management of a Natural Resource (3 cr)

FW 2001—Introduction to Fisheries, Wildlife, and Conservation Biology (3 cr)
or
NRES 4101—Conservation of Plant Biodiversity (3 cr)

NRES 3021—Plant Resource Management and the Environment (3 cr)
or
FR 4411—Silviculture Systems (3 cr)

Required Courses

General Education and Professional Courses
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)
FR 4144—Forest Hydrology and Watershed Management (3 cr)
or
NRES 3061W—Water Quality: Management of a Natural Resource (3 cr)
FR 4131—Geographic Information Systems for Natural Resource Analysis (3 cr)
FR 4262—Remote Sensing in Natural Resources (3 cr)
Math 1142—Short Calculus (4 cr)
or
Math 1271—Calculus I (4 cr)
and Math 1272—Calculus II (4 cr)
NRES 3261W—Economics and Natural Resource Economics (3 cr)
or
“B” or better in high school physics
Soil 3221—Soil Conservation and Land Use Management (3 cr)
Soil 3416—Plant Nutrients in the Environment (3 cr)
or
Soil 3612—Soil and Environmental Biology (3 cr)
Soil 4511—Field Soils (3 cr)
Soil 5555—Wetland Soils (3 cr)
WRS 5001—Introduction to Field Research in Water Resources (Itasca) (2 cr)
or
NRES 3051—Experience and Training in a Field Setting (1-3 cr)
or
NRES 3205—Field Ecology in NRES (4 cr)
WRS 3101—Water Resources: Individuals and Institutions (3 cr)
or
NRES 3241W—Natural Resource Policy and Administration (3 cr)
Policy, Management, and Planning
FR 4232W—Management of Recreational Lands (4 cr)
FR 4259—Analysis of Outdoor Recreation Behavior (3 cr)
NRES 3011W—Ethics, Conflict and Leadership in Resource Management (3 cr)
NRES 3202W—Social Change: Environmental Dispute Resolution, Leadership, and Collaborative Partnerships (3 cr)
NRES 3245—Recreation Policy and Landscape-level Planning (3 cr)
NRES 419SW—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
Anth 3041—Ecological Anthropology (3 cr)
ApEc 4311—Tourism Development Principles, Processes, Policies (3 cr)
Geog 3361—Land Use, Landscapes, and the Law (3 cr)
Geog 5724—The Meaning of Place (3 cr)
NRES 3241W—Natural Resource Policy and Administration (3 cr)
Rhet 3266—Group Process, Team Building, and Leadership (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
FR 2101—Forest Plants (Itasca) (1 cr) and FR 2104—Forest Measurement Techniques (Itasca) (1 cr) and FR 2102—Forest Ecology—Field Experience (Itasca) (2 cr)
FR 4262—Remote Sensing of Natural Resources (3 cr)
Hort 5071—Restoration and Reclamation Ecology (3 cr)
LA 5204—Landscape Ecology (3 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 arboricultural 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 3266—Group Process, Team Building and Leadership (3 cr)
Rhet 3562—Technical and Professional Writing (4 cr) or EngC 3027—Advanced Expository Writing (4 cr)

Mathematical Thinking
Math 1142—Short Calculus (4 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)

B.S.

Math 1142—Short Calculus (4 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)

or Phys 1101—Fundamental Physics I (4 cr) and "B" or better in high school physics
Soil 2125—Basic Soil Science (4 cr) or Soil 1125—The Soil Resource (4 cr)

Social Sciences and Humanities
Anth 3041—Ecological Anthropology (3 cr) or Econ 1101—Principles of Microeconomics (4 cr)
Pol 1001—American Democracy in a Changing World (4 cr)

History—(at least 6 cr, including one course in literature and one course in “other humanities”)

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 arboricultural 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 3266—Group Process, Team Building and Leadership (3 cr)
Rhet 3562—Technical and Professional Writing (4 cr) or EngC 3027—Advanced Expository Writing (4 cr)

