M.S. IN ENVIRONMENTAL SCIENCE

The Master of Science in Environmental Science is an applied program designed to meet the needs of a wide variety of students, including those already working in the environmental field or those just completing their baccalaureate education. Both thesis and non-thesis options are available as well as a Five-year B.S./M.S. Program. Evening classes are offered; some labs are available on weekends.

The Department of Biology, Chemistry and Environmental Science is actively engaged in research projects and in teaching a full complement of coursework. We encourage student involvement in our applied and basic research and enjoy guiding students through their own particular areas of research interest. Located in the environmentally rich coastal plain of Virginia, there is access to a variety of excellent field research sites. The department conducts research at ecological study sites in Canada, Utah, Nevada, Blue Ridge Mountains of Virginia, piedmont rivers of Virginia, Hoffler Creek Nature Preserve in Portsmouth, the Great Dismal Swamp National Wildlife Refuge, and aquatic research at Lake Maury close to the CNU campus.

All course offerings are taught in the newly built 160,000-square-foot Mary Brock Forbes Hall containing 70 teaching labs and student research space.

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Master of Science in Environmental Science

The Master of Science in Environmental Science is designed for current and prospective students in the rapidly growing field of environmental monitoring and conservation. This degree program is flexible enough to fit the interests and needs of a wide variety of students and is designed for students planning to pursue a Ph.D., teachers desiring a M.S. in a biological science, or students interested in careers involving environmental assessment, monitoring and conservation.

The core courses are those mentioned most frequently by employers, consultants and educators as those needed for successful employment. The remainder of the curriculum is designed to enhance the understanding of ecosystem ecology, the conservation of organisms and their environment, and environmental chemistry. Many of these courses involve or consist entirely of fieldwork, since the majority of the employers surveyed are seeking graduates with first-hand knowledge of analyzing the environment.

Admission Requirements for Degree-seeking Students

1. A baccalaureate degree from a regionally accredited college or university with a minimum grade point average of 3.00 on a 4.00 scale.
2. An official transcript from the baccalaureate institution with the degree posted, and official transcripts for all graduate work taken at other institutions.
3. Three letters of recommendation from people who can attest that the applicant is likely to be successful in graduate-level academic work. All recommendations must arrive in unopened envelopes with the reference's signature across the envelope flap.
4. Scores from the Graduate Record Examination General Test taken within five years prior to the date of admission. Graduate Record Examination (GRE) score at or above 950 cumulative on the Verbal and Quantitative sections is required, and a score at or above 1000 is preferred. GRE scores are used as one of several indicators of the applicant's ability to succeed in graduate studies. For applicants already holding a master’s degree, the GRE may be waived by permission of the Director of Graduate Studies. A letter to the Director of Graduate Studies requesting a waiver is required.

Academic Policy for Non-degree Students

Students seeking non-degree admission status must have a grade point average of at least 3.0 on a 4.0 scale. Non-degree students are limited to 12 hours of graduate study. Up to 12 credits of graduate study may be applied to the graduate degree should a non-degree student apply and be accepted to degree-seeking status. Should a non-degree student desire additional courses beyond the 12-credit limit, he or she may petition the Graduate Program Coordinator for a waiver of this limit. Non-degree seeking students must meet the prerequisites before enrolling in a graduate course or obtain the consent of the instructor. Admission requirements for non-degree students are found on page 16 of this catalog.

Changing from Non-degree Status to Degree-seeking Status

A non-degree student may apply to change to degree-seeking status if he or she:

- has completed 12 hours of CNU graduate courses with a cumulative 3.0 GPA or higher,
- has a status of Good Academic Standing, and
- has submitted passing scores from the Graduate Record Exam.

To apply, submit the ***Request for Change to Degree-seeking Status*** form to Graduate Admissions along with the documentation listed in **Admissions Requirements for Degree-seeking Students** shown on this page.

Academic Prerequisites

Students will provide evidence of satisfactory completion of a broad background of undergraduate courses including, yet not limited to: cellular biology, molecular biology, organismal biology, ecology, genetics, and statistics, as well as complete sequences of general and organic chemistry.

