Programs of Study

- Accounting and Finance (ACFI)
- Agricultural Sciences (ANFS)
- Analytics (DATA)
- Biochemistry (BCHM)
- Biological Sciences (DBS)
- Biotechnology (BIOT)
- Business Administration (ADMN)
- Chemical Engineering & Bioengineering (CHBE)
- Chemistry (CHEM)
- Civil and Environmental Engineering (CEE)
- College Teaching (GRAD)
- Communication Sciences and Disorders (CSD)
- Community Development Policy and Practice (CSPP)
- Computer Science (CS)
- Computing (COMP)
- Cybersecurity Policy and Risk Management (CPRM)
- Decision Sciences (DS)
- Earth Sciences (ESCI)
- Economics (ECON)
- Education (EDC)
- Education (EDUC)
- Electrical and Computer Engineering (ECE)
- English (ENGL)
- Genetics (GEN)
- Geospatial Science (GSS)
- Global Conflict and Human Security (GCHS)
- Health Care (HLTC)
- Health Management & Policy (HMP)
- History (HIST)
- Human Development and Family Studies (HDFS)
- Human Services (HMSV)
- Integrated Applied Mathematics (IAM)
- Justice Studies (JUST)
- Kinesiology (KIN)
- Leadership (LD)
- Liberal Studies (LS)
- Marine Science and Ocean Engineering (SMOE)
- Mathematics and Statistics (MATH)
- Mechanical Engineering (ME)

- Microbiology (MICR)
- Molecular, Cellular, Biomedical Sciences (MCBS)
- Music (MUSI)
- National Security Intelligence Analysis (NSIA)
- Natural Resources (NR)
- Natural Resources and Earth Systems Science (NRESS)
- Nonprofit
- Nursing (NURS)
- Nutritional Sciences (NUTR)
- Occupational Therapy (OT)
- Ocean Engineering (OE)
- Oceanography (OCE)
- Operations Management (OPS)
- Physics (PHYS)
- Political Science & International Affairs (PSIA)
- Project Management (PM)
- Psychology (PSYC)
- Public Administration (CSPP)
- Public Health (PHP)
- Public Policy (CSPP)
- Recreation Management and Policy (RMP)
- Social Work (SW)
- Sociology (SOC)
- Spanish (SPAN)
- Systems Design (ENGR)
- Women's and Gender Studies (WGS)

Accounting and Finance (ACFI)

https://paulcollege.unh.edu/accounting-finance-department

Degree Offered: Master of Science (M.S.)

Programs are offered in Durham.

The Department of Accounting and Finance within the Peter T. Paul College of Business and Economics offers two master's programs: the Master of Science in Accounting and the Master of Science in Finance. Both master's programs emphasize strong analytical and communication skills while fostering an awareness of ethical issues. The Paul College is accredited by the Association to Advance Collegiate Schools of Business (AACSB).

The Master of Science in Accounting provides students with range and depth in accounting while developing their ability to become innovative problem solvers in public accounting firms, large corporations, non-profits, and small businesses. Students with undergraduate accounting degrees can complete the program in one year of full-time study or three years of part-time study Students without an undergraduate degree in accounting can apply but will need to take additional undergraduate foundation courses prior to beginning the graduate program. The program satisfies the 150-credit hour requirement of most Certified Public Accounting state licensing boards, including the state of New Hampshire.

The Master of Science in Finance provides students with the analytical, programming, and problem-solving skills necessary to succeed in a complex financial environment. Upon graduation, these skills can be utilized in a variety of institutions, including investment banks, commercial banks, corporations, and asset management firms. Applicants must have an undergraduate degre but can come from any background. The program can be completed full-time in 10 months.

- Accounting (M.S.)
- Finance (M.S.)

Accounting and Finance(ACFI)

ACFI 801 - Corporate Finance

Credits: 3
This course provides the foundation of corporate finance. Topics include investment criteria, capital structure, valuation, merger and acquisitions, real options, and payout policy.
Repeat Rule: May be repeated for a maximum of 6 credits.
Grade Mode: Letter Grading

ACFI 802 - Investments

Credits: 3
This course provides an overview of several important topics in investments: securities and markets, asset pricing theory, stock analysis and valuation, fixed income securities, stock options, and applied portfolio management.
Repeat Rule: May be repeated for a maximum of 6 credits.
Grade Mode: Letter Grading

ACFI 803 - International Financial Management

Credits: 3
This course explores the financial management of firms operating in a global environment. Topics typically include foreign exchange markets, the financing of international trade, multinational tax management, derivatives used to mitigate internationa exposure, and the financial impact of foreign currency usage.
Mutual Exclusion: No credit for students who have taken ADMN 846.
Grade Mode: Letter Grading

ACFI 804 - Derivative Securities and Markets

Credits: 3

This course explores the basic types of derivative instruments (forwards, futures, options, swaps) and their use in the context of financial risk management by investors, firms and financial institutions. Topics include the mechanics of derivatives markets, practical and theoretical aspects of hedging and speculating using derivatives, and methodologies for pricing derivatives.

Prerequisite(s): ACFI 801 with a minimum grade of B- and ACFI 802 with a minimum grade of B-.

Repeat Rule: May be repeated for a maximum of 6 credits.

Grade Mode: Letter Grading

ACFI 805 - Financial Institutions

Credits: 3

This course explores the financial institutions that create credit and liquidity for businesses and other borrowers, the financial instruments that facilitate credit and liquidity creation, and the markets in which those instruments are sold or traded. Special emphasis is paid to commercial banks.

Prerequisite(s): ACFI 801 with a minimum grade of B- and ACFI 802 with a minimum grade of B-.

Repeat Rule: May be repeated for a maximum of 6 credits.

Grade Mode: Letter Grading

ACFI 806 - Financial Modeling and Analytics

Credits: 3

The main objective of the course is to bridge the gap between theory and practice by using software applications and real-world data to solve a variety of financial problems. The course is very 'hands-on' and is expected to help students develop skills that ar useful in a variety of jobs in finance, accounting, insurance, and real estate.

Prerequisite(s): ACFI 801 (may be taken concurrently) with a minimum grade of B- and ACFI 802 (may be taken concurrently) wit a minimum grade of B-.

Repeat Rule: May be repeated for a maximum of 6 credits.

Grade Mode: Letter Grading

ACFI 807 - Equity Analysis and Firm Valuation

Credits: 3

This course is intended to provide practical tools for analyzing and valuing a company's equity. Primarily an applications course, covers several valuation models such as market multiples and free cash flow models, and focuses on the implementation of finance theories to valuation problems. This course is not recommended if you have already taken the undergraduate FIN 707 at UNH.

Prerequisite(s): ACFI 801 with a minimum grade of B- and ACFI 802 with a minimum grade of B- and ACFI 872 with a minimum grade of B-.

Repeat Rule: May be repeated for a maximum of 6 credits.

Equivalent(s): ADMN 838

Grade Mode: Letter Grading

ACFI 810 - Big Data in Finance

Credits: 3

This course serves as an introduction to many aspects of big data utilization, specifically as it applies to finance. Topics typically include high frequency trading, stock market anomalies, data management, fintech innovations, and safety and ethics when working with big data. Programming languages common to finance, such as Stata, SAS, and Python, are learned and used to analyze and manipulate data.

Prerequisite(s): ACFI 801 with a minimum grade of B- and ACFI 802 with a minimum grade of B-.

Repeat Rule: May be repeated for a maximum of 6 credits.

Grade Mode: Letter Grading

ACFI 811 - Investment Banking

Credits: 3

This course provides an introduction to investment banking, focusing on the strategic considerations and financial analysis that are utilized when performing research related to investment banking activities. Specific topics typically include valuation, deal

structuring, initial public offerings (IPOs), mergers and acquisitions (M&A), and leveraged buyouts (LBOs).
Repeat Rule: May be repeated for a maximum of 6 credits.
Grade Mode: Letter Grading

ACFI 820 - Corporate Taxation

Credits: 3
Provides coverage of advanced topics from a strategic viewpoint and an understanding of the history and development of taxatic the role taxes play in financial and managerial decisions, and how taxes motivate people and institutions. The major tax issues inherent in business and financial transactions and their consequences are also explored.
Grade Mode: Letter Grading

ACFI 825 - Ethics and Non-Profit Accounting

Credits: 3
This course aims to: (1) increase students understanding of, and sensitivity to, ethical issues in accounting and (2) provide a foundation for the conceptual and practical issues surrounding accounting for not-for-profit entities. Ethics topics include:ethica reasoning and cognitive processes, business ethics and corporate governance, ethics in accounting judgments and decisions, an legal/regulatory/professional responsibilities of accountants. Not-for-profit accounting topics include: planning, budgeting, accounting, and internal and external financial reporting for not-for-profit entities.
Equivalent(s): ACFI 897
Grade Mode: Letter Grading

ACFI 830 - Advanced Auditing

Credits: 3
This course is designed to establish an advanced competence in auditing theory and practice. Specifically, students will gain an i depth understanding of current academic auditing research and the philosophy of strategic-systems auditing through readings, presentations, case studies, and a service learning project with a local non-profit organization.
Grade Mode: Letter Grading

ACFI 835 - Governmental Accounting

Credits: 3
The objective of this course is to provide a foundation for the conceptual and practical issues surrounding accounting for governmental entities. Topics include: planning, budgeting, accounting, and internal and external financial reporting for government organizations.
Equivalent(s): ACFI 895
Grade Mode: Letter Grading

ACFI 840 - Forensic Acctg & Fraud Exam

Credits: 3
This course builds on audit coursework, but is not limited to an audit perspective. It covers the major schemes used to defraud organizations and individuals. Students develop skills in the areas of fraud protection, detection, analysis, and some skills relatir to investigations.
Grade Mode: Letter Grading

ACFI 844 - Topics in Advanced Accounting

Credits: 3
Theory and practice of accounting for corporate acquisitions and mergers and the preparation and presentation of consolidated financial statements. Other topics include multinational consolidations, interim reporting and partnership accounting.
Grade Mode: Letter Grading

ACFI 845 - International Accounting

Credits: 3
The first goal of this course is to provide an overview of how accounting is practiced differently around the world. This goal is accomplished by the first part of the course, which mainly discusses differences between International Financial Reporting