Mathematical Thinking
Math 1142—Short Calculus (4 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)

or Phys 1101—Fundamental Physics I (4 cr) and "B" or better in high school physics
Soil 2125—Basic Soil Science (4 cr) or Soil 1125—The Soil Resource (4 cr)

Social Sciences and Humanities
Anth 3041—Ecological Anthropology (3 cr)
or Econ 1101—Principles of Microeconomics (4 cr)
Pol 1001—American Democracy in a Changing World (4 cr)

History—(at least 6 cr, including one course in literature and one course in “other humanities”)

The College of Natural Resources
has an 11 to 1 student-faculty ratio, ensuring personal attention from world-class instructors.
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 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 (4 cr)
or EngC 3027—Advanced Expository Writing (4 cr)

Mathematical Thinking

Math 1142—Short Calculus (4 cr)
or Math 2391—Calculus I (4 cr)
or Math 2392—Calculus II (4 cr)
Stat 3011—Introduction to Statistical Analysis (4 cr)
or Stat 4092—Linear Models and Statistical Computing (4 cr)
or Math 4082—Probability and Mathematical Statistics (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)
Chem 1021/1022—Chemistry Principles I and II (4 cr ea)
or Chem 1011—General Principles of Chemistry (4 cr)
or BioC 1012—General Principles of Biochemistry (3 cr)
Phys 1101—Fundamental Physics I (4 cr)
or 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 Econ 1102—Principles of Macroeconomics (3 cr)
or Econ 1102—Principles of Macroeconomics (4 cr)
All paper science and engineering graduates in the class of ‘98 had an average starting salary of $46,500.

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 3305—Fundamentals of Lumber Grading (1 cr)
WPS 3312—Building Materials Estimating (1 cr)
WPS 3332—Introduction to Residential Construction (2 cr)
WPS 4201—Wood Industry Tours (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 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 4401W—Forest Products Marketing (4 cr)

**Marketing/Business**

Acct 2050—Introduction to Financial Reporting (4 cr)
Acct 3001—Introduction to Management Accounting (4 cr)
BLaw 3058—The Law of Contracts and Agency (4 cr)
Fin 3001—Finance Fundamentals (2 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)

**Additional Required Courses**

Chem 1021—Chemical Principles I (4 cr)
Chem 1022—Chemical Principles II (4 cr)
Biol 1009—General Biology (4 cr)

**Suggested Electives**

EngC 1011—University Writing and Critical Reading (4 cr)
or Rhet 1101—Writing to Inform, Convince, and Persuade (4 cr)

**Communication Skills**

Rhet 1101—Writing to Inform, Convince, and Persuade (4 cr)
or EngC 1011—University Writing and Critical Reading (4 cr)
Rhet 3562—Technical and Professional Writing (4 cr)
or EngC 3096—Advanced Expository Writing (4 cr)

**Mathematical Thinking**

Math 1271—Calculus I (4 cr)
Math 1272—Calculus II (4 cr)
Math 2243—Linear Algebra and Differential Equations (4 cr)
Math 2203—Multivariable Calculus (4 cr)

**Physical and Biological Sciences**

Chem 1021—Chemical Principles I (4 cr)
Chem 1022—Chemical Principles II (4 cr)

**Special Learning Opportunities**

Work experiences in summer jobs, internships, and formal work cooperatives are 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, systematically examines industry facilities in the region. Conducted during spring break, the course takes 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 132 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 EngC 1011—University Writing and Critical Reading (4 cr)
Rhet 3562—Technical and Professional Writing (4 cr)
or EngC 3096—Advanced Expository Writing (4 cr)

Mathematical Thinking

Math 1271—Calculus I (4 cr)
Math 1272—Calculus II (4 cr)
Math 2243—Linear Algebra and Differential Equations (4 cr)
Math 2203—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 3241W—Natural Resource Policy and Administration (3 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.

Basic Engineering

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

or AEM 2021—Statistics and Dynamics (4 cr)

WPS 4302—Wood Chemistry (3 cr)

WPS 4305W—Pulp and Paper Technology (3 cr)

WPS 4306—Analysis of Production Systems (2 cr)

WPS 4312—Material Science of Paper (3 cr)

WPS 4359—Surface, Colloids, and Coating Processes (4 cr)

WPS 4362W—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 experiences in summer jobs, internships, and formal work cooperatives are 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 for 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 systematically examines industry facilities in the region. Conducted during spring break, the course takes students off-campus to visit production facilities and meet with leaders in today’s wood and paper science profession.