Goals of the Program

The curriculum of this program will contribute to the achievement of instructional goals in the following areas:

1. Solid background in ecological and environmental conservation theory;
2. Skills required for employment with environmental assessment/monitoring businesses, and state and federal governmental agencies;
3. Research and technical writing skills;
4. Preparation for further graduate work.

Curriculum

The Master of Science in Environmental Science degree program consists of thesis or non-thesis options. Many courses feature a prominent laboratory or field component in order to teach analytical and practical skills, while other courses are designed to build research and technical writing skills. The remainder of the course offerings is designed to enhance the understanding of ecology and the natural history of organisms. Many of the courses involve, or consist entirely of, fieldwork since employers are seeking graduates with first-hand knowledge of the environment and environmental assessment methods. Late afternoon and evening courses are available. Most courses beyond the core courses may be taken in any sequence.

Thesis Option

The thesis option is a 33-hour program that requires 7 hours of core courses, 20 hours of concentration courses (chosen with the guidance of the student's advisor and thesis committee), and 6 hours of thesis research. An oral presentation and defense of the written thesis are required.

Non-Thesis Option

The non-thesis option is a 36-hour program that consists of 7 hours of core courses, 26 hours of concentration courses designed with the guidance of the student's advisor and committee, and 3 hours of project research. Non-thesis project research, typically limited in scope and with a reduced time demand than the thesis, will be designed under the supervision of the advisor and committee. An oral report and written report of the completed project are required.

Graduation Requirements

Thesis Option

- Successful completion of 27 hours (minimum) of the M.S. in Environmental Science degree program coursework and 6 hours of thesis (ENVS 699);
- Cumulative graduate grade point average of 3.00 in all CNU courses submitted for graduate credit with no more that two grades of ***C;***
- Successful completion of the comprehensive examination;
- Successful defense of thesis and presentation of the appropriate number of approved copies to the Office of Graduate Studies by the published deadline;
- Presentation of an electronic copy of the thesis to the chair of the committee in an acrobat.pdf format on CD suitable for archive purposes only.

Non-Thesis Option

- Successful completion of 33 hours (minimum) of the M.S. in Environmental Science degree program coursework and 3 hours of non-thesis project (ENVS 689);
- Cumulative graduate grade point average of 3.00 in all CNU courses submitted for graduate credit with no more that two grades of ***C;***
- Successful completion of the comprehensive examination;
- Oral presentation and written copy of project to advisor and committee;
- Presentation of an electronic copy of project to the chair of the committee in an acrobat.pdf format on CD suitable for archive purposes only.

Internships and Graduate Assistantships

Graduate assistants are employed to conduct research, perform administrative activities, and/or teach as directed by the graduate faculty within the department. The position requires a weekly time commitment and is awarded on a competitive basis. To qualify, a student must be a degree-seeking student with no limits or provisions, be enrolled in 6-9 graduate credit hours in the semester of the award. Contact the Graduate Program Coordinator for details. Additional information is on page 35 of this catalog.

Internships with environmental departments of municipalities, resource agencies, laboratories and engineering firms are available. The student gains practical experience in a workplace environment learning detailed methods of site evaluation, environmental assessment and technical report preparation. Many of the internships offer financial support to the student.

Master of Science in Environmental Science
Program of Study 33-36 Credits

Core Courses (7 credits)

ENVS 505	Technical and Scientific Writing (2)
ENVS 510/510L	Biometry & Lab (5)

Concentration Courses (20 credits for Thesis Option OR 26 credits for Non-Thesis Option)

ENVS 518	Biological Conservation: Theory and Practice (3)
ENVS 519	Restoration Ecology (3)
ENVS 522	Summer Field Studies (2)
ENVS 525	Environmental Regulations (3)
ENVS 530	Biogeography (3)
ENVS 532/532L	Wetlands Ecology & Lab (4)
ENVS 534/534L	Marine Ecology & Lab (4)
ENVS 535/535L	Ornithology & Lab (4)
ENVS 536/536L	Terrestrial Ecology & Lab (4)
ENVS 538/538L	Limnology and Aquatic Biology & Lab (4)
ENVS 540/540L	Environmental Microbiology & Lab (4)
ENVS 541	Urban Wildlife (3)
ENVS 545/545L	Mammalogy & Lab (4)
ENVS 550	Global Change (3)
ENVS 555/555L	GIS & Spatial Analysis Techniques & Lab (4)
ENVS 590	Topical Seminars in Environmental Science (1-4 cr.)
CHEM 535	Nanochemistry and Nanotechnology (3)
CHEM 543	Atmospheric Chemistry (3)
CHEM 545/545L	Instrumental Methods in Environmental & Lab (4)
CHEM 555/555L	Environmental Instrumental Analysis & Lab (4)
CHEM 560	Polymer Chemistry (3)
CHEM 565	Environmental Chemistry (3)
CHEM 570	Advanced Organic Chemistry (3)
CHEM 580	Chemical Spectroscopy (3)