Standards (IFRS) and U.S. Generally Accepted Accounting Principles (U.S. GAAP). The second goal of this course is to understand accounting issues uniquely confronted by companies involved in international business, such as the accounting for foreign currency transactions, the translation of foreign currency financial statements for the purpose of preparing consolidated financia statements, and other issues that are of particular importance to multinational corporations. This goal is accomplished by the second part of the course.
Prerequisite(s): ACC 621 with a minimum grade of D-.
Grade Mode: Letter Grading

ACFI 850 - Accounting Theory and Research

Credits: 3
The objective of this course is to study the role of accounting information both in a decision-making and in a performance-evaluation context. This objective will be achieved by studying various accounting theories and the role that research has played developing and testing those theories.
Grade Mode: Letter Grading

ACFI 860 - Advanced Business Law

Credits: 3
Focuses on legal issues such as the formation, management, and operation of corporations, and partnerships, and rights and liabilities of shareholders and partners; as well as an analysis of securities regulations. Also covers the due process and equal protection provisions of the Constitution as they relate to business activities. Includes an in depth analysis of the Uniform Commercial Code such as sales, secured transactions, and negotiable instruments. Real and personal property issues are also explored.
Grade Mode: Letter Grading

ACFI 870 - Programming in Finance with Quantitative Applications

Credits: 3
This course provides students with tools necessary to manipulate, analyze, and interpret financial data. Programming languages covered may include C++, Python, R, SAS, and Stata. Quantitative applications involving data from Bloomberg, CRSP, and Compustat are incorporated into the material.
Repeat Rule: May be repeated for a maximum of 6 credits.
Grade Mode: Letter Grading

ACFI 871 - Financial Theory

Credits: 3
This course provides a rigorous overview of modern financial analysis. Topics include valuation, risk analysis, corporate investment decisions, and security analysis and investment management.
Prerequisite(s): ACFI 801 with a minimum grade of B- and ACFI 802 with a minimum grade of B- and ACFI 870 (may be taken concurrently) with a minimum grade of B-.
Repeat Rule: May be repeated for a maximum of 6 credits.
Grade Mode: Letter Grading

ACFI 872 - Corporate Financial Reporting

Credits: 3
This course covers the preparation and analysis of financial statements. It focuses on the measuring and reporting of corporate performance for investment decisions, stock valuation, bankers' loan risk assessment, and evaluations of employee performanc Emphasizes the required interdisciplinary understanding of business. Concepts from finance and economics (e.g., cash flow discounting, risk, valuation, and criteria for choosing among alternative investments) place accounting in the context of the business enterprise.
Repeat Rule: May be repeated for a maximum of 6 credits.
Grade Mode: Letter Grading

ACFI 873 - Cases in Finance

Credits: 3

This course is an application of financial knowledge to case studies. A number of Harvard business cases will be analyzed and discussed in detail, including buy vs. rent decisions, corporate governance, weighted average cost of capital calculations and merger and acquisition strategies.
Prerequisite(s): ACFI 801 (may be taken concurrently) with a minimum grade of B- and ACFI 802 (may be taken concurrently) wit a minimum grade of B-.
Repeat Rule: May be repeated for a maximum of 6 credits.
Grade Mode: Letter Grading

ACFI 874 - Finance Experience

Credits: 3
This course enhances student knowledge regarding real-life applications of finance concepts, and includes activities such as: Bloomberg Terminal trainings, executive guest speaker talks, and career opportunities in the field. Presentation skills and networking abilities are emphasized.
Prerequisite(s): ACFI 801 (may be taken concurrently) with a minimum grade of B- and ACFI 802 (may be taken concurrently) wit a minimum grade of B-.
Repeat Rule: May be repeated for a maximum of 6 credits.
Grade Mode: Letter Grading

ACFI 890 - Accounting Information Systems

Credits: 3
Accounting information systems and the use of computers for decision making with emphasis on sources and types of informatic and the use of analytical tools in solving accounting management problems.
Grade Mode: Letter Grading

ACFI 892 - Independent Study

Credits: 1-6
Projects, research, and reading programs in areas required for concentration within a specialized master's program in accounting or finance. Approval of the student's plan of study by adviser or by proposed instructor required.
Repeat Rule: May be repeated for a maximum of 6 credits.
Grade Mode: Letter Grading

ACFI 896 - Topics

Credits: 3
Special topics.
Repeat Rule: May be repeated for a maximum of 12 credits.
Grade Mode: Letter Grading

Accounting and Finance Faculty

Accounting (M.S.)

https://paulcollege.unh.edu/business-administration/program/ms/accounting

The Master of Science in Accounting, offered by the Peter T. Paul College of Business and Economics, develops students' advance accounting knowledge, strong analytical and communication skills, as well as awareness of ethical issues for careers in public accounting firms, small businesses, non-profit organizations, and major corporations.

The AACSB-accredited MSA program satisfies the 150-hour course load required by most U.S. state licensing boards, including th state of New Hampshire. Students learn additional accounting knowledge in specialized courses that provide strong preparatio for the CPA exam process.

Designed for students with undergraduate degrees in accounting, the graduate program can be completed in one year of full-tim study or three years of part-time study, with classses offered during the day.

Applicants without an undergraduate degree in accounting or business will be required to complete additional foundation undergraduate courses prior to beginning the graduate program. If an applicant has not completed all of the foundation courses the admissions committee may offer provisional admission and require that the applicant take certain foundation courses prior t beginning the standard course of study.

Students with Non-Accounting Business Degrees

Foundation courses that must be completed at the undergraduate level are:

ACC 621	Intermediate Financial Accounting I	4
ACC 622	Intermediate Financial Accounting II	4
ACC 623	Advanced Managerial Accounting	4
ACC 626	Introduction to Federal Taxation	4
ACC 724	Auditing	4
ACC 747	Business Law	4
Total Credits		**24**

Students with Non-Business Degrees

In addition to the accounting foundation courses listed above, students with non-business degrees are typically required to complete these courses at the undergraduate level:

ADMN 502	Financial Accounting	4
ADMN 503	Managerial Accounting	4
ECON 401	Principles of Economics (Macro)	4
ADMN 510	Business Analytics and Statistics	4
ADMN 570	Introduction to Financial Management	4

In addition, students must choose two of the following:		
ADMN 575	Behavior in Organizations	
ADMN 585	Marketing	
ADMN 580	Quantitative Decision Making	
Total Credits		**2**

Degree Requirements

Students complete seven required courses and three elective courses.

Required Core Courses		
ACFI 820	Corporate Taxation	
ACFI 825	Ethics and Non-Profit Accounting	
ACFI 835	Governmental Accounting	
ACFI 844	Topics in Advanced Accounting	
ACFI 860	Advanced Business Law	
ACFI 890	Accounting Information Systems	
ACFI 850	Accounting Theory and Research (Capstone)	
Electives [1]		
Select three courses from the following:		
ACFI 830	Advanced Auditing	
ACFI 840	Forensic Acctg & Fraud Exam	
ACFI 896	Topics (International Accounting)	
ACFI 896	Topics (Applied Tax Research and Planning)	
ACFI 896	Topics (Advanced Topics in Tax)	
ACFI 896	Topics (Advanced Business Taxation)	
Total Credits		**3**

[1] Electives are chosen to help develop specialization in a particular area. Please note that elective course offerings are subject to class enrollment and may not be offered each year.

Accelerated Master's Overview

Accelerated Master's programs offer qualified University of New Hampshire undergraduate students the opportunity to begin

graduate coursework in select graduate programs while completing a bachelor's degree. Accelerated master's programs are designed to provide students with an efficient and cost-effective pathway to earn both a bachelor's and master's degree or graduate certificate, enhancing career opportunities and long-term earning potential.

- ACCELERATED MASTER'S HIGHLIGHTS
- ACCELERATED MASTER'S ADMISSION REQUIREMENTS
- ACCELERATED MASTER'S REQUIREMENTS

Accounting (M.S.) Accelerated Option

This graduate degree program is approved to be taken on an accelerated basis in articulation with the following undergraduate program(s):

Business Administration: Accounting (B.S.)

Students select from the following approved 800-level courses that can be completed in the undergraduate senior year for dual credit:

ACFI 820	Corporate Taxation	3
ACFI 825	Ethics and Non-Profit Accounting	3
ACFI 830	Advanced Auditing	3
ACFI 835	Governmental Accounting	3
ACFI 840	Forensic Acctg & Fraud Exam	3
ACFI 844	Topics in Advanced Accounting	3
ACFI 860	Advanced Business Law	3
ACFI 890	Accounting Information Systems	3
ACFI 896	Topics (Approved Elective Topics)	3

Additional Information

Within the accelerated option, high achieving students also have an opportunity to participate in the MSA Financial Leadership in Accounting pathway. This provides an opportunity to complete an UG accounting degree + winter internship + MSA in 4.5 years. This expands on the benefits of the accelerated MSA option with a "busy season" winter internship and access to unique leadership events. Please seek more details from the MSA Director and/or Accounting Department Chair and apply for Accelerate Master's admission before completing 90 undergraduate credits.

Program Learning Outcomes

- Students will demonstrate core accounting knowledge.
- Students will demonstrate the ability to solve complex problems in accounting.
- Students will engage in effective teamwork behaviors.
- Students will communicate effectively in an accounting context.
- Students will demonstrate an understanding of the key differences between US and international accounting standards.
- Students will demonstrate an understanding of the ethical and professional dimensions of accounting practices.

Finance (M.S.)

https://paulcollege.unh.edu/academics/ms-finance

The Master of Science in Finance, offered by the Peter T. Paul College of Business and Economics, develops students' abilities to provide solutions to the increasingly diverse and complex financial challenges of modern organizations. The program can be completed in one year of full-time study by students with undergraduate preparation in business, economics, and/or STEM fields and is open to others after appropriate foundation coursework. Designed to develop the highest levels of skill in financial modeling, investment analysis, evaluation, problem-solving, and communication of complex financial information, the program offers specialized training in one of three non-mandatory options: investments, financial analytics & fintech, or a student-design track. Students will also develop strong understanding of ethical considerations and professional standards necessary in the field of finance and will be well-prepared for a variety of roles including corporate finance, investment banking, and start-up enterprises.