**Minor Requirements**

Complete 14 credits from the following:

WPS 4302—Wood Chemistry (3 cr)

WPS 4305W—Pulp and Paper Technology (3 cr)

WPS 4313—Pulp and Paper Unit Operations (4 cr)

WPS 4314—Pulping 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 4362W—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 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)

Rhet 3562—Technical and Professional Writing (4 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 3305—Fundamentals of Lumber Grading (1 cr)

WPS 4201—Wood Industry Tours (1 cr)

WPS 4301—Statics and Engineering Mechanics (3 cr)

WPS 4302—Wood Chemistry (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 4401W—Forest Products Marketing (4 cr)

**Industrial Engineering/Operations Management**

IE 4521—Statistics, Quality, and Reliability (4 cr)

IE 5531—Engineering Optimization I (4 cr)

IE 5551—Production Planning and Control (4 cr)

IE 5552—Design and Analysis of Manufacturing Systems (4 cr)

HRIR 3021—Human Resource Management and Industrial Relations (2 cr)

OMS 3001—Introduction to Operations Management (2 cr)

OMS 3056—Production and Inventory Management (4 cr)

**Additional Required Courses**

CSci 1101—Introduction to Computers and Problem Solving (3 cr)

NRES 1041W—Natural Resources as Raw Materials (3 cr)
Suggested Electives
Acct 2050—Introduction to Financial Reporting (4 cr)
IE 5541—Project Management (4 cr)
IE 5553—Simulation of Manufacturing Systems (4 cr)
HRIR 3071—Collective Bargaining and Labor Relations (4 cr)
Mgmt 3001—Fundamentals of Management (2 cr)

Special Learning Opportunities
Work experiences in summer jobs, internships, and formal work cooperatives are integral components of the production management specialization. Opportunities for outside employment 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 systematically examines industry facilities in the region. Conducted during spring break, the course takes 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 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 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)
Rhet 3562—Technical and Professional Writing (4 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 3305—Fundamentals of Lumber Grading (1 cr)
WPS 3312—Building Materials Estimating (1 cr)
WPS 3332—Introduction to Residential Construction (2 cr)
WPS 4201—Wood Industry Tours (1 cr)
WPS 4301—Statics and Engineering Mechanics (3 cr)
WPS 4303—Wood Deterioration and Preservation (3 cr)
WPS 4307—Wood-Base Panel Technology (3 cr)
WPS 4309—Wood-Fluid Relationships (2 cr)
WPS 4333—Systems Approach to Residential Construction (2 cr)
WPS 4334W—Advanced Residential Building Science (3 cr)
WPS 4335—Building Testing and Diagnostics (2 cr)
WPS 4355—Mechanics and Structural Design with Wood Products (3 cr)

Supporting Courses
Arch 5501—Environment and Material Forces in Architecture (3 cr)
CE 3402—Introduction to Construction Materials (3 cr)
CE 4101W—Project Management (3 cr)
DHA 2402—Residential Technology (3 cr)
DHA 2463—Housing and Community (3 cr)
IE 5531—Engineering Optimization I (4 cr)
HRIR 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
CSci 1101—Introduction to Computers and Problem Solving (3 cr)
NRES 1024W—Natural Resources as Raw Materials (3 cr)

Suggested Electives
BLLaw 3058—Law of Contracts and Agency (3 cr)
ORS 3059—Quality Management (4 cr)
PubH 5200—Topics in Environmental Health (2 cr)
WPS 4401W—Forest Products Marketing (4 cr)

Special Learning Opportunities
Work experiences in summer jobs, internships, and formal work cooperatives are 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, systematically examines industry facilities in the region. Conducted during spring break, the course takes students off-campus to visit production facilities and meet with leaders in today’s wood and paper science profession.