Thesis or Project (6 credits for Thesis Option OR 3 credits for Non-Thesis Option)

ENVS 699	Thesis Research (6)
ENVS 689	Project Research for Non-thesis (3)

TOTAL **33 credits** (Thesis) **OR** **36 credits** (Non-Thesis)

Five-Year B.S./M.S. Program in Environmental Science

The Master of Science in Environmental Science is designed for current and prospective students in the rapidly growing field of environmental monitoring and conservation. This five-year program leads to both a Bachelor of Science and a Master of Science in Environmental Science and provides a solid background in ecological and environmental conservation theory.

This degree program is flexible enough to fit the interests and needs of a wide variety of students and is designed for students planning to pursue a Ph.D., teachers desiring a Master of Science in a biological science, or students interested in careers involving environmental assessment, monitoring or conservation.

How and When to Apply

After completion of 30 credit hours of undergraduate study, complete the *Statement of Intent* to participate in the five-year program. In this Statement, the student and his/her undergraduate advisor design a tentative five-year course schedule and discuss the objectives and requirements of the program. This form is distributed to the faculty advisor and the Graduate Program Coordinator.

After completion of 65 credit hours of undergraduate study, the application to the Five-Year BS/MS Program is submitted no later than February 1 of the junior year. The *Application for Admission to the Five-Year Program* is available from the Graduate Program Coordinator. The application for admission is reviewed by a Graduate Admissions Committee and the Office of Graduate Studies.

Requirements for Admission

Criteria for student admission into a five-year program:

a) Undergraduate cumulative GPA of 3.0 or higher. Transfer students must demonstrate at least 12 hours of earned credit at CNU with a GPA of 3.0 or higher.
b) GPA in the student's major of at least 3.0.
c) Submission of one of the following:
    i) A minimum SAT Score of 1100 with at least 530 in the verbal and quantitative sections (must be less than five years old);
    ii) ACT Score of a composite score of 24, with the ACT math score no less than 22, and an English plus Reading score no less than 46;
    iii) Graduate Record Examination (GRE) General Test score at or above 950 for the Verbal and Quantitative sections combined. GRE scores are used as one of several indicators of the applicant's ability to succeed in graduate studies.
d) Two letters of recommendation. One must be from a faculty member in the major who has taught or mentored the student in a major course or research project.

Program Requirements

a) Upon acceptance into the five-year program, students work with their academic advisors and the Graduate Program Coordinator to determine a specific Program of Study. The Program of Study must be filed with the Office of Graduate Studies. Students begin taking graduate courses in their senior year at CNU.
b) To continue in the five-year program a student must maintain a 3.0 GPA, and remain in good standing by earning a grade of ***B-*** or better in any graduate course taken while in the undergraduate status.
c) If an undergraduate student in a five-year program earns a single grade of ***F*** or two grades of ***C+*** or lower in a graduate-level course(s), that student will not be allowed to continue in the five-year programand the offer of admission to the graduate program will be rescinded.
d) Upon completion of the normal requirements in the student’s undergraduate program, a baccalaureate degree will be awarded to the student.