All admitted candidates must have completed certain foundation courses. These courses can be completed prior to entry or as part of the Master of Science in Finance program. These courses include:

ADMN 570	Introduction to Financial Management	4
ECON 401	Principles of Economics (Macro)	4
or ECON 402	Principles of Economics (Micro)	
ADMN 510	Business Analytics and Statistics	4
or MATH 425	Calculus I	

The Master's of Science in Finance (MSF) curriculum requires students to take a minimum of 10 classes (a total of **30 credits**), fro which 8 are required core classes and 2 are electives. Students may choose to specialize their MSF degree in the *Financial Analyti & Fintech* option or the *Investments* option by completing an additional elective in that specialized area for a total of 11 classes (3 credits).

Core Coursework		
ACFI 801	Corporate Finance	3
ACFI 802	Investments	3
ACFI 806	Financial Modeling and Analytics	3
ACFI 870	Programming in Finance with Quantitative Applications	3
ACFI 871	Financial Theory	3
ACFI 872	Corporate Financial Reporting	3
ACFI 873	Cases in Finance	3
ACFI 874	Finance Experience	3
Electives		
Select 6-9 credits		6-9

Total Credits		**30-3**

Elective Options/Specialization Areas

Financial Analytics & Fintech Option

Select three courses from the following:

ACFI 810	Big Data in Finance	
ACFI 807	Equity Analysis and Firm Valuation	
ACFI 811	Investment Banking	
ACFI 896	Topics (FinTech Venture)	

Investments Option

Select three courses from the following:

ACFI 804	Derivative Securities and Markets	
ACFI 805	Financial Institutions	
ACFI 807	Equity Analysis and Firm Valuation	
ACFI 811	Investment Banking	

(or other approved electives in finance, decision sciences, economics, or statistics)

Student-designed option electives
Students can design their own option and choose their electives after obtaining the consent and approval of the MSF Director or director's designee.

Non-option student electives
Students who prefer not to declare an option can choose any elective offered by the M.S. Finance program. However, without a study plan pre-approved by the MSF Director or director's designee, a student may only take one non-finance elective.

Accelerated Master's Overview

Accelerated Master's programs offer qualified University of New Hampshire undergraduate students the opportunity to begin graduate coursework in select graduate programs while completing a bachelor's degree. Accelerated master's programs are designed to provide students with an efficient and cost-effective pathway to earn both a bachelor's and master's degree or graduate certificate, enhancing career opportunities and long-term earning potential.

- ACCELERATED MASTER'S HIGHLIGHTS
- ACCELERATED MASTER'S ADMISSION REQUIREMENTS
- ACCELERATED MASTER'S REQUIREMENTS

Finance (M.S.) Accelerated Option

This graduate degree program is approved to be taken on an accelerated basis in articulation with the following undergraduate program(s):

Business Administration: Finance (B.S.)

Students select from the following approved 800-level courses that can be completed in the undergraduate senior year for dual credit:

ACFI 801	Corporate Finance	3
ACFI 802	Investments	3
ACFI 804	Derivative Securities and Markets	3
ACFI 806	Financial Modeling and Analytics	3
ACFI 870	Programming in Finance with Quantitative Applications	3
ACFI 872	Corporate Financial Reporting	3

Program Learning Outcomes

- Students will demonstrate knowledge of core content areas of finance.
- Students will demonstrate the ability to articulate advanced issues in finance and apply them in a business context.
- Students will demonstrate an understanding of the preparation and usage of financial statements.
- Students will demonstrate the ability to solve complex financial problems.
- Students will demonstrate an understanding of the ethical dimensions of decision making in a global business environment.
- Students will demonstrate effective oral and written communication skills in business decisions and environments.
- Students will demonstrate the ability to extract, cleanse and analyze financial data using statistical software or programming tools.

Agricultural Sciences (ANFS)

https://colsa.unh.edu/agriculture-nutrition-food-systems

Degrees offered: Master of Science (M.S.) and Doctor of Philosophy (Ph.D.)

These programs are offered in Durham.

The Department of Agriculture, Nutrition, and Food Systems offers advanced degrees in Agricultural Sciences at the Masters and Doctoral levels.

Emphasis is placed on acquiring basic and practical knowledge and research experience in one or more of the diverse componen of plant and animal agriculture and food systems including: breeding and genetics, physiology, environmental interactions, organismal health, field and greenhouse production, protected agriculture, and the social and economic dimensions of food production and distribution systems. The agricultural sciences graduate programs prepare students to become highly knowledgeable and competent in professional fields related to agriculture and food systems, and leaders in collaborative and interdisciplinary efforts to address local, regional, national and/or global agricultural issues.

With a M.S. or Ph.D. in Agricultural Sciences, students may pursue careers in plant and animal agriculture, food production and distribution systems, teaching, public service, positions in federal, state, nonprofit, private organizations, and/or related fields.

- Agricultural Sciences (M.S.)
- Agricultural Sciences (Ph.D.)

Agriculture, Nutrition, and Food Systems (ANFS)

ANFS 850 - Food system solutions; increasing sustainability and equity

Credits: 4
We will study a range of solutions to address cross-cutting issues in the food system, including unsustainable farming systems, inequitable access to nutritious food, dietary patterns that promote chronic disease, and the lack of sustainable livelihoods for farmers and food chain workers. Students will learn to critically examine policies, programs and social movements aimed at increasing the equity and sustainability of the food system. We will identify the strengths and weaknesses of these approaches, recognizing the limits and blind spots, uneven impacts, and leverage points of the proposed solutions we study. Food systems coursework required prior to taking this course.
Grade Mode: Letter Grading

› **View Course Learning Outcomes**

ANFS 895 - Special Topics

Credits: 1-4
Advanced studies in specific areas of relevance to agriculture, nutrition, and/or food systems.
Repeat Rule: May be repeated for a maximum of 8 credits.
Grade Mode: Letter Grading

ANFS 899 - Master's Thesis

Credits: 1-10
Master's thesis research.
Repeat Rule: May be repeated for a maximum of 10 credits.
Grade Mode: Graduate Credit/Fail grading

ANFS 901 - Introduction to Agriculture, Nutrition, and Food Systems Graduate Studies

Credits: 1

This course explores foundational ANFS graduate program expectations (proposed timelines, programmatic requirements, resources, and research opportunities) while modeling collaborative, interdisciplinary, and inquiry-based systems learning. Students will investigate selected topics that permeate across traditional discipline boundaries, thus developing skills ubiquitously applicable to all. Students will sharpen critical thinking, writing and presentation skills to apply systems thinking to graduate research studies. The importance of values, ethics, networking, and work/life balance will be explored.
Grade Mode: Letter Grading

ANFS 933 - Design, Analysis, and Interpretation of Experiments

Credits: 4
Through in-depth consideration of common general linear models used in the analysis of variance, this course introduces gradua students to the fundamental concepts and statistical methods necessary to plan, conduct, and interpret effective experiments. T course provides an opportunity for graduate students to receive critical input on the experimental design and analysis of their individual research projects. All analyses are conducted using the open-source package R; no previous coding experience is required.
Grade Mode: Letter Grading

ANFS 997 - Agriculture, Nutrition, and Food Systems Seminar

Credits: 1
Graduate student, faculty and invited presenters on current topics in agriculture, animal science, plant science, nutritional sciences and food systems. Open to COLSA graduate students only.
Repeat Rule: May be repeated for a maximum of 4 credits.
Grade Mode: Graduate Credit/Fail grading

ANFS 999 - Doctoral Dissertation Research

Credits: 0
Doctoral dissertation research.
Grade Mode: Graduate Credit/Fail grading

Please see https://colsa.unh.edu/agriculture-nutrition-food-systems/faculty-staff-directory for faculty.

Agricultural Sciences (M.S.)

https://colsa.unh.edu/agriculture-nutrition-food-systems/program/ms/agricultural-sciences

The Master of Science (M.S.) in Agricultural Sciences graduate program offered by the Department of Agriculture, Nutrition, and Food Systems (ANFS) offers a flexible course of study that provides education and research experience in plant and animal agriculture, aquaculture, food systems, and related fields.

Emphasis is placed on acquiring basic and practical knowledge and research experience in one of the following core emphasis areas:

1. Diverse components of plant and animal agricultural systems including breeding and genetics, nutrition, physiology, environmental interactions, organismal health, agroecology, and pathology. Students may also focus on production system including field-based and post-harvest practices.
2. Food systems analysis to address the social, economic, and environmental relationships that shape outcomes in plant and animal agricultural systems. Students work on food and agriculture related questions and challenges ranging from food production, processing, aggregation and distribution, access, consumption, and management of food waste.

The agricultural sciences graduate program prepares students to become highly knowledgeable and competent in professional fields related to agriculture and food, and leaders in collaborative and interdisciplinary efforts to address local, regional, nationa and/or global issues at the intersection of agriculture, food and the environment.

The M.S. program is thesis-based, with the expectation of providing substantial research experience and the opportunity to publish new knowledge in the field of interest.

Master of Science (M.S.) in Agriculture Sciences students plan a program of study in conjunction with their advisor and Master's Thesis Committee, including required courses and competencies. A minimum of **30 graduate credits**, including 6-10 research credits (ANFS 899 Master's Thesis), are required. A thesis proposal is developed within the first year for approval by the thesis committee. All M.S. students must write a thesis which must be accepted by the advisor(s), committee members, and the Gradua School. The degree is completed when the student has completed the required coursework, presented and passed a thesis defense, and the thesis is approved by the Master's Thesis Committee and accepted by the Graduate School.

Up to 8 credits of graduate credit from another institution may be transferred, provided the credits were not counted toward another degree, and the course grade was a B or higher. Petitions requesting transfer credit must be supported by the advisor an graduate committee and approved by the UNH Graduate School

1. Core Course Requirements:

ANFS 899	Master's Thesis	6-1(
ANFS 901	Introduction to Agriculture, Nutrition, and Food Systems Graduate Studies [1]	
ANFS 997	Agriculture, Nutrition, and Food Systems Seminar [2]	

[1] To be taken at the earliest opportunity, typically in the initial fall semester of the graduate program.

[2] This 1 credit course may be repeated up to a maximum of 4 credits and should be taken every semester by M.S. students.

2. Competency Requirements: In addition to the core required courses, students will be expected to demonstrate competency i areas of experimental design and analysis, and in scientific writing and communication. Students must take at least one course from each competency. The competencies may be fulfilled by courses chosen in consultation with the advisor and committee. Depending on the student, one or both of these competency requirements may have been fulfilled through other

course work or professional experience as approved by the committee and ANFS graduate coordinator.

