## Degree Programs and Minors

<table>
<thead>
<tr>
<th>Program/Minor</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fisheries and Wildlife</td>
<td>230</td>
</tr>
<tr>
<td>Conservation Biology Specialization</td>
<td>230</td>
</tr>
<tr>
<td>Fisheries Specialization</td>
<td>231</td>
</tr>
<tr>
<td>Wildlife Specialization</td>
<td>232</td>
</tr>
<tr>
<td>Fisheries and Wildlife Minor</td>
<td>232</td>
</tr>
<tr>
<td>Pre-Veterinary Medicine</td>
<td>232</td>
</tr>
<tr>
<td>Forest Resources</td>
<td>233</td>
</tr>
<tr>
<td>Forest Management and Planning Track</td>
<td>234</td>
</tr>
<tr>
<td>Forest Conservation and Ecosystem Management Track</td>
<td>234</td>
</tr>
<tr>
<td>Forest Resources Minor</td>
<td>235</td>
</tr>
<tr>
<td>Natural Resources and Environmental Studies</td>
<td>235</td>
</tr>
<tr>
<td>Environmental Assessment and Monitoring Concentration</td>
<td>235</td>
</tr>
<tr>
<td>Environmental Education Concentration</td>
<td>236</td>
</tr>
<tr>
<td>Planning, Policy, and Law Concentration</td>
<td>237</td>
</tr>
<tr>
<td>Resource Conservation and Environmental Management Concentration</td>
<td>238</td>
</tr>
<tr>
<td>Water and Soil Resources Concentration</td>
<td>239</td>
</tr>
<tr>
<td>Natural Resources and Environmental Studies Minor</td>
<td>241</td>
</tr>
<tr>
<td>Recreation Resource Management</td>
<td>242</td>
</tr>
<tr>
<td>Recreation Resource Management Track</td>
<td>242</td>
</tr>
<tr>
<td>Resource Based Tourism Track</td>
<td>243</td>
</tr>
<tr>
<td>Urban and Community Forestry</td>
<td>243</td>
</tr>
<tr>
<td>Wood and Paper Science</td>
<td>244</td>
</tr>
<tr>
<td>Forest Products Marketing Specialization</td>
<td>245</td>
</tr>
<tr>
<td>Paper Science and Engineering Specialization</td>
<td>246</td>
</tr>
<tr>
<td>Paper Science and Engineering Minor</td>
<td>246</td>
</tr>
<tr>
<td>Forest Products Production Management Specialization</td>
<td>246</td>
</tr>
<tr>
<td>Residential Building Science and Technology Specialization</td>
<td>247</td>
</tr>
</tbody>
</table>
General Information

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—The college is housed in seven buildings on the University’s Twin Cities campus. The Natural Resources Administration Building, Green Hall, Kaufert Laboratory, Hoedson Hall, McNeal 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 and GIS Lab, and some Department of Fisheries, Wildlife, and Conservation Biology 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, Wildlife, and Conservation Biology office; Entomology, Fisheries, and Wildlife Library; labs; lecture rooms; and faculty facilities are in Hodson Hall and the Engineering and Fisheries Laboratory. The Water Resources Center is located in McNeal Hall. Adjacent to college facilities is the regional headquarters of the USDA Forest Service North Central Research Station.

CNR holds several field sessions at the Cloquet Forestry Center. The Center includes more than 3,700 acres of virgin and second-growth forest in a major forest products manufacturing area of northeastern Minnesota; Fisheries and wildlife; forest resources; natural resources and environmental studies; and urban and community forestry majors spend a three-week summer term at the Center during their sophomore and junior years. Forest resources students complete a five-week advanced forestry field 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 three departments: the Department of Fisheries, Wildlife, and Conservation Biology (200 Hodson Hall); the Department of Forest Resources (115 Green Hall); the Department of Wood and Paper Science (203 Kaufert Laboratory); and an interdisciplinary program called natural resources and environmental studies (135 Natural Resources Administration Building).

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 the College of Natural Resources 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—For official and up-to-date information about the University’s admissions policies, procedures, and deadlines, please see the latest edition of the Undergraduate Application Booklet available from the Office of Admissions or online at <http://admissions.tc.umn.edu>.

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. degrees. CNR offers six major curricula:

- fisheries and wildlife (with specializations in fisheries, wildlife, and conservation biology);
- forest resources (with tracks in forest management and planning; and forest conservation and ecosystem management);
- 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 (with tracks in recreation resource management, and resource based tourism);
- urban and community 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 among programs, students may transfer between majors at the end of their freshman or sophomore 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 more, consult the Graduate School Catalog or the CNR Web site at <www.cnr.umn.edu>.

Minors

CNR offers five 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, natural resources and environmental studies, paper science and engineering, and urban and community forestry. CNR 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 and Minors 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 two-semester 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—To complete the lower division honors program, students must complete 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 other University honors programs and transfer institutions.

Students must also complete at least two honors courses with a grade of B or better, and 60 semester credits with a cumulative GPA of 3.30 or higher.

Qualifications for Upper Division Applicants
Upper division honors students must have a cumulative GPA of 3.30 or higher with at least 60 credits completed. After admission, students must achieve a GPA of at least 3.50 in their last 60 credits.

Application Procedure for Upper Division Applicants—Students must submit an upper division honors application, a research proposal, and 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.

Graduation with Honors—Participation in the honors program is required for graduation with the traditional honors designations of cum laude, magna cum laude, or summa cum laude, defined below. Candidates for graduation with honors must complete the following:
- At least 40 credits in upper division courses (3xxx, 4xxx, or 5xxx) at the University of Minnesota, Twin Cities.
- Two semesters (2 credits/semester) of directed research with the results reported in an acceptable honors thesis and as an oral seminar. Students may use research they conducted while participating in the Undergraduate Research Opportunities Program if approved by the departmental honors program coordinator to partially fulfill the directed research component of their honors program. Courses are FW 4801H, FW 4802H; FR 4801H, FR 4802H; NRES 4801H, NRES 4802H; and WPS 4801H, WPS 4802H.
- One semester (1 credit) of honors seminar within the student’s chosen curriculum: FW 4200, FR 4200, NRES 4200, WPS 4200.
- The last 60 credits of A-F registration (including transfer coursework) with the minimum GPAs specified below. Transcripts of students graduating with honors show one of the following:
  - Cum laude (minimum GPA: 3.50);
  - Magna cum laude (minimum GPA: 3.66);
  - Summa cum laude (minimum GPA: 3.75).

Students also receive recognition during commencement.
Policies

College Level Examination Program (CLEP)—
Students may earn credit for the CLEP social science and humanities examinations prepared by the College Entrance Examination Board. CLEP also offers a number of subject examinations for credit.

CNR accepts CLEP scores at the 75th percentile or higher for exemption up to 8 credits in a selected number of courses. Contact the CNR Student Services Office for more information.

Dean’s List—To be eligible for the CNR Dean’s List, a student must be a current CNR student and have completed 12 credits (A-F registration) with a GPA of at least 3.67. Students on the Dean’s List receive a letter from the dean and are publicly listed in the Honors and Recognition area of the Natural Resources Administration Building. There is a transcript notation for each term a student is on the Dean’s List.

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

Grading—All required courses in the major must be taken A-F with grades of C- or better; students who receive a grade below C- in a major course must repeat the course.

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 must report the incident to the college Student Scholastic Standing Committee. 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 less than C- is earned. A course may be repeated only once and the grade in the repeated course is counted in GPA and credit totals; the first grade is bracketed (does not count toward credit totals or cumulative GPA). It is the student’s responsibility to report any repeated courses to the CNR Student Services Office.

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

Suspension—To appeal a suspension (see Probation in 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.
- Major coursework is defined as all required courses listed in each major program including specialization courses, track courses, concentration courses, professional courses, and writing courses. The only courses not included in this policy are free electives and courses taken beyond those in the major coursework to satisfy liberal education requirements.
- 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 degree program. The remaining themes may be satisfied by careful selection among core professional and elective courses. See individual CNR degree programs for specific courses.

**Field Session Requirements**—Forest resources, urban and community forestry, and fisheries and wildlife majors are required to complete a three-week summer field session at the Cloquet Forestry Center in their sophomore or junior years. To attend, students must have completed 30 semester credits and attained a cumulative GPA of at least 2.00. Forest resources and urban and community forestry students must also have completed the following courses with a grade of at least C: Biol 1009 or 1001, Chem 1011 or 1021, and precalculus or college algebra. Fisheries and wildlife students must have completed the following courses with a grade of at least C: one year or introductory biology and Biol 3407. NRES students are required to complete either a field session at Cloquet 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 1001, and FR 3104 or Biol 3407. The Cloquet session is also open to students not enrolled in CNR.

Students in the forest resources major are required to complete an advanced field session at the Cloquet Forestry Center in their senior year. To attend, students must attain a cumulative GPA of at least 2.00, complete the introductory field session, FR 4218, 4262, 4411, and 4431. This five-week session is held in the spring during the May session 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**

**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 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 spring break 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 May session following spring semester.

**Wildlife Handling**—FW 5625—Wildlife Handling offers hands-on experience immobilizing, assessing, and testing large animals. Students interested in conservation biology, zoo management or wildlife gain a unique perspective from this four-day, intensive course.

**Advanced Water Quality**—NRES 4062—Advanced Water Quality, offered during May session, provides an intensive, two-week field experience.

**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 (SPAN) 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 SPAN destinations change from year to year. The University also cosponsors two specialized options for CNR students: a tropical biology/conservation program in Costa Rica and a marine biology program in Denmark.

Integrated classroom study programs permit students to take regular university courses alongside students from the host-country. The University’s student exchanges and consortium memberships provide access to universities in many countries. Conservation and resource management curricula taught in English are available in Australia, Canada, Fiji, Finland, Ghana, the Netherlands, the Philippines, South Africa, Tanzania, and the
General Information

College of Natural Resources

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 always seek credit in their major. Study abroad is encouraged for language acquisition or cultural learning. The resulting credits can often be used as electives or to fulfill second language or liberal education requirements. 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 the career services coordinator and by department faculty. A series of special employment seminars are provided by the Career Services Office on topics such as résumé writing, interviewing, initiating internship and job searches, and summer/seasonal intern hiring updates. Each major also requires an orientation class for all incoming students to provide interaction with faculty and alumni in their chosen professional field.