Graduate Course Hours

Graduate credit hours taken as a five-year B.S./M.S. undergraduate are subject to the following requirements:

a) A maximum of nine (9) hours of credit will be allowed while classified as an undergraduate.
b) All courses must be approved by the student's advisor and be part of the student's Plan of Study.
c) The student will be held to the same standards in these classes as a graduate student.
d) To continue to take graduate courses as an undergraduate, a student must complete each course with a grade of B- or better.
e) Graduate cross-listed courses will count toward the student's major requirements in exactly the same way that the corresponding undergraduate cross-listed courses would count. If a graduate course, which is not cross-listed, is used to satisfy a requirement of the undergraduate major then the student must get the course substitution approved by the department chair to substitute the graduate course for a required course in the major. Any graduate-level course used to satisfy undergraduate major requirements will not be eligible to be transferred to the graduate transcript.
f) Five-year students are required to do the thesis option in order to complete the curriculum within the five years.
g) Students in the five-year program who have taken graduate courses (up to 9 credit hours) as undergraduates will have 6 graduate credits moved to their graduate transcripts and will be required as graduate students to take a minimum of 24 graduate credits for the M.S. in Environmental Science thesis track (see example below).
h) The number of credit hours on the graduate transcript must total at least 30 overall.

Example of Five-year Program Course of Study

Example: Five-year student takes **nine** graduate credit hours while in undergraduate status

Undergraduate Status

9 credits	Graduate Courses taken in senior year (6 credits to be moved to Graduate Transcript)
117 credits	Undergraduate Courses
126 credits	Total

Graduate Status

6 credits	Graduate Courses transferred from Undergraduate Transcript
2 credits	Summer
12 credits	Fall
10 credits	Spring
30 credits	Total for MS in ENVS

Further information about this program may be found at ***http://www.cnu.edu/bces/pdf/fiveyear_msenvs.pdf.***

M.S. IN ENVIRONMENTAL SCIENCE
COURSES OF INSTRUCTION

ENVIRONMENTAL SCIENCE

ENVS 505. Technical and Scientific Writing (2-2-0)
This course discusses the fundamentals of technical writing with consideration of other types of scientific writing. The stylistic and mechanical problems characteristic of technical writing are considered and worked on individually and in groups. Students write and edit journal articles.

ENVS 510. Biometry (3-3-0)
Corequisite: ENVS 510L
The application of statistical methods to biological problems. Experimental design, data acquisition, single and multiple analysis of variance, regression and correlation are covered. Test selection and modeling are also included.

ENVS 510L. Biometry Laboratory (2-0-3)
Corequisite: ENVS 510.
Develops skills in the use of statistical software packages including relational databases.

ENVS 518. Biological Conservation: Theory and Practice (3-3-0)
Biological conservation is a relatively new, applied discipline having more ethical and sociopolitical ramifications than is typical of non-medical scientific disciplines. This course covers the development of conservation theory, biodiversity and problems of determining and evaluating biodiversity, relevant ecological principles, and ethical and economic issues. The course considers current conservation problems and the methods and strategies. The first part of the course is in lecture format and the second part is in seminar format.

ENVS 519. Restoration Ecology (3-3-0)
This course familiarizes the student with the newly emerging science of restoration ecology, including its theoretical foundation and its application in today's world. The first part of the course concerns case studies and the second part of the course, in seminar format, concerns recently published studies found in the peer-reviewed literature.

ENVS 522. Summer Field Studies (2-0-2)
A one-week field camp in selected habitats emphasizing application of field data gathering and processing techniques to the solving of multifaceted environmental problems. Travel, camping and boat work required. An additional day on campus is required for student presentations.

ENVS 525. Environmental Regulations (3-3-0)
A seminar designed to explore current environmental regulations and their impact on various constituents.

ENVS 530. Biogeography (3-3-0)
The study of the patterns of distributions of organisms, both past and present, and the abiotic and biotic factors that produced those distributions.

ENVS 532. Wetlands Ecology (4-3-0)
Corequisite: ENVS 532L
A study of the structure and function of wetland systems from salt to fresh and tropical to the arctic. Concepts will cover hydrology, biogeochemistry, wetland development and succession. Wetland delineation, management, creation and restoration apply these concepts.

ENVS 532L. Wetlands Ecology Laboratory (0-0-4)
Corerequisite: ENVS 532
Field exercises in local wetlands applying principles from lecture.

ENVS 534. Marine Ecology (4-3-0)
Corequisite: ENVS 534L
Ecology of the disturbed and non-disturbed marine environment. Topics covered include: global distribution of marine organism and the factors influencing their distribution, plankton ecology, the benthos, salt marsh and sea grass ecology, rocky shore and coral reef ecology, human exploitation and interference in marine habitats, and sampling techniques in marine systems.