Communication Competency		
Select at least one course:		
BIOL 902	Writing and Publishing Science	1
NR 905	Grant Writing	1
BIOL 950	Scientific Communication	1
Experimental Design and Analysis Competency		
Select at least one course:		
ANFS 933	Design, Analysis, and Interpretation of Experiments	4
SOC 902	Sociological Methods II: Research Design	4

3. Electives: Each student, in consultation with their graduate committee, will define one or more areas of informal specializatio and will take additional courses appropriate for their area(s) of specialization.

4. Additional Requirements:

- All students in the Agricultural Sciences Graduate Programs are expected to present their research in ANFS departmental seminar at least twice (including the thesis defense seminar). Students are also encouraged to present at professional conferences and acquire teaching and/or mentoring experience.
- Written and oral defense of research proposal. Approval form must be on file with department.
- Thesis

Additional Information:

Additional information can be found in the program graduate handbook, which includes expectations, guidelines, and detailed policies.

Annual Evaluation: The annual evaluation of graduate students ensures that students receive the mentorship they deserve and are making progress toward completion of their degrees. The annual evaluation of graduate students consists of a collaborative effort between faculty adviser and student to:

- Complete a self-assessment;
- Present a professional quality CV suitable for awards, job applications, and internships;
- Produce a narrative of service or other activities not captured on a CV;
- Develop annual goals.

Program Learning Outcomes

Students graduating with an M.S. in Agricultural sciences will meet objectives in the following areas:

Discipline specific knowledge

- Identify and explain discipline specific research methods
- Build knowledge and understanding in key areas of agricultural sciences including food systems, and animal and plant-base

agricultural production systems

Research design and analysis

- Apply appropriate study design to answer a research question
- Use appropriate statistical methods to analyze and interpret research results

Scientific method

- Develop, defend, and execute a research idea to advance knowledge in the student's specific field of study

Critical thinking

- Ability to collect and critically evaluate information from the primary research literature to expand knowledge of agricultural and food systems
- Develop skills to critically evaluate and analyze their research data

Communication

- Communicate effectively in writing through the development of an argument supported by evidence
- Communicate effectively in oral formats when addressing project-specific research and agriculture and food related issues
- Convey research results in written and oral format to both professionals and the public

Professionalism

- Conduct research in an ethical manner
- Deliver professional oral and written communications
- Demonstrate collaboration and leadership skills

Agricultural Sciences (Ph.D.)

https://colsa.unh.edu/agriculture-nutrition-food-systems/program/phd/agricultural-sciences

The Doctor of Philosophy (Ph.D.) in Agricultural Sciences graduate program offers a flexible course of study that provides education and research experience plant and animal agriculture, food systems, and related fields. Graduate students are engage in an interdisciplinary department focusing on the farm to fork wellness continuum and an integrated approach to solving problems. Students will also develop independent and team research experience.

Our faculty offer education and research opportunities in the diverse components of food systems, and plant and animal agricultural systems including breeding and genetics, physiology, environmental interactions, protected agriculture, organismal health, agroecology, and pathology. Beyond the classroom and the lab, students will hone communication skills that are essenti for professional scientists through teaching, extension, and outreach opportunities with stakeholders and constituents.

With a Ph.D. in Agricultural Sciences, students are prepared to pursue careers in college teaching and research positions in indus and government. Students may work in plant and animal agriculture, food production and distribution systems, teaching, public service, research in federal, state, nonprofit, private organizations, or related fields.

The Ph.D. program is thesis-based, with the expectation of generating and publishing substantial new knowledge in the field of interest.

Doctor of Philosophy (Ph.D.) graduate students work with their advisor and Doctoral Guidance Committee to plan a program of study including the required core courses, competencies, and develop a research proposal. To complete the degree, students mu complete a research proposal, pass a qualifying exam, conduct dissertation research, and complete and defend a dissertation.

Guidance and Dissertation Committees: During the first semester, the student and advisor jointly select members of a guidanc committee. A nomination form must be sent to the graduate school to officially appoint the committee membership. The Guidan Committee consists of 5 members and is responsible for approving the proposal and oversees the qualifying examination. Once the student has advanced to candidacy, the Doctoral Dissertation Committee is formed. The Dissertation Committee is responsib for administering the dissertation exam.

Dissertation Proposal and Defense: All Ph.D. students are required to develop a formally approved research proposal typically the end of the third semester and no later than the fourth semester. Proposals are approved by the dissertation committee and t major advisor. In addition to the written proposal, students are expected to present a proposal defense presentation. This proposal should consist of the following:

1. comprehensive review of the literature related to the student's research topic.
2. statement of need/justification.
3. research goal with a list of research objectives with stated hypotheses that address the major research questions.
4. plan of work describing the experimental approaches or methods to be used in answering the thesis questions.
5. Expected outcomes and potential pitfalls for each objective.
6. Timeline for completion of the work.
7. preliminary research where appropriate.

Candidacy: Following approval of the research proposal and completion of coursework, doctoral students should advance to candidacy. Candidacy is reached after passing a formal qualifying examination that assesses both broad basic knowledge of the student's field, and topics central to the research project. The purpose of the exam is to measure of the student's likelihood of successfully completing a doctoral program. The qualifying exam comprises written and oral components.

1. Written exam: Student choose three areas of specialization in consultation with their Doctoral Guidance Committee. The advisor solicits questions from Committee members and administers the exam. Once completed, Committee members evaluate the responses. The student is expected to demonstrate competence in each of the chosen areas, reflected in clear,

concise, well-organized synthetic essays. The exam may be “closed book” or “open book” at the discretion of the advisor.

2. Oral exam: An oral exam is conducted by the Doctoral Guidance Committee and chaired by the advisor. The student should demonstrate mastery of fundamental concepts in the designated areas of specialization, draw upon a broad spectrum of information to answer theoretical and practical questions. There may be focus on any area that was deemed weak in the written exam.

When the student has passed both parts of the qualifying exam, the advisor will inform the Graduate School and recommend tha the student be advanced to candidacy in the Ph.D. degree program.

Dissertation and Oral Defense: All students must complete a dissertation reporting original research. After completion of the research, the candidate must provide a copy of the dissertation to the Doctoral Dissertation committee at least two weeks prior t the final oral examination. The final thesis defense consists of two parts: an oral presentation of the research in a public seminar, and an oral defense of the dissertation conducted by the Doctoral Dissertation Committee. Final approval of the dissertation will be determined by a majority vote of the committee.

Number of Credits Required: There is no specific credit requirement for the Ph.D., though students must take the required core courses and fulfill the competences outlined below. Up to 8 credits of graduate credit from another institution may be transferre provided the credits were not counted toward another degree, and the course grade was a B or higher. Petitions requesting transfer credit must be supported by the advisor and graduate committee and approved by the UNH Graduate School.

1. Core Course Requirements:

ANFS 901	Introduction to Agriculture, Nutrition, and Food Systems Graduate Studies [1]	
ANFS 997	Agriculture, Nutrition, and Food Systems Seminar [2]	
ANFS 999	Doctoral Dissertation Research [3]	

[1] To be taken at the earliest opportunity, typically in the initial fall semester of the program.

[2] All students are required to register and participate for a minimum of 3 credits.

[3] All students are required to register and participate at least twice, and must be taken after candidacy.

2. Competency Requirements: In addition to the core required courses, students will be expected to demonstrate competency i areas of experimental design and analysis, and in scientific writing and communication. Students must take at least one course from each competency. The competencies may be fulfilled by courses chosen in consultation with the advisor and committee. Depending on the student, one or both of these competency requirements may have been fulfilled through other course work or professional experience as approved by the committee and ANFS graduate coordinator.

Communication Competency

Select at least one course from the following:

BIOL 902	Writing and Publishing Science
NR 905	Grant Writing
BIOL 950	Scientific Communication

Experimental Design and Analysis Competency

Select at least one course from the following:

ANFS 933	Design, Analysis, and Interpretation of Experiments

SOC 902	Sociological Methods II: Research Design

3. Electives: Each student, in consultation with their graduate committee, will define one or more areas of informal specializatio and will take additional courses appropriate for their area(s) of specialization.

4. Additional Information:

- All students in the Agricultural Sciences Ph.D. Program are expected to present their research in ANFS departmental seminar least three times (including the defense seminar). Students are also encouraged to present at professional conferences and acquire teaching and/or mentoring experience.

Annual Evaluation: The annual evaluation of graduate students ensures that students receive the mentorship they deserve and are making progress toward completion of their degrees. The annual evaluation of graduate students consists of a collaborative effort between faculty adviser and student to:

- Complete a self-assessment;
- Present a professional quality CV suitable for awards, job applications, and internships;
- Produce a narrative of service or other activities not captured on a CV;
- Develop annual goals.

Program Learning Outcomes

Students graduating with a Ph.D. in Agricultural Sciences will meet objectives in the following areas:

Discipline specific knowledge

- Identify and explain discipline specific research methods
- Build knowledge and understanding in key areas of agricultural sciences including food systems, and animal and plant-based agricultural production systems

Research design and analysis

- Identify the strengths and weaknesses of study designs utilized in agriculture or food systems research
- Apply appropriate research design to answer a question
- Identify and apply appropriate statistical methods to analyze and interpret research results

Scientific method

- Independently develop, defend, and execute a research idea to advance knowledge in the student's specific field of study

Critical thinking

- Ability to collect and critically evaluate information from the primary research literature to expand knowledge of agricultural and food systems
- Draw conclusions from the literature and make recommendations based on an understanding of the system, scientific evidence, related factors, and desired outcomes
- Develop skills to critically evaluate and analyze their research data

Communication

- Communicate effectively in writing through the development of an argument supported by evidence
- Communicate effectively in oral formats when addressing project-specific research and complex agriculture and food related

issues

- Contribute written works to the scientific community in the form of peer-reviewed publications and presentation at scientific conferences

Professionalism

- Conduct research in an ethical manner
- Deliver professional oral and written communications
- Demonstrate collaboration and leadership skills

Analytics (DATA)

https://www.unh.edu/analytics/

Degrees Offered: Graduate Certificate

The Introduction to Data Science Certificate is an online 16 week graduate program that exposes students to current, cutting edg data programming, statistical modeling and visualization tools through guided, online instruction and applied case studies. This certificate program offers a flexible, short-turnaround time to completion allowing busy employees to participate. Enjoy applied learning in a self-paced but facilitated environment with course instructors and a student success coach.