Student Organizations

Governance—Students are encouraged to 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 the 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 and Coffman Union. 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, Wildlife and Conservation Biology Club (with an affiliated student chapter of The Wildlife Society), Women in Natural Resources, Xi Sigma Pi Honor Society, Water Quality Team, Urban Forestry Club, Residential Building Science and Technology Club.

Directory

(area code 612)

CNR Administration

Dean's Office
235 Natural Resources Administration Building
624-3234
<www.cnr.umn.edu>

Student Services
135 Natural Resources Administration Building
624-6768
<www.cnr.umn.edu/ug>

Career Services
135 Natural Resources Administration Building
624-6768
<www.cnr.umn.edu/careers/index.php>

Admissions/Prospective Student Services
135 Natural Resources Administration Building
624-6768
<www.cnr.umn.edu/ug/prospective>

Departments, Divisions, and Programs

Bell Museum of Natural History
10 Church Street S.E.
624-7083
<www1.umn.edu/bellmuse/>

Fisheries, Wildlife, and Conservation Biology
200 Hodson Hall
624-3600
<www.fw.umn.edu>

Forest Resources
115 Green Hall
624-3400
<www.cnr.umn.edu/FR/>

Natural Resources and Environmental Studies
135 Natural Resources Administration Building
624-6768
<www.cnr.umn.edu/ug/>

Wood and Paper Science
207 Kaufert Lab
625-5200
<www.cnr.umn.edu/WPS/>

Cloquet Forestry Center
Cloquet, MN 55720
218-879-0850
<www.cnr.umn.edu/cfc/>

Visit the CNR Career Center for listings of summer jobs, internships, and permanent jobs in environmental and natural resources areas.
Fisheries and Wildlife

Department of Fisheries, Wildlife, and Conservation Biology
B. S.

The fisheries and wildlife curriculum gives students 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. For more information about liberal education requirements, see page 31 in this catalog.

All required courses in the major must be taken A-F and completed with a grade of at least C-. See Graduation Requirements in the CNR General Information section for more information.

Required Courses

Communication Skills
EngC 1013—University Writing and Critical Reading: Nature and the Environment (4 cr)
or Rhet 1101—Writing to Inform, Convince, and Persuade (4 cr)
Rhet 1223—Oral Presentations in Professional Settings (3 cr)
or Comm 1101—Introduction to Public Speaking (3 cr)
Rhet 3562W—Technical and Professional Writing (4 cr)
or EngC 3027W—Advanced Expository Writing (4 cr)

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

Physical, Chemical, and Biological Sciences
Biol 2012—General Zoology (4 cr)
Chem 1021—Chemical Principles I (4 cr)
Chem 1022—Chemical Principles II (4 cr)
GCD 3022—Genetics (3 cr)
or Biol 4003—Genetics (3 cr)

Select one of the following groups:
Biol 1009—General Biology (4 cr)
and Biol 2022—General Botany (3 cr)
or Biol 1001—Introductory Biology I: Evolutionary and Ecological Perspectives (4 cr)
and Biol 1002W—Introductory Biology II: Molecular, Cellular, and Developmental Perspectives (5 cr)
Select one of the following groups:
Phys 1001W—Energy and the Environment (4 cr)
and Geo 1001—The Dynamic Earth: An Introduction to Geology (4 cr)
or Ast 1001—Exploring the Universe (4 cr)
or Geog 1425—Introduction to Meteorology (3 cr)
and Geog 1426W—Introduction to Meteorology Laboratory (1 cr)
or Phys 1101—Introductory College Physics I (4 cr)
and Phys 1102—Introductory College Physics II (4 cr)
or Phys 1201—Introductory Physics for Pre-Medicine and Biology I (5 cr)
and Phys 1202—Introductory Physics for Pre-Medicine and Biology II (5 cr)

Core Courses
Biol 3407—Ecology (3 cr)
FW 1001—Orientation in Fisheries, Wildlife, and Conservation Biology (1 cr)
NRES 3011W—Ethics and Leadership in Resource Management (3 cr)

Conservation Biology Specialization
The conservation biology 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.

All required courses in the specialization must be taken A-F and completed with a grade of at least C-. See Graduation Requirements in the CNR General Information section for more information.

Required Courses

Communications, Leadership, Policy
Choose two of the following:
FW 5003—Human Dimensions of Biological Conservation (3 cr)
NRES 3202W—Environmental Conflict Management, Leadership, and Planning (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)
FW 4129—Mammalogy (4 cr)
FW 4136—Ichthyology (4 cr)
FR 1101—Dendrology (3 cr)
PBio 4321—Taxonomy of Minnesota Flora (3 cr)
PBio 4511—Plant Systematics (3 cr)

Community and Ecosystem Ecology
LA 3204—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 4699W—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)
FW 4108—Field Methods in Research and Conservation of Vertebrate Populations (Cloquet) (3 cr)
FW 4106—Important Plants in Fisheries and Wildlife Habitats (Cloquet) (1 cr)
or other related field session approved by department
FW 4701—Fisheries and Wildlife Problem Solving (2 cr)
or FW 4801H—Honors Research (2 cr)
and FW 4802H—Honors Research (2 cr)
and FW 4200H—Honors Seminar (1 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)
Electives—Select courses to total 128 credits for graduation with the B.S. degree. Please 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 3131—GIS in Natural Resource Analysis (3 cr)
NRES 3001—Colloquium: Perspectives on Treaty Rights (2 cr)
NRES 3002—Colloquium: Exotic Species (2 cr)
NRES 3021—Plant Resource Management and the Environment (3 cr)
NRES 3101—Conservation of Plant Biodiversity (3 cr)
NRES 3211—Survey, Measurement, and Modeling in Natural Resources (3 cr)
NRES 4061W—Water Quality: Management of a Natural Resource (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. All required courses in the specialization must be taken A-F and completed with a grade of at least C-. See Graduation Requirements in the CNR General Information section for more information.

Required Courses
Communications, Leadership, Policy
Select one of the following:
FW 5003—Human Dimensions of Biological Conservation (3 cr)
NRES 3202W—Environmental Conflict Management, Leadership, and Planning (3 cr)
NRES 3241—Natural Resources Policy and Administration (3 cr)

Animals and Plants
FW 4136—Ichnology (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)
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 (Cloquet) (1 cr)
FW 4108—Field Methods in Research and Conservation of Vertebrate Populations (Cloquet) (3 cr)
FW 4701—Fisheries and Wildlife Problem Solving (2 cr)
or FW 4801H—Honors Research (2 cr)
and FW 4802H—Honors Research (2 cr)
and FW 4200H—Honors Seminar (1 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 2111—Biochemistry for the Agricultural and Health Sciences (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 Pre-veterinary medicine 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—Select courses to total 128 credits for graduation with the B.S. degree. Please give strong consideration to courses on the list below or in any of the three areas of specialization (i.e., fisheries, wildlife, conservation biology).

EEB 4601—Lincolnology (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 (Cloquet) (1 cr)
FW 4108—Field Methods in Research and Conservation of Vertebrate Populations (Cloquet) (3 cr)
FW 4701—Fisheries and Wildlife Problem Solving (2 cr)
or FW 4801H—Honors Research (2 cr)
and FW 4802H—Honors Research (2 cr)
and FW 4200H—Honors Seminar (1 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 2111—Biochemistry for the Agricultural and Health Sciences (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 Pre-veterinary medicine 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—Select courses to total 128 credits for graduation with the B.S. degree. Please 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 2111—Biochemistry for the Agricultural and Health Sciences (3 cr)
EEB 4601—Lincolnology (3 cr)
FR 3114—Forest Hydrology and Watershed Management (3 cr)
FW 5411—Aquatic Toxicology (3 cr)
FW 5455—Sustainable Aquaculture (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.

All required courses in the specialization must be taken A-F and completed with a grade of at least C-. See Graduation Requirements in the CNR General Information section for more information.

Required Courses

Communications, Leadership, Policy
Select one of the following:
FW 5003—Human Dimensions of Biological Conservation (3 cr)
NRES 3202W—Environmental Conflict Management, Leadership, and Planning (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—Limnology (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 4108—Field Methods in Research and Conservation of Vertebrate Populations (Cloquet) (3 cr)
FW 4701—Fisheries and Wildlife Problem Solving (2 cr) or FW 4801H—Honors Research (2 cr) and FW 4802H—Honors Research (2 cr) and FW 4200H—Honors Seminar (1 cr)
FW 5051—Analysis of Populations (3 cr)
FW 5603W—Habitats and Regulation of Wildlife (3 cr) or FW 4136—Ichthyology (4 cr) or FW 5455—Sustainable Aquaculture (3 cr)

Electives—Select courses to total 128 credits for graduation with the B.S. degree. Please give strong consideration to courses on the list below or in any of the three areas of specialization (i.e., fisheries, wildlife, conservation biology).

Biol 2012—General Zoology (4 cr)
Biol 3301—Biology of Microorganisms (5 cr)
Biol 3407—Ecology (3 cr)
Biol 3408—Ecology (3 cr)
Biol 3605—Ecology and Evolution (3 cr)
Biol 3211—Animal Physiology (3 cr)
Biol 3301—Biology of Microorganisms (5 cr)
Biol 3302—Cell Biology (3 cr)
Biol 3407—Ecology (3 cr)

Pre-Veterinary Medicine

Students may fulfill the minimum requirements for admission to the University’s College of Veterinary Medicine and other colleges of veterinary medicine by completing a bachelor’s degree in fisheries and wildlife within any of the three areas of specialization. Although the 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.