ENVS 534L. Marine Ecology Laboratory (0-0-4)
Corerequisite: ENVS 534
Extensive field and local bay exercises applying principles from lecture.

ENVS 535. Ornithology (4-3-0)
Corequisite: ENVS 535L
An introduction to the biology of birds. Topics covered include anatomy, physiology, behavior, ecology, evolution, identification and conservation. Students are expected to present an in-class lecture and lead one lab session.

ENVS 535L. Ornithology Laboratory (0-0-4)
Corerequisite: ENVS 535
Lab is field-oriented and includes several Friday afternoon field trips and two weekend trips lasting one or two days. Students are required to attend two Friday afternoon trips and at least one weekend trip. Lab focuses on the identification of birds using both ocular and acoustic characters.

ENVS 536. Terrestrial Ecology (4-3-0)
Corerequisite: ENVS 536L
A study of the structure and function of terrestrial systems focusing on the distinctive landscapes of the mid-Atlantic coastal region. Concepts will cover population, community and ecosystem ecology of plants and animals within these systems with attention given to the processes and functions that are distinct within and common among these systems.

ENVS 536L. Terrestrial Ecology Laboratory (0-0-4)
Corerequisite: ENVS 536
Field exercises in local terrestrial ecosystems applying principles from lecture.

ENVS 538. Limnology and Aquatic Biology (4-3-0)
Corerequisite: ENVS 538L
Interactions of physical, chemical and biological properties in natural and degraded freshwater ecosystems. Emphasis on application of field data gathering, processing and functional classification of organisms in aquatic communities.

ENVS 538L. Limnology & Aquatic Biology Lab (0-0-4)
Corerequisite: ENVS 538
Extensive field and laboratory exercises in local lakes and streams applying principles from lecture.

ENVS 540. Environmental Microbiology (4-3-0)
Corerequisite: ENVS 540L
The course investigates the role microorganisms play in terrestrial, aquatic, and marine ecosystems. The course explores: the dynamics of microbial populations and communities; normal microbiota and their interactions with other organisms; and environmental pathologies in which microorganisms are the primary agent (e.g., coliforms and other fecal contaminants in water, and adicophiles in mine tailings).

ENVS 540L. Environmental Microbiology (0-0-4)
Corerequisite: ENVS 540
Laboratory exercises include classic environmental testing procedures and novel new assessment procedures that have their roots in biochemistry and molecular biology.

ENVS 541. Urban Wildlife (3-3-0)
Prerequisites: At least one upper-level course in ecology and/or zoology
An introductory course into wildlife management, focusing on wildlife in urban ecosystems. In addition to considering general wildlife issues such as nutrition, cover, water and disease, the course explores the urban climate and ecosystems, the types of species that typically inhabit North American urban ecosystem, human-wildlife interactions, and management strategies to benefit desired species and to control undesired species.

ENVS 545. Mammalogy (4-3-0)
Corerequisite: ENVS 545L
A study of the basic principles of mammalian biology. Students learn to recognize Virginia's mammals and gain an understanding of global mammalian diversity and systematics. The course provides a broad understanding of the natural history of mammalian groups and species, and investigates the roll of mammals in natural and urban systems. Conservation of this important taxonomic group is also discussed. Students are expected to present an in-class lecture and lead one lab session.

ENVS 545L. Mammalogy Lab (0-0-4)
Corerequisite: ENVS 545
The lab is field oriented, and includes regular field trips to explore field biology and field identification.

ENVS 550. Global Change (3-3-0)
An examination of the evidence for and causes of global change. The impact of changes in the global cycles of C, N, P and H2O on ecosystem structure and function are examined. Atmosphere, terrestrial and aquatic biosphere changes are discussed along with their effect on plant and animal communities. Students present current scientific papers on various issues within this field.

ENVS 555. GIS & Spatial Analysis Techniques (4-3-0)
Corerequisite: ENVS 555L
In this course, computer information mapping, output design, spatial analyzes, GPS applications, and remote sensing techniques are discussed, explored (hands-on), and applied to local and regional problems.