- Data Science (Graduate Certificate)

Analytics (DATA)

DATA 800 - Introduction to Applied Analytic Statistics

Credits: 3
This course is designed to give students a solid understanding of the experience in probability, and inferential statistics. The cour provides a foundational understanding of statistical concepts and tools required for decision making in a data science, business, research or policy setting. The course uses case studies and requires extensive use of statistical software.
Grade Mode: Letter Grading

DATA 820 - Programming for Data Science

Credits: 3
In this class, students will build their foundational toolbox in data science: upon completion, students will be able to use the computer from the command line; practice version control with GIT & GitHub; gain a mastery of programming in Python; data wrangling with Python and perform an exploratory data analysis (EDA) in Python. All learning objectives are achieved through active application of these techniques to real world datasets.
Prerequisite(s): DATA 800 (may be taken concurrently) with a minimum grade of B-.
Grade Mode: Letter Grading

DATA 821 - Data Architecture

Credits: 3
In this class, students will learn the foundations of databases and large datasets: upon completion, students will be able to explo out-of-ram datasets though traditional SQL databases and NoSQL databases. Students will also be introduced to distributed computing. All learning objectives are achieved through active application of these techniques to world datasets.
Prerequisite(s): DATA 800 with a minimum grade of B- and DATA 820 with a minimum grade of B-.
Grade Mode: Letter Grading

DATA 822 - Data Mining and Predictive Modeling

Credits: 3
In this class, students will learn foundations of practical machine learning: upon completion, students will be able to understand and apply supervised and unsupervised learning in Python to build predictive models on real world datasets. Techniques covere include (but not limited to): preprocessing, dimensionality reduction, clustering, feature engineering and model evaluation. Models covered include: generalized linear models, tree-based models, bayesian models, support vector machines, and neural networks. All learning objectives are achieved through active application of these techniques to real world datasets.
Prerequisite(s): DATA 800 with a minimum grade of B- and DATA 820 with a minimum grade of B- and DATA 821 (may be taken concurrently) with a minimum grade of B-.
Mutual Exclusion: No credit for students who have taken ADMN 872.
Grade Mode: Letter Grading

Data Science (Graduate Certificate)

https://cps.unh.edu/online/program/graduate-certificate/data-science

Program offered online.

The Introduction to Data Science Certificate is an online 16 week graduate program that exposes students to current, cutting edg data programming, statistical modeling and visualization tools through guided, online instruction and applied case studies. This certificate program offers a flexible, short-turnaround time to completion allowing busy employees to participate. Enjoy applied learning in a self-paced but facilitated environment with course instructors and a student success coach.

- Introduction to Data Science to provide basic level of quantitative training
- In as little as 16 weeks to Certificate completion
- Exposure to the tools and methods used in today's ever changing data science environment
- Interdisciplinary and applied nature

Who Should Enroll?

Professionals who want to increase their earning potential, advance their careers, and make a greater impact within their busine or organization with advanced data analytic and coding skills. This certificate is beneficial to those in the fields of business analy data analyst, financial analyst, computer scientist, programmers, database administrators, researchers, statisticians, and marketing.

Admissions Information

Please see the Graduate School website for admissions requirements.

The graduate certificate in Data Science requires the completion of 4 core courses.

DATA 800	Introduction to Applied Analytic Statistics	
DATA 820	Programming for Data Science	
DATA 821	Data Architecture	
DATA 822	Data Mining and Predictive Modeling	
Total Credits		**1**

Biochemistry (BCHM)

https://colsa.unh.edu/molecular-cellular-biomedical-sciences

Degrees Offered: Ph.D., M.S.

This program is offered in Durham.

The Department of Molecular, Cellular, and Biomedical Sciences offers a Doctor of Philosophy (Ph.D.) degree, a Master of Science (M.S.), and an accelerated master's program (B.S./M.S.) in Biochemistry. Graduate students (Ph.D. and M.S.) in biochemistry are typically supported by teaching or research assistantships, as well as by competitive internal and external fellowship programs. F more information about the program, including admission and degree requirements, please contact the Department of Molecula Cellular, and Biomedical Sciences at mcbs.dept@unh.edu.

Distinctive Features of the Program

The Graduate Program in Biochemistry combines a rigorous curriculum in biochemistry with diverse research opportunities at th frontier of chemical, molecular, and cellular biology, as well as biophysics. The program aims to train interdisciplinary researche savvy in modern technologies and data science, interested in a mechanistic understanding of biology. Incoming students are giv the opportunity for laboratory rotations to explore the various areas of biochemistry in those cases where a thesis advisor has nc been identified or where exposure to a variety of experimental approaches is advantageous.

The Graduate Program in Biochemistry offers:

- Outstanding research training in many cutting-edge research areas such as cellular structure and function, genome stability, protein structure and function, signal transduction, and structural biology.
- Weekly seminar series that includes both distinguished invited speakers and graduate student research presentations.
- Opportunities to gain teaching and mentoring experiences with undergraduate students in the biological sciences.
- Excellent track record for graduates attaining careers in academia, biomedical research institutes, biotechnology and pharmaceutical companies, health professions, and state and federal governmental agencies.

Admission Requirements

An applicant is expected to have completed basic courses in chemistry, biological sciences, mathematics, and physics. Otherwise well-qualified applicants will be permitted to correct deficiencies in undergraduate education by enrollment in the appropriate courses or by independent study during the first year. Applicants must submit a personal statement and three letters of recommendation. The personal statement should specify the applicant's research interests and potential faculty mentors. Applicants from non-English-speaking countries must also provide TOEFL (Test of English as a Foreign Language) scores.

Accelerated Master's Degree Requirements

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

Admission to the combined degree program is highly competitive. Students wishing to pursue this option must have a grade po average greater than 3.2 at the time of application. A thesis advisor must be identified during the junior year and the approval o the advisor must be obtained. Prior to the first semester of the senior year, the student must formally apply to the Graduate School and receive early admission to the Biochemistry Graduate Program. The requirement for the Graduate Record Examination is waived for combined degree applicants.

- Biochemistry (Ph.D.)
- Biochemistry (M.S.)

Biochemistry (BCHM)

BCHM 802 - Endocrinology

Credits: 4

Structure and function of vertebrate endocrine systems through the lens of physiology, biochemistry, and cell and molecular biology, with special reference to mammals. Current investigations of the body's major endocrine glands, such as the brain, thyroid, pancreas, adrenals and gonads, as regulators and integrators of biological systems. A previous cell biology course is recommended. One semester of biochemistry recommended.

Equivalent(s): ANSC 802

Grade Mode: Letter Grading

BCHM 825 - Cell Phenotyping and Tissue Engineering Laboratory

Credits: 4

Introduction to culture and phenotyping of mammalian cells (cell line models), with applications to bioengineering and biomedical sciences.. Skills, techniques, and knowledge covered include sterile technique, cell culture, cell line models, cell proliferation, cell survival, cell migration, cell adhesion, and drug response. Inquiry-based team projects investigate cell proliferation, cell death, transfection, flow cytometry, 3D scaffolds, or cell imaging. Introductory microbiology and microbiology lab recommended.

Grade Mode: Letter Grading

Special Fee: Yes

BCHM 850 - Physical Biochemistry

Credits: 3

Structure, interactions, and physical-chemical properties of biomolecules. Thermodynamic, kinetic, and spectroscopic methods for the study of proteins and nucleic acids. 1-2 semesters of organic chemistry and one semester of calculus recommended.

Grade Mode: Letter Grading

BCHM 851 - Principles of Biochemistry I

Credits: 4

In-depth survey of biochemistry: macromolecule structure; structure and function of proteins, nucleic acids, carbohydrates, and lipids; introduction to metabolic pathways. One semester of organic chemistry recommended.

Grade Mode: Letter Grading

BCHM 852 - Principles of Biochemistry II

Credits: 4

In-depth survey of biochemistry: metabolism of amino acids, nucleotides, carbohydrates and lipids; synthesis and regulation of macromolecules; molecular biology of the eukaryotic cell.

Prerequisite(s): BCHM 851 with a minimum grade of B-.

Grade Mode: Letter Grading

BCHM 853 - Cell Culture

Credits: 5

Principles and Technical Skills fundamental to the culture of animal and plant cells, tissues and organs. Introduction to the techniques of sub-culturing, establishing primary cultures, karyotyping, serum testing, cloning, growth curves, cryopreservation hybridoma formation and monoclonal antibody production, and organ cultures. Application of cell culture to contemporary research in the biological sciences. Lab. Introductory microbiology and microbiology lab recommended.

Grade Mode: Letter Grading

Special Fee: Yes

BCHM 854 - Molecular Biology Research Methods

Credits: 5

Theory and application of current technologies to manipulate DNA. Hands-on experience that includes DNA isolation and quantitation methods, cloning, PCR, DNA sequencing, and analysis of gene products. Lab. Introductory genetics recommended.

Equivalent(s): GEN 854, PBIO 854
Grade Mode: Letter Grading
Special Fee: Yes

BCHM 855 - Protein Biochemistry Laboratory

Credits: 5
Application of modern approaches to the characterization and purification of proteins. Emphasis on recombinant protein production and purification, analytical techniques for characterization of proteins, enzyme kinetics, and molecular visualization protein structure. One semester of biochemistry recommended.
Grade Mode: Letter Grading
Special Fee: Yes

BCHM 860 - Pharmacology

Credits: 4
Introduction to the basic principles and fundamental concepts of pharmacology, with a focus on molecular mechanisms and pathological basis of therapeutics and the curative effects. Foundations of pharmacology including pharmacodynamics and pharmacogenomics; drugs affecting the nervous system (neuropharmacology); drugs affecting other systems; chemotherapeutic drugs. One semester of biochemistry recommended.
Grade Mode: Letter Grading

BCHM 863 - Biochemistry of Cancer

Credits: 4
Evaluation of the hallmarks of cancer, including molecular mechanisms of carcinogenesis, roles of oncogenes and dysregulated cell development, function and metabolism, tumor immunology, and the biological basis of cancer therapy. One semester of biochemistry recommended.
Grade Mode: Letter Grading

BCHM 894 - Protein Structure and Function

Credits: 4
Analysis of how the three-dimensional architecture of soluble and membrane proteins contributes to their biochemical function; methods for determining the structure of proteins; protein folding; protein targeting; and mechanisms of enzyme catalysis. Computer resources used for protein modeling and structural prediction. One semester of biochemistry recommended.
Grade Mode: Letter Grading

Biochemistry program faculty.