Biol 3021—Biochemistry (3 cr)
Chem 2301—Organic Chemistry I (3 cr)
Chem 2302—Organic Chemistry II (3 cr)
Chem 2311—Organic Chemistry Lab I (3 cr) or Phys 1101 and Phys 1102—Introductory College Physics (4 cr, 4 cr) or Phys 1201 and Phys 1202—Introductory Physics for Premedicine and Biology (5 cr, 5 cr) or Phys 1301 and Phys 1302—Introductory Physics for Science and Engineering (4 cr, 4 cr) or VPB 2032—General Microbiology with Lab (4 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 planning and forest conservation and ecosystem management. Students taking the forest management and planning track receive training in principles and techniques of resource management. Students taking the forest conservation and ecosystem management track focus on conservation issues and strategies and on a broader understanding of ecosystem structure and function. Students should choose one of these tracks as early as possible in their college careers.

Degree Requirements
To complete the degree, students must complete 120 credits. Students must also meet the University’s liberal education and writing intensive (W) requirements; for more information, see liberal education on page 31 in this catalog. Courses with an asterisk (*) fulfill both major and liberal education requirements.

All required courses in the major must be taken A-F and completed with a grade of at least C-. See Graduation Requirements in the CNR General Information section for more information.

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: Perspectives on Multiculturalism (4 cr)
or EngC 1013—University Writing and Critical Reading: Nature and the Environment (4 cr)
or EngC 1014—University Writing and Critical Reading: Contemporary Public Issues (4 cr)
Rhet 1223—Oral Presentation in a Professional Setting (3 cr)
or Comm 1101—Introduction to Public Speaking (3 cr)

Mathematical Thinking
Math 1142—Short Calculus (4 cr)
or Math 1271—Calculus I (4 cr)
Stat 3011—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)
Phys 1001—Energy and the Environment (4 cr)
or “B” or better in high school physics
Soil 1125—The Soil Resource (4 cr)
or Soil 2125—Basic Soil Science (4 cr)

Social Sciences and Humanities
NRES 3261W—Economics and Natural Resource Management (3 cr)*
Social science course (3 cr)*
Historical perspective course (3 cr)*
Literature course (3 cr)*
Arts and humanities course (3 cr)*

Professional Required Core Courses

Introductory Courses
FR 1001—Orientation and Information Systems (1 cr)

Resource Assessment
FR 3131—Geographic Information Systems (GIS) for Natural Resources (4 cr)
FR 3218—Assessment and Modeling of Forests (3 cr)
FR 3262—Remote Sensing of Natural Resources and Environment (3 cr)

Forest Management Professional Requirements
FR 3471—Forest Management and Planning (3 cr)
NRES 3202W—Environmental Conflict Management, Leadership, and Planning (3 cr)
or NRES 3011W—Ethics and Leadership in Resource Management (3 cr)
NRES 3241W—Natural Resource Policy and Administration (3 cr)
RM 4232W—Managing Recreational Lands (4 cr)

Management of Vegetation, Wildlife, Soil, and Water Resources
FR 1101—Dendrology: Identifying Forest Trees and Shrubs (3 cr)
FR 3104—Forest Ecology (4 cr)
FR 3411—Silviculture: Managing Forest Ecosystems (4 cr)
FR 3114—Hydrology and Watershed Management (3 cr)
PIPa 3003—Diseases of Forest and Shade Trees (3 cr)
or Ent 4251—Forest and Shade Tree Entomology (3 cr)
FW 2001—Introduction to Fisheries, Wildlife, and Conservation Biology (3 cr) (recommended for sophomores)
or FW 5603W—Habitats and Regulation of Wildlife (3 cr)

Field Training in Assessment and Biology of Forests
(taught at Cloquet Forestry Center during the summer)
FR 2101—Identifying Forest Plants (1 cr)
FR 2102—Northern Forests Field Ecology (2 cr)
FR 2104—Measuring Forest Resources (1 cr)

The wildlife handling class offers hands-on experience immobilizing, assessing, and testing large animals. Students interested in conservation biology, zoo management, or wildlife gain a unique perspective from this course.
Forest Management and Planning Track
This track is for students who wish to become directly involved in forest land management or find positions in specialized areas such as resource analysis and 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.
All required courses in this track must be taken A-F and completed with a grade of at least C-. See Graduation Requirements in the CNR General Information section for more information.

Required Courses
Physical and Biological Sciences
Chem 1021—Chemical Principles I (4 cr)
and Chem 1022—Chemical Principles II (4 cr)
or Chem 1011—General Principles of Chemistry (4 cr)
and BioC 2011—Biochemistry for the Agricultural and Health Sciences (3 cr)

Introductory Professional Course
WPS 1301—Wood as a Raw Material (3 cr)

Forest Management Professional Requirement
FR 3431—Timber Harvesting and Road Planning (2 cr)

Advanced Training in Assessment and Management of Forest Resources
(taught at Cloquet Forestry Center during May session)
FR 5615—Field Remote Sensing and Resource Survey (2 cr)
FR 5611—Field Silviculture (3 cr)
FR 5621—Field Timber Harvesting and Road Planning (2 cr)

Additional Professional Requirements
Students select, with faculty adviser approval, a minimum of 6 additional credits in professional courses chosen from the list below. Courses used to satisfy other requirements may not be used to fill the 6-credit professional requirement.
Ent 4251—Forest and Shade Tree Entomology (3 cr)
FR 251—Natural Resources in Sustainable International Development (3 cr)
FR 4118—Physiological Ecology of Woody Plants (3 cr)
FR 5142—Tropical Forest Ecology (3 cr)
FR 5153—Forest and Wetland Hydrology (3 cr)
FR 5228—Advanced Assessment and Modeling (3 cr)
FR 5264—Advanced Forest Management Planning (3 cr)
FR 5412—Digital Remote Sensing (3 cr)
FW 5603W—Habitats and Regulation of Wildlife (3 cr) (recommended for juniors or seniors)
FW 5604W—Fisheries Ecology and Management (3 cr)
Geo 1001—The Dynamic Earth: An Introduction to Geology (4 cr)
NRES 3002—Colloquium: Exotic Plants and Animals (1 cr)
NRES 3101—Conserving our Plant Biodiversity (3 cr)
NRES 4061W—Managing Natural Water Quality (3 cr)
NRES 5002—Colloquium: Restoration of Stream Ecosystems (1 cr)
PlPa 3003—Diseases of Forest and Shade Trees (3 cr)
or Ent 4251—Forest and Shade Tree Entomology (3 cr)
Soil 3416—Plant Nutrients in the Environment (3 cr)
Soil 5555—Wetland Soils (3 cr)
Soil 5711—Forest Soils (2 cr)

Electives
Choose 4 credits of electives from any discipline.

Forest Conservation and Ecosystem Management Track
This track is for students who wish to learn the fundamentals of forest resources management while gaining depth in conservation issues and strategies and in the structure and function of ecosystems. Graduates might pursue careers as forest managers and conservationists or seek careers in research, teaching, and technical support for forest and related resource management and conservation.

Electives (9 cr)
Choose 9 credits of electives from courses listed above, from suggested courses listed below, or from any other discipline.
Anth 3041—Ecological Anthropology (3 cr)
EEB 4002—Ecology of Minnesota (2 cr)
EEB 4631—Global Ecology (4 cr)
Geo 3002—Climate Change and Human History (3 cr)
GloS 5301—Environment and Empire (3 cr)
HSci 3244—History of Ecology and Environmentalism (3 cr)
PBio 5412—Plant Physiology
Pol 3872—Global Environmental Cooperation (3-4 cr)
Soil 3221—Soil Conservation and Land-use Management (3 cr)
Forest Resources Minor
The forest resources minor (17 cr) helps students in natural resources and other areas gain deeper understanding of the scientific foundations of forestry, the management of forest resources, and the importance of forest resources to society. Students select from an array of courses in forest assessment, forest biology and management, and forest economics and policy. Students may include a three-week hands-on field session at the Cloquet Forestry Center 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 (Cloquet) (1 cr)  
 and FR 2102—Forest Ecology: Field Experience (Cloquet) (2 cr)  
 and FR 2104—Forest Measurement Techniques (Cloquet) (1 cr)  
 FR 3104—Forest Ecology (4 cr)  
 FR 3411—Silvicultural Systems (3 cr)

Additional Required Courses (7 cr)
Students take at least 7 cr selected from the following groups; at least 3 cr must be taken from the first group.

Forest Policy, Management, and Planning
FR 5471—Forest Management and Planning (3 cr)  
 FR 5501—Urban Forest Management (3 cr)  
 NRES 3241W—Natural Resource Policy and Administration (3 cr)  
 NRES 3261W—Economics and Natural Resource Management (3 cr)  
 RRM 4232—Management of Recreational Lands (3 cr)

Resource Assessment
FR 3131—Geographic Information Systems for Natural Resource Analysis (3 cr)  
 FR 3218—Assessment and Modeling of Forests (3 cr)  
 FR 3262—Remote Sensing of Natural Resources (3 cr)

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

Required Courses
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: Perspectives on Multiculturalism (4 cr)  
 or EngC 1014—University Writing and Critical Reading: Contemporary Public Issues (4 cr)  
 Rhet 1223—Oral Presentation in Professional Setting (3 cr)  
 or Comm 1101—Introduction to Public Speaking (3 cr)  
 Rhet 3562W—Technical and Professional Writing (4 cr)  
 or EngC 3027W—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 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)

Natural Resources and Environmental Studies
B.S.
Natural resources and environmental studies is an interdisciplinary major focusing on the use and management of natural resources and the study of 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.

The natural resources and environmental studies curriculum has five areas of concentration from which students choose to complete their degree requirements. Areas of concentration include environmental assessment and monitoring; environmental education; planning, policy, and law; resource conservation and environmental management; and water and soil resources. In addition to the core requirements in each area of concentration, students choose up to 15 credits of “Additional Required Professional Courses” in consultation with their faculty advisers. Students then complete a Concentration Contract signed by their faculty adviser listing the additional professional courses on which they have agreed. The completed Concentration Contract is filed in the Student Services Office and is used to clear students for graduation.