ENVS 555L. GIS & Spatial Analysis Techniques Laboratory (0-0-4)
Corerequisite: ENVS 555
Lab includes the application of ArcGIS (ESRI Co.) software in combination with collecting field data with Trimble GPS to geospatially address environmental questions.

ENVS 590. Topical Seminars in Environmental Science (1-4 credits)
Prerequisites: These vary depending on the topic offered.
A variety of environmental science-related topics not available in the regular curriculum are offered. These courses will be designed to fill a particular need not met by the regular courses or may be designed to use the talents of an environmental scientist who is not part of the faculty.

ENVS 595. Advanced Topics in Environmental Science
(Credit varies)
Course topics are selected on the basis of faculty and student interests.

ENVS 599. Independent Study (1-3 Credits)
Qualified students may enrich their program through directed reading or independent research under faculty supervision and for University credit. Goals, prerequisites, stages and grading are agreed upon in writing by the faculty member and the student and are submitted for approval prior to enrollment. See page 19 for specific instructions and procedures.

ENVS 689. Project Research for Non-Thesis (1-3 Credits, taken in increments)
The student may not proceed beyond the first credit without Project Research Committee approval of the project.

ENVS 699. Thesis Research (1-6 Credits, taken in increments)
The student may not proceed beyond the first credit without thesis committee approval of the proposal.

CHEMISTRY

CHEM 535. Nanochemistry & Nanotechnology (3-3-0)
This course will cover the fundamentals of nanochemistry and nanotechnology in terms of synthesis, characterization and applications of nanomaterials.

CHEM 543. Atmospheric Chemistry (3-3-0)
This course presents an introduction to the chemistry of the troposphere and stratosphere. Emphasis is placed on the structure of the atmosphere, photochemical smog, global climate change and greenhouse gases, stratospheric ozone depletion, and particulate matter in the troposphere.

CHEM 545. Instrumental Methods in Chemistry (4-2-0)
Corerequisite: CHEM 545L
Application of chemical principles to instrumentation. Instruction in operation of a variety of modern instruments.

CHEM 545L. Instrumental Methods in Chemistry Laboratory (0-0-5)
Corerequisite: CHEM 545
Laboratory exercises include instruction in operation of a variety of modern instruments.

CHEM 555. Environmental Instrumental Analysis (4-2-0) *Prerequisite: CHEM 445 or 545;*
Corerequisite: CHEM 555L
Analytical methods for the analysis of environmentally significant substances in both trace and macroscopic abundances using modern instrumental methods. Analyses include both desirable and objectionable impurities in air and water, such as oxygen in water samples and heavy metal in water, and trace gases and other atmospheric impurities. Emphases in AA and GC-MS with other instruments used as needed.

CHEM 555L. Environmental Instrumental Analysis Laboratory (0-0-5)
Corerequisite: CHEM 555
Laboratory exercises include instruction in operation of instruments and analyses specific to the environmental field.

CHEM 560. Polymer Chemistry (3-3-0)
This course investigates the synthesis, characterization, processing, testing and application of a wide variety of polymer materials. Structure-property relationships will be emphasized.

CHEM 565. Environmental Chemistry (3-3-0)
The study of the reactions, transport, effects, sources and fates of chemical species in the atmospheric, aquatic and terrestrial environments. Students prepare a comprehensive paper and presentation.

CHEM 570. Advanced Organic Chemistry (3-3-0)
Synthesis is a central part of organic chemistry. Students in this course study the recent developments in organized chemistry and learn how to keep abreast of this ever-changing subject.

CHEM 580. Chemical Spectroscopy (3-3-0)
Prerequisite: *CHEM 342 or Approval of Instructor*
The course focuses on the application of quantum mechanics and group theory to determining molecular structure and to developing concepts central to the theory behind and design of modern analytical instrumentation.

CHEM 595. Advanced Topics in Chemistry (Credit varies)
Course topics are selected on the basis of faculty and student interests.

CHEM 599. Independent Study (1-3 Credits)
Qualified students may enrich their program through directed reading or independent research under faculty supervision and for University credit. Goals, prerequisites, stages and grading are agreed upon in writing by the faculty member and the student and are submitted for approval prior to enrollment. See page 19 for specific instructions and procedures.