Biochemistry (Ph.D.)

https://colsa.unh.edu/molecular-cellular-biomedical-sciences/program/phd/biochemistry

The Ph.D. in Biochemistry combines a rigorous curriculum in biochemistry and related disciplines with interdisciplinary research opportunities at the frontiers of biochemistry, molecular biology, and cell biology. Graduates of the program are equipped for leadership positions in biotechnology and pharmaceutical companies, academic and government research laboratories, and successful careers in teaching and research at the college and university level.

Distinctive Features of the Program

- Advanced course offerings include signal transduction pathways, pharmacology, physical biochemistry, proteomics, endocrinology, structural biology, bioinformatics, and cancer biology
- Emphasis on interdisciplinary research training
- Well-equipped research laboratories and core facilities on the UNH campus
- Laboratory rotations upon entry to the program to become familiar with different research laboratories
- Weekly graduate student seminar presentations, as well as a departmental seminar series of invited speakers
- Opportunities to gain teaching experiences as a Graduate Teaching Assistant

Research Opportunities

- Cancer biology
- Protein structure, function, and regulation
- Signal transduction pathways
- Molecular and cellular neuroscience
- Genomics and bioinformatics
- Regenerative biology
- Molecular immunology
- Chemical biology

Financial Support

- Students admitted to the Ph.D. Program are typically supported by Research Assistantships or Teaching Assistantships
- Internal summer and academic year fellowships are available to students on a competitive basis.

Career Prospects

- Research directors in biotechnology and pharmaceutical industries
- Principle investigators of academic research labs and research institutes, state and federal government agencies
- Academic preparation for future teaching roles in a college or university environment

Admission Requirements

- Completion of foundational courses in biology, chemistry (including organic chemistry), physics, and mathematics
  - Otherwise well-qualified applicants can correct academic deficiencies with enrollment in appropriate courses or independent study during the first year of graduate studies
- Applicants from non-English speaking countries must provide Test of English as a Foreign Language (TOEFL) scores
- Three letters of recommendation

- Personal statement, including research interests and identification of two or three potential Biochemistry faculty thesis advisors.

Ph.D. Requirements

The Ph.D. in Biochemistry requires the completion of significant, original independent research and preparation of a dissertation for submission to the Graduate School. A minimum of two semesters of Doctoral Research (MCBS 999) is required. Graduate cred are earned for courses numbered 800-999. In most cases, it is expected that the Ph.D. degree will be completed within four to six years of admission to the graduate program. Demonstration of proficiency in biochemistry will be assessed in the first year by examination or coursework.

Guidance Committee: Initially, the Graduate Program Coordinator will assist the student in choosing courses. Following selectio of the thesis advisor, the student and the advisor jointly agree on the members of the Guidance Committee, and communicate th recommendation to the Biochemistry Graduate Program Coordinator. The Doctoral Guidance Committee Nomination Form must be completed and submitted to the Graduate School by the end of the first year. The Guidance Committee consists of five faculty members: the advisor (as chairperson), two other members of the biochemistry graduate faculty, and up to two faculty members from other graduate programs. However, only three members of the Guidance Committee are required for the second-year exam The Committee meets soon after selection of a thesis advisor to determine the student's curriculum. Courses required by the Guidance Committee must be taken for credit and completed with a passing grade (at least a B-minus). Courses recommended b the committee may be audited or taken for credit, but in either case, the student is expected to be familiar with the subject matte of these courses. It is recommended that the Guidance Committee meet each semester thereafter to assess the student's academ and research progress.

Doctoral Dissertation Committee: The Doctoral Committee is composed of the faculty advisor (as chairperson), two other facul members in the graduate program in biochemistry, and up to two faculty members from other graduate programs. In most cases the Guidance Committee constitutes the Doctoral Committee. The Doctoral Committee evaluates the dissertation and administe the final examination. The Doctoral Committee meets annually to assess the progress toward completion of the Ph.D. requirements.

Qualifying Examination and PhD Candidacy:

After completion of required coursework in the program and fulfilling other degree requirements, students seek the approval of the advisory committee to proceed to the qualifying exam, which should occur within 3-6 months of approval. Typically, the qualifying exam takes place in the third year - between the 4^{th} to 6^{th} semester of the candidate student's academic program. The purposes of the qualifying exam are to i) assess the depth and breadth of knowledge in biochemistry, molecular, and cellular biology, and in the student's specific research domain; ii) evaluate the student's capability of critical thinking and to develop a rigorous research proposal, and iii) assess the student's proficiency in scientific writing and communication, and to articulate an defend a research proposal.

The qualifying exam consists of both a written and an oral section, both of which center on a student's proposed dissertation top Alternatively, after consulting with the advisor and the advisory committee and receiving their approval, students may develop a research proposal on a topic that is derived from published research article(s). Students are expected to develop their research proposals under the oversight of their advisor and/or committee members, who should provide students guidance on topic selection and writing, with the aim of enhancing both scientific premise and written communications. It is recommended that th student and advisor meet at least three times to discuss and revise the proposal prior to submission to the committee. The stude may submit the proposal to the committee only upon approval by their advisor. The advisor should ensure that the final version the proposal is a product of original, creative thinking from the student.

The **written section** of the qualifying exam is a research proposal, typically following the format of NIH NRSA predoctoral F31 fellowship (sample F31 proposal are available for reference (see https://www.niaid.nih.gov/grants-contracts/sample-applications)). Alternatively, for research that is more related to NSF themes or other funding agencies, it may follow the format graduate research fellowship of NSF or other funding agencies.

Specifically, the written section should include the following:

- **Specific Aims:** a one-page summary that outlines the gap-in-knowledge, the research's main objectives, the main hypothese and the potential impact the research could have. This should be structured to include 2-3 specific aims, each with a testable

hypothesis.

- **Research Strategy:**
  - **Background, Significance and Premise:** a summary of the existing knowledge in the field, with an emphasis on the importance of the proposed research in advancing our understanding of biological processes while addressing broader socioeconomic needs. This should raise specific questions that will be addressed in the research and provide the scientifi foundation and importance of the proposed work.
  - **Innovation:** A concise description of the uniqueness, specifically the technical and/or conceptual novelty of the propose research.
  - **Approach:** A description of the methods and approaches that are employed, including identification of resources and expertise that the student will engage to tackle the research. This section should also highlight potential challenges and limitations and provide alternative approaches, in case the main hypothesis fails.
  - **Timeline:** A general timeline that outlines the anticipated milestones and deadlines for completing the research. This demonstrates the student's ability to plan and manage a research project effectively.

The research proposal is submitted to the advisory committee for evaluation at least three weeks before the oral exam. Committ members may approve or reject the written proposal. If a committee member rejects the submitted proposal, they must provide response to the student, with copy to the advisor and other committee members. The responses should articulate specific shortcomings and actionable steps that the student may take to rectify. The advisor is responsible for convening the committee t collectively assess the quality of the proposal. After the discussion, the committee will provide general comments and additional revision critiques specifying strengths and weaknesses of the proposal, as well as the necessary improvements that must be mac by the student before submitting a revised version. Only after a majority of the members of the advisory committee has approve the written proposal, the student moves to the oral defense.

Students are encouraged, in consultation with their advisor, to submit their research proposals to NIH to compete for a NRSA F31 predoctoral fellowship.

The **oral section** is contingent upon the student having successfully completed the written section. The specific content of the or exam is determined, in consultation with the advisory committee, primarily by the content of the written proposal. Students may give a brief update (~10 minutes) on their coursework and research progress at the beginning of the oral examination (~10 minutes). The presentation of the research proposal may last 30-40 minutes, followed by questions from the committee. Questio may arise from general knowledge in biochemistry, molecular, and cellular biology, or specifically associated with the proposed project. Students are expected to defend the significance, premise, rationale, methodologies, and experimental plans outlined ir their proposals. They are expected to present a feasible project utilizing available resources at UNH, the advisor's laboratory, and collaborative supports. The oral exam typically lasts 90-120 minutes. Upon the completion of questions from the committee, the student will be asked to leave the defense room while the committee discusses the oral examination. The committee discussion should last no longer than 15 minutes, and consensus by the committee should be reached after a discussion. Afterwards, the student will be invited back into the room to hear the committee's verdict and their specific feedback on both the oral portion of their exam, and the qualifying exam in general.

The grading of the qualifying exam includes **Pass, Conditional Pass, or No Pass**. Upon passing the qualifying examination, the student advances to PhD candidacy, officially declaring the intended dissertation topic. For students receiving a Conditional Pass specific weaknesses identified by the committee are addressed through additional revision or research. Students who receive a N Pass have demonstrated insufficient scientific premise, mastery of lab skills or critical thinking. In this case, they have the option retake the qualifying exam within 6 months. Students who cannot pass the qualifying exam after 2nd trial are advised to pursue a master's degree.

Dissertation: The student is required to prepare a written doctoral dissertation for submission to the Doctoral Committee. The dissertation must represent significant and original research written in a clear, comprehensible style. A copy of the complete thesis must be made available to the committee at least two weeks before the date of the final examination. Publication of the dissertation by ProQuest is required.

Final Defense: An oral examination of the doctoral dissertation consists of two parts: an oral presentation of the research that is open to the public, and an oral defense of the dissertation conducted by the doctoral committee. Final approval of the doctoral dissertation will be determined by a majority vote of the doctoral committee.

Teaching Requirement: Teaching assignments in the laboratory, in lectures, or in an individual instruction format are an essential part of the graduate academic programs of the department and are designed to give graduate students practical teaching experience. Normally, one year of part-time teaching will be required of each doctoral student.

Program Learning Outcomes

All MCBS graduates will be able to:

- Critically apply theories, methodologies, and knowledge to address fundamental questions in their primary area of study.
- Pursue research of significance in the discipline (or an interdisciplinary or creative project). Students plan and conduct this research (or implement their project) under the guidance of an advisor, while developing intellectual independence that typifies true scholarship.
- Demonstrate skills in oral and written communication sufficient to present and publish work in their field, and to prepare gra proposals.
- Follow the principles of ethics in their field, and in academia, as well as adhere to established principles of scientific rigor anc reproducibility.
- Demonstrate, through service, the value of their discipline to the academy and community at large.
- Demonstrate a mastery of skills and knowledge at a level required for college and university undergraduate teaching in their discipline and assessment of student learning.
- Interact productively with individuals from diverse backgrounds in the roles of team members, leaders and mentors with integrity and professionalism.