Degree Requirements
To complete the degree, students must complete 120 credits including required courses in the major, the University’s liberal education requirements, and approved writing intensive (W) courses. For more information, see page 31 in this catalog. Courses with an asterisk (*) fulfill both major and liberal education requirements.

Environmental Assessment and Monitoring Concentration

Required Courses
**Environmental Education Concentration**

The environmental education concentration focuses on skills and knowledge necessary 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 teaching and learning in informal settings.

All required courses in the concentration must be taken A-F and completed with a grade of at least C-. See Graduation Requirements in the CNR General Information section for more information.

**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: Perspectives on Multiculturalism (4 cr)
- or EngC 1014—University Writing and Critical Reading: Contemporary Public Issues (4 cr)
- Rhet 1223—Oral Presentation in Professional Setting (3 cr)
- or Comm 1101—Introduction to Public Speaking (3 cr)
- Rhet 3562W—Technical and Professional Writing (4 cr)
- or EngC 3027W—Advanced Expository Writing (4 cr)

**Mathematical Thinking**
- Math 1142—Short Calculus (4 cr)
- or 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)
- or Biol 2022—General Botany (3 cr)
- or Biol 2012—General Zoology (4 cr)
- Chem 1011—General Principles of Chemistry (4 cr) and BioC 2011—Biochemistry for the Agricultural and Health Sciences (3 cr)
- or Biol 2022—General Botany (3 cr)
- Geo 1001—The Dynamic Earth: An Introduction to Geology (4 cr)
- or 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)*

**Additional Required Courses**

12 credits from the following list. Course selections must be made in consultation with a faculty adviser; contract required. Courses from this list may be used to fulfill either required courses or additional required professional courses, with a faculty adviser; contract required.

- Soil 4021W—Environmental Impact Statements (3 cr)
- Soil 4511—Field Study of Soils (1 cr)
- Soil 5555—Wetlands Soils (3 cr)

**Physical and Biological Sciences**

- Biol 1001—Introductory Biology I: Evolutionary and Ecological Perspectives (4 cr)
- or Biol 1009—General Biology (4 cr)
- or Biol 2022—General Botany (3 cr)
- or Biol 2012—General Zoology (4 cr)
- Chem 1011—General Principles of Chemistry (4 cr) and BioC 2011—Biochemistry for the Agricultural and Health Sciences (3 cr)
- or Biol 2022—General Botany (3 cr)
- Geo 1001—The Dynamic Earth: An Introduction to Geology (4 cr)
- or 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 3241W—Natural Resource Policy and Administration (3 cr)
or NRES 3245—Recreation Policy and Landscape-level Planning (3 cr)
NRES 3211—Survey, Measurement, and Modeling in Natural Resources (3 cr)
NRES 4061W—Water Quality: Management of a Natural Resource (3 cr)
or FR 3114—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 4811—Natural Resources Interpretation (3 cr)
or Rec 5311—Programming Outdoor and Environmental Education (3 cr)

Optional courses with an asterisk may be used to fulfill both major and liberal education requirements.

Additional Required Professional Courses
15 credits from the following list. Course selections must be made in consultation with a faculty adviser; contract required.
Agro 4103—World Food Problems (3 cr)
Anth 3041—Ecological Anthropology (3 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 5540—Special Topics: Science Education – Principles of Environmental Education
CI 5747—Global and Environmental Education: Content and Practice (3 cr)
Comm 5451—Intercultural Communication Processes (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 3204—Landscape Ecology (3 cr)
NRES 3201W—Economics and Natural Resource Management (3 cr)
NRES 4051—Natural Resources Interpretation (3 cr)
Pol 3872—Global Environmental Cooperation (3 cr)
Rec 5301—Wilderness and Adventure Education (3 cr)
Rec 5311—Programming Outdoor and Environmental Education (3 cr)
Rhet 3383—In Search of Nature (3 cr)
Soil 5501—Principles of Waste Management (3 cr)

Planning, Policy, and Law Concentration
The planning, policy, and law concentration focuses on planning and management activities with emphases on environmental, social, and cultural factors. Application areas encompass watershed, landscape, and site planning, and address issues of development, resource protection, land use, and regulation at local, state, and national levels.

Students must select a sub-specialization (track) in either planning or in policy and law.

All required courses in the concentration must be taken A–F and completed with a grade of at least C-. See Graduation Requirements in the CNR General Information section for more information.

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: Perspectives on Multiculturalism (4 cr)
or EngC 1014—University Writing and Critical Reading: Contemporary Public Issues (4 cr)
Rhet 1223—Oral Presentation in Professional Setting (3 cr)
or Comm 1101—Introduction to Public Speaking (3 cr)
Rhet 3562W—Technical and Professional Writing (4 cr)
or EngC 3027W—Advanced Expository Writing (4 cr)

Mathematical Thinking
Math 1142—Short Calculus (4 cr)
Stat 3011—Introduction to Statistical Analysis (4 cr)
or Stat 4121—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)
Chem 1011—General Principles of Chemistry (4 cr)
and BioC 2011—Biochemistry for the Agricultural and Health Sciences (3 cr)
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
ApEc 1101—Principles of Microeconomics (3 cr)*
or Econ 1101—Principles of Microeconomics (4 cr)*
Pol 1001—American Democracy in a Changing World (4 cr)*

Additional Required Courses
FR 3104—Forest Ecology (4 cr)
or Biol 3407—Ecology (3 cr)
FW 2001—Introduction to Fisheries, Wildlife, and Conservation Biology (3 cr)
or NRES 1001—Orientation and Information Systems (1 cr)
NRES 1041W—Natural Resources as Raw Materials (3 cr)
NRES 1201—Conservation of Natural Resources (3 cr)
NRES 3000, or 3001, or 3002 or 5002—Colloquium (choose one) (1-2 cr)
NRES 3011W—Ethics and Leadership in Resource Management (3 cr)
or NRES 3202W—Environmental Conflict Management, Leadership, and Planning (3 cr)
NRES 3021—Plant Resource Management and the Environment (3 cr)
or FR 3411—Silviculture Systems (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 Management Techniques (Cloquet) (4 cr)
NRES 3212—Survey, Measurement, and Modeling in Natural Resources (3 cr)
or NRES 4061W—Water Quality: Management of a Natural Resource (3 cr)
or FR 3114—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)

*Courses with an asterisk may be used to fulfill both major and liberal education requirements.

Concentration Tracks
Students must complete either the planning track or the policy and law track in addition to the required courses listed above.

Planning Track in the Planning, Policy, and Law Concentration
Additional Required Professional Courses (9 cr)
FR 1101—Dendrology (3 cr)
FR 3131—Geographical Information Systems for Natural Resources Analysis (3 cr)
NRES 3245—Recreation Policy and Landscape-level Planning (3 cr)
Select an additional 12 credits from the three groups listed below. At least 3 credits must be chosen from each group. Course selections must be made in consultation with a faculty adviser; contract required.

**Social Context for Planning**
- ApEc 5321—Regional Economic Analysis (3 cr)
- Geog 5601—Land Use Planning (3 cr)
- PA 5034—Community Analysis and Planning Techniques (1.5 cr)
- PA 5251—Strategic Planning and Management (1.5 cr)
- PA 5252—Strategy and Tactics in Project Planning and Management (1.5 cr)
- RRM 4232W—Management of Recreational Lands (4 cr)

**Biological/Physical Context for Planning**
- FR 3262—Remote Sensing of Natural Resources (3 cr)
- Hort 5071—Restoration and Reclamation Ecology (3 cr)
- LA 3501—Environmental Design and Its Biological and Physical Context (3 cr)
- LA 3204—Landscape Ecology (3 cr)
- PA 5241—Environmental Planning (4 cr)
- Soil 4021W—Environmental Impact Statements (3 cr)

**Ways of Understanding and Mitigating Natural Resource Conflict**
- ApEc 4311—Tourism Development Principles, Processes and Policies (3 cr)
- Geog 3355—Environmental Quality (4 cr)
- Geog 5724—Meanings of Place (3 cr)
- NRES 3241W—Natural Resource Policy and Administration (3 cr)
- NRES 3261W—Economics and Natural Resources Management (3 cr)
- PA 5011—Organizational Analysis, Management and Design (3 cr)
- Rhet 3266—Group Process, Team Building, and Leadership (3 cr)
- RRM 5259—Visitor Behavior Analysis (3 cr)

**Policy and Law Track in the Planning, Policy, and Law Concentration**
- Additional Required Professional Courses (6 cr)
  - NRES 3241W—Natural Resource Policy and Administration (3 cr)
  - NRES 3261W—Economics and Natural Resources Management (3 cr)
- Select an additional 12 credits from the three groups listed below. At least one course must be chosen from each group. Course selections must be made in consultation with a faculty adviser; contract required.

**Policy Analysis**
- ApEc 3311—Introduction to Public Policy Analysis (3 cr)
- ApEc 5651—Economics of Natural Resource and Environmental Policy (3 cr)
- PA 5002—Introduction to Policy Analysis (1.5 cr)
- PA 5013—Law and Urban Land Use (3 cr)
- Pol 3085—Quantitative Analysis in Political Science (4 cr)

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

**Implications of Policy on Natural Resources Planning and Management**
- Anth 3041—Ecological Anthropology (3 cr)
- FR 3251—Role of Renewable Natural Resources in Developing Countries (1 cr)
- FR 5146—Dynamics of Global Change (3 cr)
- Geog 3361—Land Use, Landscapes and the Law (3 cr)
- Geog 5724—Meanings of Place (3 cr)
- LA 3501—Environmental Design and Its Biological and Physical Context (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**

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

All required courses in the concentration must be taken A-F and completed with a grade of at least C-. See Graduation Requirements in the CNR General Information section for more information.

**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: Perspectives on Multiculturalism (4 cr)
- or EngC 1014—University Writing and Critical Reading: Contemporary Public Issues (4 cr)
- Rhet 1223—Oral Presentation in Professional Setting (3 cr)
- or Comm 1101—Introduction to Public Speaking (3 cr)
- Rhet 3562W—Technical and Professional Writing (4 cr)
- or EngC 3027W—Advanced Expository Writing (4 cr)

**Mathematical Thinking**
- Math 1142—Short Calculus (4 cr)
- or 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)
- or Biol 2022—General Botany (3 cr)
- or Biol 2012—General Zoology (4 cr)
- or Chem 1021—Chemistry Principles I (4 cr)
- or Chem 1022—Chemistry Principles II (4 cr)
- or Chem 1011—General Principles of Chemistry (4 cr)
- or BioC 2011—Biochemistry for the Agricultural and Health Sciences (3 cr)
- or Phys 1001—Energy and the Environment (4 cr)
- or "B" or better in high school physics
- or Geo 1001—The Dynamic Earth: An Introduction to Geology (4 cr)
- or Soil 2125—Basic Soil Science (4 cr)
- or Soil 1125—The Soil Resource (4 cr)

**Social Sciences and Humanities**
- EngC 1011—University Writing and Critical Reading (4 cr)
- or EngC 1012—University Writing and Critical Reading: Perspectives on Multiculturalism (4 cr)
- or EngC 1014—University Writing and Critical Reading: Contemporary Public Issues (4 cr)
- or Rhet 1101—Writing to Inform, Convince, and Persuade (4 cr)
- or Rhet 3562W—Technical and Professional Writing (4 cr)
- or EngC 3027W—Advanced Expository Writing (4 cr)

**Additional Required Courses**
- FR 3104—Forest Ecology (4 cr)
- or Biol 3407—Ecology (3 cr)
- or FW 2001—Introduction to Fisheries, Wildlife, and Conservation Biology (3 cr)
- or NRES 1001—Orientation and Information Systems (1 cr)
- or NRES 1041W—Natural Resources as Raw Materials (3 cr)
- or NRES 1201—Conservation of Natural Resources (3 cr)
- or NRES 3000 or NRES 3001 or NRES 3002 or NRES 5002—Colloquium (choose one) (1-2 cr)
- or NRES 3011W—Ethics and Leadership in Resource Management (3 cr)
- or NRES 3021—Plant Resource Management and the Environment (3 cr)
- or FR 3411—Silviculture Systems (3 cr)
- or NRES 3051—Experience and Training in a Field Setting (1-3 cr)
- or NRES 3205—Field Ecology in NRES (4 cr)
- or FR 2101, FR 2102, FR 2104—Forest Plants; Forest Ecology: Field Experience; and Forest Measurement Techniques (Cloquet) (4 cr)
- or NRES 3211—Survey, Measurement, and Modeling in Natural Resources (3 cr)
- or NRES 3241W—Natural Resource Policy and Administration (3 cr)
- or NRES 3245—Recreation Policy and Landscape-level Planning (3 cr)
- or NRES 3261W—Economics and Natural Resources Management (3 cr)
NRES 4061W—Water Quality: Management of a Natural Resource (3 cr)
or FR 3114—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)

* Courses with an asterisk may be used to fulfill both major and liberal education requirements.

**Additional Required Professional Courses**

15 credits required from the following list. Course selections must be made in consultation with your faculty adviser; contract required.

*Agro 3203—Environment, Global Food Production and the Citizen (3 cr)
*AptEc 1102—Macroeconomics (3 cr)
or Econ 1102—Macroeconomics (4 cr)
*AptEc 5611—Land and Water Economics (3 cr)
*CE 5591—Environmental Law for Engineers (3 cr)
*EEB 4601—Linnology (3 cr)
*FR 3121—GIS for Natural Resource Analysis (3 cr)
*FR 3251—Role of Renewable Natural Resources in Developing Countries (1 cr)
*FR 3262—Remote Sensing of Natural Resources (3 cr)
*FR 3601—Elements of Surveying (1 cr)
*FR 4461—Water Quality: The International Dimension (3 cr)
*FW 5411—Aquatic Toxicology (3 cr)
*FW 5455—Sustainable Aquaculture (3 cr)
*FW 5571—Avian Conservation and Management (3 cr)
*FW 5603W—Habitats and Regulation of Wildlife (3 cr)
*FW 5604W—Fisheries Ecology and Management (3 cr)
*Geo 5108—Principles of Environmental Geology (3 cr)
*Geo 5361—Land Use, Landscapes, and the Law (3 cr)
*Hort 5071—Landscape and Reclamation Ecology (3 cr)
*LA 3204—Landscape Ecology (3 cr)
*NRES 3001
*NRES 3002—Survey, Measurement, and Modeling in Natural Sciences (3 cr)
*PA 5013—Law and Urban Land Use (3 cr)
*PA 5212—Managing Urban Growth and Change (3 cr)
*PA 5251—Strategic Planning and Management (1.5 cr)
*PPLa 3002—Air Pollution, People and Plants: The Science and the Ethics (3 cr)
*Pol 3441—Politics of Environmental Protection (3 cr)
*Pol 3872W—Global Environmental Politics (3 cr)
*Pol 4523—Politics of the Regulatory Process (3 cr)
*Pol 5872—Global Environmental Politics (3 cr)
*PubH 5173—Hazard-Related Exposure to Physical Agents in the Environment (4 cr)
*PubH 5200—Environmental Health (2 cr)
*RRM 4423W—Management of Recreational Lands (4 cr)
*Soil 3221—Soil Conservation and Land-Use Management (3 cr)
*Soil 4021W—Environmental Impact Statements (3 cr)
*Soil 4511—Field Study of Soils (1 cr)
*Soil 5601—Principles of Waste Management (3 cr)
*Soil 4601—Soils and Pollution (3 cr)

**Water and Soil Resources Concentration**

The water and soil resources concentration focuses on the management of water and soil resources to achieve a balance between management practices and resulting water and/or soil quality. Emphasis on informed decision-making; ecological approaches to water resource management; water movement, storage and hydrologic cycles; preventing soil erosion, land degradation and resulting impacts on off-site resources. Students must choose one of the following sub-specializations (tracks): hydrology, soil and water conservation, or water quality.

**Hydrology Track in the Water and Soil Resources Concentration**

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

All required courses in the concentration must be taken A-F and completed with a grade of at least C-. See Graduation Requirements in the CNR General Information section for more information.

**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: Perspectives on Multiculturalism (4 cr)
or EngC 1014—University Writing and Critical Reading: Contemporary Public Issues (4 cr)
Rhet 1223—Oral Presentation in Professional Setting (3 cr)
or Comm 1101—Introduction to Public Speaking (3 cr)
Rhet 3562W—Technical and Professional Writing (4 cr)
or EngC 3027W—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 (3 cr)
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)
Chem 1021—Chemical Principles I (4 cr)
and Chem 1022—Chemical Principles II (4 cr)
or Chem 1011—General Principles of Chemistry (4 cr)
and BioC 2011—Biochemistry for the Agricultural and Health Sciences (3 cr)
Phys 1201—General Physics I (5 cr)
and Phys 1202—General Physics II (5 cr)
or Phys 1101—Introductory College Physics I (4 cr)
and Phys 1102—Introductory College Physics II (4 cr)
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**

AptEc 1101—Principles of Microeconomics (3 cr)*
or Econ 1101—Principles of Microeconomics (4 cr)*

**Additional Required Core Courses**

CE 3502—Fluid Mechanics (3 cr)
FR 3104—Forest Ecology (4 cr)
or Biol 3407—Ecology (3 cr)
FR 3114—Forest Hydrology and Watershed Management (3 cr)
FW 2001—Introduction to Fisheries, Wildlife, and Conservation Biology (3 cr)
Geo 5701—General Hydrogeology (3 cr)
NRES 1001—Orientation and Information Systems (1 cr)
NRES 1201—Conservation of Natural Resources (3 cr)
NRES 3000 or NRES 3001 or NRES 3002 or NRES 5002—Colloquium (choose one) (1-2 cr)
NRES 3021—Plant Resource Management and the Environment (3 cr)
or FR 3411—Silviculture Systems (3 cr)
NRES 3211—Survey, Measurement, and Modeling in Natural Resources (3 cr)
NRES 3241W—Natural Resource Policy and Administration (3 cr)
or FR 5101—Water Resources: Individuals and Institutions (3 cr)
NRES 4061W—Water Quality: Management of a Natural Resource (3 cr)
or CE 4541—Environmental Water Chemistry (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)
WRS 5001—Field Methods in Water Resources (Cloquet) (2 cr)
* Courses with an asterisk may be used to fulfill both major and liberal education requirements.

Additional Required Professional Courses
12 credits required from the following list. Course selections must be made in consultation with a faculty adviser; contract required.
CE 4501—Hydrologic Design (4 cr)
CE 4512—Open Channel Hydraulics (3 cr)
FR 5153—Forest and Wetland Hydrology (3 cr)
Geo 4601—Limnology (3 cr)
Geo 4701—Geomorphology (3-4 cr)
Soil 5232—Soil Physics: Transport Properties and Processes (3 cr)
Soil 5555—Wetland Soils (3 cr)

Soil and Water Conservation Track in the Water and Soil Resources Concentration
Students completing the soil and water conservation track meet the requirements for certification as soil conservationists with the USDA Natural Resource Conservation Service. They can serve as soil and water conservationists for a watershed district, other governmental units, or in a private organization.
All required courses in the concentration must be taken A-F and completed with a grade of at least C-. See Graduation Requirements in the CNR General Information section for more information.