Graduates of the Biochemistry Ph.D. degree program will be able to:

- Demonstrate extensive knowledge and understanding of fundamental biochemistry principles and their area of specializatio in the field.
- Critically apply theories and methodologies to address fundamental questions in biochemistry through research activities.
- Design and conduct biochemical experiments in their area of specialization, analyze and interpret research data, and draw critical conclusions.
- Communicate biochemical concepts and experimental results effectively in writing and orally both in scientific technical language as well as at an appropriate level tailored for the general audience.

Biochemistry (M.S.)

https://colsa.unh.edu/molecular-cellular-biomedical-sciences/program/ms/biochemistry

The M.S. in Biochemistry combines a rigorous curriculum in biochemistry and related disciplines with interdisciplinary research opportunities at the frontiers of biochemistry, molecular biology, and cell biology. Graduates of the program are equipped for successful careers in biotechnology and pharmaceutical companies, or in academic and government research laboratories. Graduates are also prepared for doctoral programs, medical school, or other health-related professional programs.

Distinctive Features of the Program

- Advanced course offerings include signal transduction pathways, pharmacology, physical biochemistry, proteomics, endocrinology, structural biology, bioinformatics, and cancer biology
- Emphasis on interdisciplinary research training
- Well-equipped research laboratories and core facilities on the UNH campus
- Laboratory rotations upon entry to the program to become familiar with different research laboratories
- Weekly graduate student seminar presentations, as well as a departmental seminar series of invited speakers
- Opportunities to gain teaching experiences as a Graduate Teaching Assistant
- Accelerated M.S. program available to UNH students enrolled in the B.S. program in Biochemistry, Molecular, and Cellular Biology or related disciplines.

Research Opportunities

- Tumor cell biology
- Protein structure, function, and regulation
- Signal transduction pathways
- Molecular and cellular neuroscience
- Genomics, proteomics, and bioinformatics
- Regenerative biology
- Molecular immunology
- Chemical biology

Financial Support

- Students admitted to the M.S. Program are typically supported by Research Assistantships or Teaching Assistantships
- Teaching Assistantships are not available for students enrolled in the Accelerated M.S. program
- Internal summer and academic year fellowships are available to students on a competitive basis.

Career Prospects

- Research scientists in biotechnology and pharmaceutical industries
- Lab managers in academic research labs and research institutes, state and federal government agencies
- Continuing education in doctoral programs and professional health programs (e.g., medical school)

Admission Requirements

- Completion of foundational courses in biology, chemistry (including organic chemistry), physics, and mathematics
    - Otherwise well-qualified applicants can correct academic deficiencies with enrollment in appropriate courses or

independent study during the first year of graduate studies

- Applicants from non-English speaking countries must provide Test of English as a Foreign Language (TOEFL) scores
- Three letters of recommendation
- Personal statement, including research interests and identification of two or three potential Biochemistry faculty thesis advisors.

M.S. Degree Requirements

Student must meet the Graduate School's requirements for the master's degree and are expected to develop a culminating thes based on the completion of a research project. Demonstration of proficiency in biochemistry will be assessed in the first year by examination or coursework. All candidates for the M.S. degree must pass an oral examination based on the thesis or project repo and on the graduate courses completed in the degree program.

Credits: A minimum of **30 graduate credits** is required including 6-10 master's thesis credits (MCBS 899 Master's Thesis). Graduate credits are earned for courses numbered 800-999. Up to 12 credits earned at UNH in co-listed 7XX/8XX courses may be taken for graduate credits upon approval of the Graduate School. Typically, master's students enroll in BCHM 851 Principles of Biochemistry I & BCHM 852 Principles of Biochemistry II during their first year of study, unless diagnostic examinations indicate that undergraduate preparation in general biochemistry is sufficient.

Thesis Committee: During the first semester, the Graduate Program Coordinator will assist the student in choosing courses. Following selection of the thesis advisor, the student and the advisor jointly agree on the members of the Thesis Committee no later than during the second semester and communicate this recommendation to the Biochemistry Graduate Program Coordinator. The Master's Supervisory Committee Nomination Form must be completed and submitted to the Graduate School. The Thesis Committee consists of the advisor as chair and two other members. The committee meets soon after selection of a thesis project to approve the student's proposed curriculum.

Courses required by the Thesis Committee must be taken for credit and completed with a passing grade (B-minus or better). Courses recommended by the committee may be audited or taken for credit, but in either case the student is expected to be familiar with the subject matter of these courses. It is recommended that the student meet with their Thesis Committee every semester to review progress of the thesis project and academics.

Written Thesis and Oral Presentation: Students must prepare a written master's thesis for submission to their Thesis Committe A copy of the complete thesis must be made available to the committee at least 14 days before the date of the final examination. Consult the *Thesis and Dissertation Manual* provided by the Graduate School for details on preparing the manuscript.

The oral examination of the master's thesis consists of two parts: an oral presentation of the research that is open to the public a an oral defense of the master's thesis conducted by the Thesis Committee.

Final approval of the master's thesis will be determined by an affirmative majority vote of the Thesis Committee. The final thesis must be submitted to the Graduate School via the procedures outlined in the *Thesis and Dissertation Manual*. As their program nears completion, students must submit the Intent-to-Graduate prior to the deadline posted on the Graduate School's calendar.

Accelerated Master's Overview

Accelerated Master's programs offer qualified University of New Hampshire undergraduate students the opportunity to begin graduate coursework in select graduate programs while completing a bachelor's degree. Accelerated master's programs are designed to provide students with an efficient and cost-effective pathway to earn both a bachelor's and master's degree or graduate certificate, enhancing career opportunities and long-term earning potential.

- ACCELERATED MASTER'S HIGHLIGHTS
- ACCELERATED MASTER'S ADMISSION REQUIREMENTS
- ACCELERATED MASTER'S REQUIREMENTS

Biochemistry (M.S.) Accelerated Option

This graduate degree program is approved to be taken on an accelerated basis in articulation with the following undergraduate program(s):

Biochemistry, Molecular and Cellular Biology (B.S.)

Students select from the following approved 800-level courses that can be completed in the undergraduate senior year for dual credit:

BCHM 802	Endocrinology	4
BCHM 825	Cell Phenotyping and Tissue Engineering Laboratory	4
BCHM 850	Physical Biochemistry	3
BCHM 851	Principles of Biochemistry I	4
BCHM 852	Principles of Biochemistry II	4
BCHM 853	Cell Culture	5
BCHM 854	Molecular Biology Research Methods	5
BCHM 855	Protein Biochemistry Laboratory	5
BCHM 860	Pharmacology	4
BCHM 863	Biochemistry of Cancer	4
BCHM 894	Protein Structure and Function	4
BIOL 806	Data Science with R for the Life Sciences	4
MICR 805	Immunology	3
CHEM 855	Advanced Organic Chemistry	3
GEN 804	Microbial Genetics and Genomics	5
GEN 805	Population Genetics	3
GEN 806	Human Genetics	4
GEN 811	Genomics and Bioinformatics	4
GEN 813	Microbial Ecology and Evolution	4
GEN 815	Molecular Evolution	4
GEN 817	Molecular Microbiology	5
GEN 821	Comparative Genomics	4
GEN 871	Molecular Genetics	4
NUTR 850	Nutritional Biochemistry	4

Additional Information

Admission Requirements

- Thesis advisor identified who supports entry into the program.
- Two letters of recommendation (one must be from the thesis advisor).
- A personal statement of research interests and career aspirations.

Program Learning Outcomes

All MCBS graduates will be able to:

- Critically apply theories, methodologies, and knowledge to address fundamental questions in their primary area of study.
- Pursue research of significance in the discipline (or an interdisciplinary or creative project). Students plan and conduct this research (or implement their project) under the guidance of an advisor, while developing intellectual independence that typifies true scholarship.
- Demonstrate skills in oral and written communication sufficient to present and publish work in their field, and to prepare gra proposals.
- Follow the principles of ethics in their field, and in academia, as well as adhere to scientific standards for rigor and reproducibility.
- Demonstrate, through service, the value of their discipline to the academy and community at large.
- Demonstrate a mastery of skills and knowledge at a level required for college and university undergraduate teaching in their discipline and assessment of student learning.
- Interact productively with individuals from diverse backgrounds in the roles of team members, leaders and mentors with integrity and professionalism.

Graduates of the Biochemistry M.S. degree program will be able to:

- Demonstrate extensive knowledge and understanding of fundamental biochemistry principles and their area of specializatio in the field.
- Critically apply theories and methodologies to address fundamental questions in biochemistry through research activities.
- Design and conduct biochemical experiments in their area of specialization, analyze and interpret research data, and draw critical conclusions.
- Communicate biochemical concepts and experimental results effectively in writing and orally both in scientific technical language as well as at an appropriate level tailored for the general audience.

Biological Sciences (DBS)

https://colsa.unh.edu/biological-sciences

Degrees Offered: Ph.D., M.S.

This program is offered in Durham.

The Biological Sciences Graduate Program offers M.S. and Ph.D. degrees in Biological Sciences, with options in Integrative and Organismal Biology and Marine Biology.

INTEGRATIVE AND ORGANISMAL BIOLOGY (IOB)

This option offers a home to students interested in basic organismal biology in all of its diverse aspects (physiology, neurobiolog behavior, cell biology, genetics, evolution, ecology, systematics, etc.), in both terrestrial and aquatic environments. Modern biology employs approaches and tools ranging from molecular to ecological levels to gain a deep understanding of organismal functions and adaptations. Students in IOB approach their studies with a focus on organisms, and apply whatever tools are necessary to answer thematic and specific questions. Students interested in combining hands-on biological projects with researc on teaching and learning biology at the post-secondary level should choose this option.