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: Perspectives on Multiculturalism (4 cr)
or EngC 1014—University Writing and Critical Reading: Contemporary Public Issues (4 cr)
Rhet 1223—Oral Presentation in Professional Setting (3 cr)
or Comm 1101—Introduction to Public Speaking (3 cr)
Rhet 3562W—Technical and Professional Writing (4 cr)
or EngC 3027W—Advanced Expository Writing (4 cr)

Mathematical Thinking
Math 1142—Short Calculus (4 cr)
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 2102—General Zoology (4 cr)
Chem 1021—Chemical Principles I (4 cr)
and Chem 1022—Chemical Principles II (4 cr)
or Chem 1011—General Principles of Chemistry (4 cr)
and BioC 2011—Biochemistry for the Agricultural and Health Sciences (3 cr)
Geo 1001—The Dynamic Earth: An Introduction to Geology (4 cr)
Phys 1001—Energy and the Environment (4 cr)
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
ApEc 1101—Principles of Microeconomics (3 cr)*
or Econ 1101—Principles of Microeconomics (4 cr)*
NRES 3261W—Economics and Natural Resource Economics (3 cr)*

Additional Required Core Courses
FR 3104—Forest Ecology (4 cr)
or Biol 3407—Ecology (3 cr)
FR 3131—Geographic Information Systems for Natural Resource Analysis (3 cr)
FR 3262—Remote Sensing of Natural Resources (3 cr)
FW 2001—Introduction to Fisheries, Wildlife, and Conservation Biology (3 cr)
NRES 1001—Orientation and Information Systems (1 cr)
NRES 1201—Conservation of Natural Resources (3 cr)
NRES 3000 or NRES 3001 or NRES 3002 or NRES 5002—Colloquium (choose one) (1-2 cr)
NRES 3021—Plant Resource Management and the Environment (3 cr)
or FR 3411—Silviculture Systems (3 cr)
NRES 3211—Survey, Measurement, and Modeling in Natural Resources (3 cr)
NRES 3241W—Natural Resource Policy and Administration (3 cr)
or WRS 5101—Water Resources: Individuals and Institutions (3 cr)
NRES 4061W—Water Quality: Management of a Natural Resource (3 cr)
or FR 3114—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)
Soil 3221—Soil Conservation and Land Use Management (3 cr)
Soil 3416—Plant Nutrients in the Environment (3 cr)
or Soil 3612W—Soil and Environmental Biology (3 cr)
Soil 4511—Field Soils (3 cr)
Soil 5555—Wetland Soils (3 cr)
WRS 5001—Field Methods in Water Resources (Cloquet) (2 cr)
or NRES 3051—Experience and Training in a Field Setting (1-3 cr)
or NRES 3205—Field Ecology in NRES (4 cr)
* Courses with an asterisk may be used to fulfill both major and liberal education requirements.

Water Quality Track in the Water and Soil Resources Concentration
Students completing the water quality track will be prepared for careers in national, state, and local government, consulting or industry. They might begin their careers as water quality technicians for a watershed district or other governmental unit, or in a private organization.
All required courses in the concentration must be taken A-F and completed with a grade of at least C-. See Graduation Requirements in the CNR General Information section for more information.

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: Perspectives on Multiculturalism (4 cr)
or EngC 1014—University Writing and Critical Reading: Contemporary Public Issues (4 cr)
Rhet 1223—Oral Presentation in Professional Setting (3 cr)
or Comm 1101—Introduction to Public Speaking (3 cr)
Rhet 3562W—Technical and Professional Writing (4 cr)
or EngC 3027W—Advanced Expository Writing (4 cr)

Mathematical Thinking
Math 1142—Short Calculus (4 cr)
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 2102—General Zoology (4 cr)
Chem 1021—Chemical Principles I (4 cr)
and Chem 1022—Chemical Principles II (4 cr)
or Chem 1011—General Principles of Chemistry (4 cr)
and BioC 2011—Biochemistry for the Agricultural and Health Sciences (3 cr)
Geo 1001—The Dynamic Earth: An Introduction to Geology (4 cr)
Phys 1001—Energy and the Environment (4 cr)
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
ApEc 1101—Principles of Microeconomics (3 cr)*
or Econ 1101—Principles of Microeconomics (4 cr)*
NRES 3261W—Economics and Natural Resource Economics (3 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 2102—General Zoology (4 cr)
Chem 1021—Chemical Principles I (4 cr)
Chem 1022—Chemical Principles II (4 cr)
CE 4541—Environmental Water Chemistry (4 cr)
or Chem 2101—Introduction to Analytical Chemistry Lecture (3 cr)
and Chem 2111—Introduction to Analytical Chemistry Lab (2 cr)
Geo 1001—The Dynamic Earth: An Introduction to Geology (4 cr)
Phys 1001—Energy and the Environment (4 cr)
or
Phys 1101—Introductory College Physics I (4 cr)
Soil 2125—Basic Soil Science (4 cr)
or
Soil 1125—The Soil Resource (4 cr)

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

Additional Required Core Courses
EEB 4601—Limnology (3 cr)
FR 3104—Forest Ecology (4 cr)
or
Biol 3407—Ecology (3 cr)
FR 3114—Forest Hydrology and Watershed Management (3 cr)
FW 2001—Introduction to Fisheries, Wildlife, and Conservation Biology (3 cr)
NRES 1001—Orientation and Information Systems (1 cr)
NRES 1201—Conservation of Natural Resources (3 cr)
NRES 3000 or NRES 3001 or NRES 3002 or NRES 5002—Colloquium (choose one) (1-2 cr)
NRES 3021—Plant Resource Management and the Environment (3 cr)
or
FR 3411—Silviculture Systems (3 cr)
NRES 3211—Survey, Measurement, and Modeling in Natural Resources (3 cr)
NRES 3241W—Natural Resource Policy and Administration (3 cr)
or
WRS 5101—Water Resources: Individuals and Institutions (3 cr)
NRES 4061W—Water Quality: Management of a Natural Resource (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)
WRS 5001—Field Methods in Water Resources (Cloquet) (2 cr)
*Courses with an asterisk may be used to fulfill both major and liberal education requirements.

Additional Required Professional Courses
12 credits required from the following list. Course selections must be made in consultation with a faculty adviser; contract required.
EEB 4605—Limnology Laboratory (1 cr)
EEB 4607—Plankton Ecology (4 cr)
EEB 4609W—Ecosystem Ecology (3 cr)
Ent 5361—Aquatic Insects (3 cr)
FR 3131—GIS for Natural Resource Management (3 cr)
or
FR 3104—Forest Ecology
FR 4461—Water Quality: The International Dimension (3 cr)
NRES 4062—Advanced Water Quality (3 cr)
NRES 4061W—Water Quality: Management of a Natural Resource (3 cr)
NRES 4062—Advanced Water Quality (3 cr)
NRES 4195W—Problem Solving in Natural Resources and Environmental Studies (4 cr)
NRES 4295W—GIS for Problem Solving in Environmental Science and Management (4 cr)
NRES 4395—Natural Resources Planning (4 cr)
NRES 4811—Natural Resources Interpretation (3 cr)
*Note: Only one NRES colloquium course may be applied to the 10 credits of other required classes.

Natural Resources and Environmental Studies Minor
This minor enables students in majors such as biology, education, journalism, political science, and others to gain a basic understanding of the principles of the use, management, and protection of natural resources and the environment. A total of 23 credits are required from the following groups of courses. Students interested in the NRES minor should contact the College of Natural Resources Student Services Office to declare the minor.

Core Requirements (13 cr)
NRES 1041—Natural Resources as Raw Materials (3 cr)
NRES 1201—Conservation of Natural Resources (3 cr)
FR 3104—Forest Ecology
or
an introductory ecology course (4 cr)
FW 2001—Fisheries, Wildlife, and Conservation Biology (3 cr)
Choose 10 additional credits from the following:
NRES 1001—Orientation and Information Systems (1 cr)
NRES 1002—Freshman Seminar (1-3 cr)
NRES 3000—Colloquium: Natural Resources and Environmental Studies (1 cr)*
NRES 3002—Colloquium: Exotic Plants and Animals (1 cr)*
NRES 3011W—Ethics and Leadership in Resource Management (3 cr)
NRES 3021—Plant Resource Management and the Environment (3 cr)
NRES 3101—Conservation of Plant Biodiversity (3 cr)
NRES 3202W—Environmental Conflict Management, Leadership, and Planning (3 cr)
NRES 3205—Field Ecology in NRES (Cloquet) (4 cr)
NRES 3211—Survey, Measurements, and Modeling in Natural Resources (3 cr)
NRES 3241W—Natural Resource Policy and Administration (3 cr)
NRES 3245—Recreation Policy and Landscape-level Planning (3 cr)
NRES 3261W—Economics and Natural Resources Management (3 cr)
NRES 3601—Our Home, Our Environment (3 cr)
NRES 4061W—Water Quality: Management of a Natural Resource (3 cr)
NRES 4062—Advanced Water Quality (3 cr)
NRES 4195W—Problem Solving in Natural Resources and Environmental Studies (4 cr)
NRES 4295W—GIS for Problem Solving in Environmental Science and Management (4 cr)
NRES 4395—Natural Resources Planning (4 cr)
NRES 4811—Natural Resources Interpretation (3 cr)

*Note: Only one NRES colloquium course may be applied to the 10 credits of other required classes.
Recreation Resource Management

Department of Forest Resources

B.S.
The recreation resource management curriculum prepares students to plan and manage natural and non-urban recreational land and water, as well as manage the people and organizations that depend on these important resources. The curriculum emphasizes natural and managed non-urban areas; natural resources-oriented recreation programs in public and private sectors; social science aspects of natural resources use; and skills in communication, planning, and management. Students select between two tracks: recreation resource management and resource based tourism. Students taking the recreation resource management track receive training in principles and techniques of resource management; students taking the resource based tourism track receive training in organizational and visitor management, policy, and administration.

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 120 credits. Students must also complete the University’s liberal education and writing intensive requirements; see page 31 of this catalog for more information. Courses with an asterisk (*) fulfill both major and liberal education requirements.

All required courses in the major must be taken A-F and completed with a grade of at least C-. See Graduation Requirements in the CNR General Information section for more information.

Required Courses

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

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: Perspectives on Multiculturalism (4 cr)
or EngC 1013—University Writing and Critical Reading: Nature and the Environment (4 cr)
or EngC 1014—University Writing and Critical Reading: Contemporary Public Issues (4 cr)
Rhet 1223—Oral Presentations in Professional Settings (3 cr)
or Comm 1101—Introduction to Public Speaking (3 cr)

Mathematical Thinking
Math 1142—Short Calculus (4 cr)
or Math 1271—Calculus I (4 cr)
Stat 3011—Introduction to Statistical Analysis (4 cr)
or Stat 5021—Statistical Analysis (4 cr)
or Soc 3811—Basic Social Statistics (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)
Chem 1011—General Principles of Chemistry (4 cr)
or BioC 2011 Biochemistry for the Agricultural and Health Sciences (3 cr)

Social Sciences and Humanities
NRES 3261W—Economics of Natural Resources Management (4 cr)
Psy 1001—Introduction to Psychology (4 cr)*
or Soc 1001—Introduction to Sociology (3 cr)*
Psy 3201—Introduction to Social Psychology (4 cr)
or Soc 3711—Principles of Social Organization (3 cr)*
or Soc 3411—Understanding Formal Organizations (3 cr)*
or Soc 3721—Principles of Social Psychology (3 cr)*
* Courses with an asterisk may be used to fulfill both major and liberal education requirements.

Recreation Resource Management Track
This track is for students who wish to develop careers in planning or managing the use of recreational land and water, and for students who plan to pursue graduate study. Graduates may become directly involved in recreation resource management and play specialized supporting roles in areas such as planning and public relations. Graduates may also pursue graduate study to facilitate career advancement or develop a foundation for research and teaching in this area.

Physical and Biological Sciences
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)

Required Professional Courses

Resource Assessment
FR 3131—Geographic Information Systems (GIS) for Natural Resources (4 cr)
NRES 3211—Survey, Measurement, and Modeling for Environmental Analysis (3 cr)

Management of Vegetation, Wildlife, Soil, and Water Resources
FR 1101—Dendrology: Identifying Forest Trees and Shrubs (3 cr)
FR 3104—Forest Ecology (4 cr)
or EEB 3001—Ecology and Society (3 cr)
or Biol 3407—Ecology (3 cr)
FR 3114—Hydrology and Watershed Management (3 cr)
or NRES 4061W—Managing Natural Water Quality (3 cr)
NRES 3021—Managing Vegetation Across Ecosystems (3 cr)
or FR 3411—Silviculture: Managing Forest Ecosystems (4 cr)
FW 2001—Introduction to Fisheries, Wildlife, and Conservation Biology (3 cr)
or NRES 3101—Conserving our Plant Biodiversity (3 cr)

Policy, Management, and Planning
ApEc 4311—Tourism Development Principles, Processes, Policies (3 cr)
NRES 3202W—Environmental Conflict Management, Leadership, and Planning (3 cr)
or NRES 3011W—Ethics and Leadership in Resource Management (3 cr)
NRES 3245—Recreation Policy and Landscape-level Planning (3 cr)
NRES 4195W—Problem Solving in Natural Resources and Environmental Studies (4 cr)
RRM 4232W—Managing Recreational Lands (4 cr)
RRM 5259—Visitor Behavior Analysis (3 cr)

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

Group 1: Social and Managerial Sciences
Anth 3041—Ecological Anthropology (3 cr)
or ApEc 5321—Regional Economic Analysis (3 cr)
Geog 3361—Land Use, Landscapes, and the Law (3 cr)
Geog 5393—The Rural Landscape (4 cr)
NRES 3241W—Natural Resource Policy and Administration (3 cr)
Rhet 3266—Group Process, Team Building and Leadership (3 cr)
RRM 3101—Native and Heritage Based Tourism (3 cr)

Group 2: Recreation Programming and Management Services
NRES 4811—Natural Resources Interpretation and Communication (3 cr)
Rec 3551—Administration and Finance of Leisure Services (4 cr)
Rec 5191—Commercial Recreation and Tourism (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)
Group 3: Management of Vegetation, Soil, and Water Resources
FR 2101—Forest Plants (Cloquet) (1 cr)
FR 2102—Forest Ecology: Field Experience (Cloquet) (2 cr)
and FR 2104—Forest Measurement Techniques (Cloquet) (1 cr)
FR 3262—Remote Sensing of Natural Resources (3 cr)
Geog 5565—Geographical Analysis of Environmental Systems and Global Change (3 cr)
Hort 5071—Restoration and Reclamation Ecology (3 cr)
LA 320—Landscape Ecology (3 cr)
LA 3501—Environmental Design and Its Biological and Physical Context (3 cr)

Electives
Choose 16 credits in other courses to reach the 120 credits required to graduate. Students should meet with their advisor when choosing these courses.

Resource Based Tourism Track
This track is for students who wish to understand the fundamentals of resource management, but focus on managing the businesses and visitors who depend on these resources for recreation and revenue. Graduates are likely to pursue opportunities developing and managing resource based tourism operations, programs, and visitors in both domestic and international locations. Graduates may also pursue graduate study to facilitate career advancement or develop a foundation for research and teaching in this area.

Physical and Biological Sciences
Geo 1001—The Dynamic Earth: An Introduction to Geology (4 cr)
or Soil 2125—Basic Soil Science (4 cr)
or Soil 1125—The Soil Resource (4 cr)

Policy, Management, and Planning (28 cr)
ApEc 4311—Tourism Development Principles, Processes, Policies (3 cr)
NRES 3245—Recreation Policy and Landscape-level Planning (3 cr)
NRES 3202W—Environmental Conflict Management, Leadership, and Planning (3 cr)
NRES 4811—Environmental Interpretation (3 cr)
or Rec 5311—Programming Outdoor and Environmental Education (3 cr)
RRM 3101—Nature and Heritage Based Tourism (3 cr)
RRM 4322W—Managing Recreational Lands (4 cr)
RRM 5259—Visitor Behavior Analysis (3 cr)
or Mktg 5010—Marketing Research (3 cr)
Rec 5191—Commercial Recreation and Tourism (3 cr)
Rec 5801—Legal Aspects of Sport and Recreation (3 cr)
or BLaw 2001—The Legal Environment (3 cr)

Service Management and Marketing (6 cr)
Mktg 3001—Principles of Marketing (3 cr)
BIE 5801—The Business of Tourism (3 cr)
or BIE 5802—Education and Human Resource Development Through Tourism (3 cr)
or Mgmt 3320—Small Business Management (3 cr)

Electives
FR 3104—Forest Ecology (4 cr)
or Biol 3407—Ecology (3 cr)
or EEB 3001—Ecology and Society (3 cr)
FR 3251—Natural Resources in Sustainable International Development (3 cr)

Recommended courses
Comm 5451—Intercultural Communication Process (3 cr)
Fina 3001—Finance Fundamentals (3 cr)

The advanced water quality class, offered during the May session, provides an intense, 3-week field experience.

Urban and Community Forestry

Department of Forest Resources

B.S.
The urban and community 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 and community 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 120 credits. Those students going into consulting or private business should choose courses in the forest health and cultural practices of urban forestry. Students interested in managing the urban landscape should concentrate on courses in the management and administration areas.

Students must also complete the University’s liberal education and writing intensive (W) requirements; see page 31 in this catalog for more information. Courses with an asterisk (*) fulfill both major and liberal education requirements.
All required courses in the major must be taken A-F and completed with a grade of at least C-. See Graduation Requirements in the CNR General Information section for more information.

**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: Perspectives on Multiculturalism (4 cr)
or EngC 1013—University Writing and Critical Reading: Nature and the Environment (4 cr)
or EngC 1014—University Writing and Critical Reading: Contemporary Public Issues (4 cr)
Rhet 1223—Oral Presentation in Professional Setting (3 cr)
or Comm 1101—Introduction to Public Speaking (3 cr)

**Mathematical Thinking**
Math 1142—Short Calculus (4 cr)
or Math 1271—Calculus I (4 cr)
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)
Chem 1021—Chemical Principles I (4 cr)
and Chem 1022—Chemical Principles II (4 cr)
or Chem 1011—General Principles of Chemistry (4 cr)
and BioC 2111—Biochemistry for Agricultural and Health Sciences (3 cr)
Soil 2125—Basic Soil Science (4 cr)
or Soil 1125—The Soil Resource (4 cr)

**Social Sciences and Humanities**
NRES 3261W—Economics of Natural Resources Management (4 cr)
Pol 1001—American Democracy in a Changing World (4 cr)
* Courses with an asterisk may be used to fulfill both major and liberal education requirements.

**Required Professional Core**

**Introductory**
FR 1001—Orientation and Information Systems (1 cr)

**Resource Assessment**
FR 3131—Geographical Information Systems (GIS) for Natural Resources (3 cr)
NRES 3211—Survey, Measurement, and Modeling in Natural Resources (3 cr)

**Field Training in the Assessment and Biology of Forests**
(taught at Cloquet Forestry Center)
FR 2101—Forest Plants (1 cr)
FR 2102—Forest Ecology Field Experience (2 cr)
FR 2104—Forest Measurement Techniques (1 cr)

**Management of Vegetation, Wildlife, Soil, and Water Resources**
Ent 4251—Forest and Shade Tree Entomology (3 cr)
FR 1101—Dendrology (3 cr)
FR 3104—Forest Ecology (4 cr)
FR 3114—Forest Hydrology and Watershed Management (3 cr)
or NRES 4061—Water Quality: Management of a Natural Resource (3 cr)
FR 3411—Silviculture Systems (3 cr)
FR 3501—Arboriculture (3 cr)
FR 4118—Tree Biology (2 cr)
or Biol 3002—Plant Biology: Function (2 cr)
FR 4501W—Urban Forest Management: Managing Greenspaces for People (4 cr)
Hort 1012—Woody Plant Materials (3 cr)
Hort 4041—Nursery Production and Management I (5 cr)
PlPa 3003—Diseases of Forest and Shade Trees (3 cr)

**Economics, Management, and Policy**
NRES 3241W—Natural Resource Policy and Administration (3 cr)
RRM 4232W—Managing Recreational Lands (3 cr)
 Urb 3001—Introduction to Urban Studies: The Complexity of Metropolitan Life (3 cr)

**Recommended Professional Courses**
Anth 3041—Ecological Anthropology (3 cr)
FR 3262—Remote Sensing of Natural Resources (3 cr)
FW 2001—Introduction to Fisheries, Wildlife, and Conservation Biology (3 cr)
FW 5603W—Habits and Regulation of Wildlife (3 cr)
Geog 3371—Introduction to Urban Geography (3 cr)
Hort 4021—Landscape Design, Implementation, and Management I (4 cr)
LA 3501—Environmental Design and Its Biological and Physical Context (3 cr)
Mgmt 3001—Fundamentals of Management (2 cr)
NRES 3021—Managing Vegetation Across Ecosystems (3 cr)
NRES 3202W—Environmental Conflict Management, Leadership, and Planning (3 cr)
NRES 3703—Agroforestry in Watershed Management (3 cr)
Rhet 3266—Group Process, Team Building, and Leadership (3 cr)
Soc 1001—Introduction to Sociology (3 cr)
Soc 3451—Urban Community (3 cr)
Soil 3416—Plant Nutrients in the Environment (3 cr)
WPS 1301—Wood as a Raw Material (3 cr)

**Electives**
Choose three credits from any discipline.

**Urban and Community Forestry Minor**
The urban forestry minor (16 cr) enables students in programs such as education, landscape architecture, horticultural sciences, natural resources, and related areas to understand the science and practice underlying the management of urban and community forests. The minor incorporates fundamental science, arboriculture, forest health, and resource management coursework. Students interested in the minor should contact the CNR Student Services Office.

**Minor Core (6 cr)**
FR 3501—Arboriculture (3 cr)
or FR 5501—Urban Forest Management (3 cr)
PlPa 3003—Diseases of Forest and Shade Trees (3 cr)
or Ent 4251—Forest and Shade Tree Entomology (3 cr)

**Additional Required Courses (10 cr)**
Select at least ten credits from the following list:
FR 3104—Forest Ecology (4 cr)
or FR 2101—Forest Plants (Cloquet) (1 cr)
and FR 2102—Forest Ecology: Field Experience (Cloquet) (2 cr)
and FR 2104—Forest Management Techniques (Cloquet) (1 cr)
FR 3218—Assessment and Modeling of Forests (3 cr)
FR 4118—Tree Biology (2 cr)
Hort 1012—Woody Plant Materials (3 cr)
NRES 3211—Survey, Measurements, and Modeling in Natural Resources (3 cr)
RRM 4232W—Management of Recreational Lands (4 cr)

**Wood and Paper Science**

**Department of Wood and Paper Science**

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

Students must also complete the University’s liberal education requirements, including the diversified core and designated theme requirements. The environment and international perspectives themes are satisfied automatically in the forest products marketing specialization by completing the required courses. For more information, see Liberal Education in the CNR general information section of this catalog.
For more information about the wood and paper science program and its specializations, contact Joe Massey, Head, Department of Wood and Paper Science at 612-624-7459 or jmassey@forestry.umn.edu.

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.

Degree Requirements

To complete the degree, students must complete 128 credits including required courses in the major, the University’s liberal education requirements, and approved writing intensive (W) courses. For more information, see page 31 in this catalog. Courses with an asterisk (*) fulfill both the major and liberal education requirements.

All required courses in the specialization must be taken A-F and completed at a grade of at least C-. See Graduation Requirements in the CNR General Information section for more information.

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: Perspectives on Multiculturalism (4 cr)
  or EngC 1014—University Writing and Critical Reading: Contemporary Public Issues (4 cr)
- Rhet 1223—Oral Presentation in Professional Setting (3 cr)
- Rhet 3562W—Technical and Professional Writing (4 cr)
  or EngC 3027W—Advanced Expository Writing (4 cr)

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

**Physical and Biological Sciences**
- Biol 1001—Introduction to Biology I: Evolutionary and Ecological Perspectives (4 cr)
  or Biol 1009—General Biology (4 cr)
- Chem 1021/1022—Chemistry Principles I and II (4 cr ea)
  or Chem 1011—General Principles of Chemistry (4 cr)
  and BioC 2011—Biotechnology for the Agricultural and Health Sciences (3 cr)
- Phys 1101—Introductory College Physics I (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)*

**Wood and Paper Science**
- WPS 1001—Wood and Paper Science Professional Orientation (1 cr)
- WPS 1002—Application of Computer and Sensor Technology to Problems in Wood and Paper Science (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)
- WPS 5402—Business Markets in the Forest Products Industry (3 cr)

**Marketing/Business**
- Accr 2050—Introduction to Financial Reporting (4 cr)
- Accr 3001—Introduction to Management Accounting (2 cr)
- Blaw 3058—The Law of Contracts and Agency (4 cr)
- Fina 3001—Finance Fundamentals (2 cr)
- Mgmt 3001—Fundamentals of Management (2 cr)
- Mktg 3001—Principles of Marketing (2 cr)
  or Mktg 3010—Marketing Research (4 cr)
  or Mktg 4030—Selling and Sales Management (4 cr)

**Additional Required Course**
- NRES 1041—Natural Resources as Raw Materials (3 cr)

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

* Courses with an asterisk may be used to fulfill both major and liberal education requirements.

Special Learning Opportunities

Work experiences in summer jobs, internships, and 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.

All paper science and engineering graduates in the 2001 class had multiple employment offers prior to graduation; those offers provided an average starting salary of $54,000.
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.

**Degree Requirements**

To complete the degree, students must complete 132 credits including required courses in the major, the University’s liberal education requirements, and approved writing intensive (W) courses. For more information, see page 31 in this catalog. Courses with an asterisk (*) fulfill both major and liberal education requirements.

All required courses in the specialization must be taken A-F and completed with a grade of at least C-. See Graduation Requirements in the CNR General Information section for more information.

**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  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)  
Math 2243—Linear Algebra and Differential Equations (4 cr)  
Math 2263—Multivariable Calculus (4 cr)  
Stat 5021—Statistical Analysis (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 for Science and Engineering I (4 cr)  
Phys 1302— Introductory Physics for Science and Engineering II (4 cr)  

**Social Sciences and Humanities**

ApEc 1101—Principles of Microeconomics (3 cr)*  
NRES 3241W—Natural Resource Policy and Administration (3 cr)*  

**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 4313—Pulp and Paper Process Unit Operations (3 cr)

WPS 4314—Papermaking Processes and Engineering Lab (3 cr)  
WPS 4318—Pulp and Paper Process Simulation and Control (3 cr)  
WPS 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)  
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)

* Courses with an asterisk may be used to fulfill both major and liberal education requirements.

**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.

**Paper Science and Engineering Minor**

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—Papermaking Processes and Process Engineering Laboratory (3 cr)  
WPS 4321—Material Science of Paper (3 cr)  
WPS 4322—Biological and Environmental Science of Paper (2 cr)  
WPS 4359—Surface, Colloids, and Coating Processes (4 cr)  
WPS 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.

**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. Courses with an asterisk (*) fulfill both major and liberal education requirements. For more information, see page 31 in this catalog.

All required courses in the specialization must be taken A-F and completed with a grade of at least C-. See Graduation Requirements in the CNR General Information section for more information.
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: Perspectives on Multiculturalism (4 cr)
or EngC 1014—University Writing and Critical Reading: Contemporary Public Issues (4 cr)
Rhet 1223—Oral Presentation in Professional Setting (3 cr)
or Comm 1101—Introduction to Public Speaking (3 cr)
Rhet 3562W—Technical and Professional Writing (4 cr)
or EngC 3027W—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 2011—Biochemistry for the Agricultural and Health Professions (3 cr)
Phys 1101—Introductory College Physics I (4 cr)
Phys 1102—Introductory College 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)*

**Wood and Paper Science**
WPS 1001—Wood and Paper Science Profession Orientation (1 cr)
WPS 1002—Application of Computer and Sensor Technology to Problems in Wood and Paper Science (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 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**
AgEe 3213—Engineering Principles and Applications (3 cr)
CE 3402—Construction Materials (3 cr)
CMgt 4013—Legal and Ethical Issues in Construction (2 cr)
or CMgt 4030—Construction Safety and Loss Control (2 cr)
IE 4521—Statistics, Quality, and Reliability (4 cr)
HRIR 3071—Collective Bargaining and Labor Relations (4 cr)
Mgmt 3001—Fundamentals of Management (2 cr)

**Additional Required Courses**
NRES 1041—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)

*Courses with an asterisk may be used to fulfill both major and liberal education requirements.

**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.

**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. Courses with an asterisk (*) fulfill both major and liberal education requirements. For more information, see page 28 in this catalog.

All required courses in the specialization must be taken A-F and completed with a grade of at least C-. See Graduation Requirements in the CNR General Information section for more information.

**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: Perspectives on Multiculturalism (4 cr)
or EngC 1014—University Writing and Critical Reading: Contemporary Public Issues (4 cr)
Rhet 1223—Oral Presentation in Professional Setting (3 cr)
or Comm 1101—Introduction to Public Speaking (3 cr)
Rhet 3562W—Technical and Professional Writing (4 cr)
or EngC 3027W—Advanced Expository Writing (4 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)

*Courses with an asterisk may be used to fulfill both major and liberal education requirements.

**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.

**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. Courses with an asterisk (*) fulfill both major and liberal education requirements. For more information, see page 31 in this catalog.

All required courses in the specialization must be taken A-F and completed with a grade of at least C-. See Graduation Requirements in the CNR General Information section for more information.

**Required Courses**
**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
Biol C 2011—Biochemistry for the Agricultural and Health Sciences (3 cr)

Phys 1101—Introductory College Physics I (4 cr)
Phys 1102—Introductory College 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)*

Arch 1401—The Designed Environment (3 cr)*

**Wood and Paper Science**
WPS 1001—Wood and Paper Science Profession Orientation (1 cr)
WPS 1002—Application of Computer and Sensor Technology to Problems in Wood and Paper Science (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)
WPS 4401—Forest Products Marketing (4 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)
OMS 3001—Introduction to Operations Management (2 cr)

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

**Suggested Electives**
BLaw 3058—Law of Contracts and Agency (3 cr)
OMS 3059—Quality Management (4 cr)
PubH 5200—Topics in Environmental Health (2 cr)

*Courses with an asterisk may be used to fulfill both major and liberal education requirements.*

**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.

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College of Natural Resources