MARINE BIOLOGY (MB)

This option is intended for students interested in marine, coastal, and estuarine ecosystems, and the organisms that inhabit ther at all levels of inquiry. Some faculty at UNH use marine organisms, ranging from microbes to fish, invertebrates, and macroalgae study physiology, molecular phylogeny, and species interactions; others focus on the structure and function of marine ecosysten Faculty interests range from basic research on marine organisms and systems to applied areas such as aquaculture and fisheries; many combine the two.

RELATED PROGRAMS

Students interested in fields such as agriculture and animal science should review programs available through the Department o Agriculture, Nutrition, and Food Systems; those interested in molecular biology and genomics should review programs in the Department of Molecular, Cellular and Biomedical Sciences, including Genetics and Molecular & Evolutionary Systems Biology; those interested in ecosystems, wildlife and forestry should review programs in the Department of Natural Resources and the Environment, including Natural Resources and Earth Systems Science (NRESS).

Admission Requirements

Applicants ordinarily will have completed an undergraduate major in biology or a related field. A basic array of courses including general biology, development, ecology, genetics, morphology, and physiology is recommended; applicants should have completed organic chemistry and a semester each of calculus and physics. Applicants whose preparation does not meet these criteria can be admitted to the program, but may need to remedy any deficiencies via courses that do not give graduate credit.

All applicants are strongly encouraged to communicate with potential advisors as part of the application process. Identifying an advisor is normally a prerequisite for admission. To contact a potential advisor in the Marine Biology or Integrative Organismal Biology option, please see the lists of faculty.

Research and Facilities

The Biological Sciences graduate program is enhanced by research in other departments and institutes across the University.

These include the School for Marine Sciences and Ocean Engineering and its associated programs and facilities:

- N.H. Sea Grant Program;

- the Institute for the Study of Earth, Oceans, and Space (EOS);
- the UNH Center for Coastal and Ocean Mapping/Joint Hydrographic Center; and (CCOM);
- the Ocean Processes Analysis Laboratory (OPAL).

There are four aquatic laboratories:

- Jackson Estuarine Lab,
- Judd Gregg Marine Research Complex,
- the Aquaculture Research Center (ARC), and
- the Shoals Marine Laboratory (SML).

The Center for Freshwater Biology (CFB) jointly administers (with the UNH Cooperative Extension) the Lakes Lay Monitoring Program, which is dedicated to the preservation and sound management of lakes through citizen-based monitoring and researcl

The University of New Hampshire Collection of insects and other arthropods is the largest arthropod depository and research collection in Northern New England (700,000 specimens and growing). Over 12,000 species are represented from different regior of New England, featuring many specimens collected from the White Mountains.

In addition, research in plant biology and agriculture is carried out in the Macfarlane Research Greenhouses, the Hodgdon Herbarium, and UNH's agricultural facilities.

The Hubbard Center for Genomic Studies provides training and research in comparative and environmental genomics, with a special emphasis on novel model species. It provides expertise in constructing DNA libraries, DNA sequencing, fragment analysis and the analysis of gene expression.

- Integrative Biology (M.S.)
- Integrative Biology (Ph.D.)
- Marine Biology (M.S.)
- Marine Biology (Ph.D.)
- Neuroscience and Behavior (M.S.)
- Neuroscience and Behavior (Ph.D.)

On This Page

Animal Sciences (ANSC)

ANSC 808 - Ruminant Nutritional Physiology

Credits: 3
Anatomy of the ruminant gastrointestinal tract, physiological factors related to rumen function, and microbial and whole-body metabolism of carbohydrates, protein, and lipids.
Grade Mode: Letter Grading

ANSC 810 - Dairy Nutrition

Credits: 4
Feeding and related management of dairy cows, nutrients and their use, digestive anatomy, physiology, energy systems, forage quality and conservation methods, metabolic disorders, ration balancing.

Grade Mode: Letter Grading

ANSC 815 - Physiology of Lactation

Credits: 4
Examines the biological and biochemical influences of the lactation process. Emphasis on the physiological effects of environments, hormones, and nutrition on milk synthesis and secretion, mammary physiology, and maternal response.
Grade Mode: Letter Grading

ANSC 827 - Advanced Dairy Management I

Credits: 4
Advanced management evaluation of milking procedures, reproduction, nutrition, mastitis, and calf and heifer management.
Grade Mode: Letter Grading

ANSC 828 - Advanced Dairy Management II

Credits: 4
Advanced management evaluation of dairy cattle, housing, milking equipment, milk quality, record keeping, herd health, financi personnel management, environmental issues. Visits to farms in the area to provide critical assessments of dairy farm businesse
Grade Mode: Letter Grading
Special Fee: Yes

ANSC 895 - Investigations

Credits: 1-4
Investigations in genetics, nutrition, management, diseases, histology, equestrian management/agribusiness, physiology, cell biology, microbiology, dairy management, or teaching experience.
Repeat Rule: May be repeated for a maximum of 4 credits.
Grade Mode: Letter Grading

ANSC 899 - Master's Thesis

Credits: 1-6
Master's students must enroll for a total of 6 credits of this course. Students may enroll in 1-6 credits per semester.
Repeat Rule: May be repeated for a maximum of 6 credits.
Grade Mode: Graduate Credit/Fail grading

ANSC 999 - Doctoral Research

Credits: 0
Doctoral Research.
Grade Mode: Graduate Credit/Fail grading
Special Fee: Yes

Biology (BIOL)

BIOL 801 - Plant Physiology

Credits: 4
This course covers general principles of plant physiology relating plant structure to function and introduce basic physiological processes underlying plant growth and development and plant responses to the environment. Course topics include plant cell structure, plant water relations, plant mineral nutrition, metabolism, photosynthesis, plant respiration, signal transduction, plan growth regulators, photomorphogenesis, plant development, reproduction, senescence, and stress physiology. Course format consists of lectures and laboratory session. The laboratory session is designed to accompany lectures in plant physiology. The laboratories' core objective is to help students visualize main basic concepts and common techniques in plant physiology by running basic experiments, analyze data, and present results. It is strongly encouraged that students have a background knowledge of plant biology and chemistry for success in this class.
Grade Mode: Letter Grading
Special Fee: Yes

› **View Course Learning Outcomes**

BIOL 804 - Plant-Microbe Interactions

Credits: 3

Microbes and plants have developed intriguing strategies to encourage, resist or profit from their coexistence. The primary objective of the course is to provide students with a comprehensive overview of the various ways in which microbes interacts wit plants, the outcomes of that interplay, and applications of these interactions and explore how these interactions impact ecosystem function. One year of general biology and a semester of Microbiology or Genetics recommended.

Grade Mode: Letter Grading

BIOL 806 - Data Science with R for the Life Sciences

Credits: 4

Introduces students to the basic data analysis and programming tools commonly used throughout the life sciences. Students wil become proficient in R programming, data wrangling and cleaning, the principles of open and reproducible science, SQL databas management, version control via Git/Github, building maps, and Bash command lines. Data sets and case studies from across th life sciences will be used throughout the course. The class culminates with an small group project.

Grade Mode: Letter Grading

BIOL 811 - Experimental Design & Analysis

Credits: 4

Design and analysis of biological and ecological research experiments. "Real world" studies used to discuss the identification of hypotheses, appropriate experimental design, and the application of statistical analyses including ANOVA, ANCOVA, correlation and regression, cluster analysis, classification and ordination techniques. Theoretical statistical concepts tailored to consider students' own thesis and dissertation research, allowing statistical problems to be addressed at various stages of the research process. Common computer packages used for analyses include Excel, JMP, Systat and R.

Grade Mode: Letter Grading

BIOL 814 - Model Organisms in Biological and Medical Research

Credits: 2

Animals, plants, and microbes serve as powerful tools for both basic and biomedical research. This course integrates historical, philosophical, sociological, and biological perspectives to examine how models are chosen and used. and how to evaluate their strengths and weaknesses. Students will study particular model species in depth, and address general epistemological question about the choice and use of model organisms. This course is designed for graduate students and advanced undergraduates interested in research.

Grade Mode: Letter Grading

BIOL 820 - Plant-Animal Interactions

Credits: 4

Animals and plants engage in a range of interactions, from plant-pollinator and plant-ant mutualisms to plant-herbivore and carnivorous plant antagonisms. This course will explore the consequences of a variety of interactions on the evolution of traits in both animals and plants, considering implications for both conservation and agriculture. Weekly recitation. One year of general biology recommended.

Grade Mode: Letter Grading

BIOL 827 - Animal Communication

Credits: 4

This course examines the principles underlying how animals communicate with each other and why they communicate the way they do by using perspectives drawn from a broad range of disciplines including physics, chemistry, ecology, psychology, economics, and behavioral ecology. Students will explore the primary literature, and work in teams to conduct independent research. The course is intended for advanced undergraduate or graduate students interested in neuroscience and behavior, evolution, wildlife and conservation biology, or zoology. One year of general biology recommended.

Grade Mode: Letter Grading

BIOL 828 - Marine Bioacoustics

Credits: 3

Marine bioacoustics is a highly interdisciplinary field of science that requires knowledge of marine biology, oceanography, physic and engineering. This course provides an introduction to the role of acoustics in aquatic biological systems and how acoustics is used to study biological processes and ecosystem dynamics. Topics include: marine animal hearing; sound production; behavior echolocation; remote sensing; research methods; and the impacts of sounds on marine animals. It is suggested that students hav a strong background in biology. College level physics and calculus is suggested.

Grade Mode: Letter Grading

BIOL 840 - Acoustic Ecology

Credits: 4

This course examines the acoustic environment and how alterations to the acoustic environment from human activities and climate change result in permanent changes to animal behavior and the resulting soundscape. Focusing on using acoustics as a tool to monitor species and habitats, students will learn quantitative approaches and best practices for acoustic ecology investigations. Students will explore the emerging field of ecological acoustics through primary literature and hands-on, independent research in habitats surrounding UNH campus. This course is intended for advanced undergraduate or graduate students interested in animal behavior, ecology, wildlife and conservation biology, or zoology. Two semesters of college-level biology required prior to taking this course.

Grade Mode: Letter Grading

Special Fee: Yes

BIOL 852 - New England Mushrooms: a Field and Lab Exploration

Credits: 4

This is a hands-on field, lab and lecture course in the identification, classification, life histories, and ecology of mushrooms and other macrofungi. Lectures focus on macrofungal ecology and systematics. Laboratory instruction emphasizes morphological, microscopic, and molecular identification techniques, plus the use of smart-phone field note recording and on-line resources. Several field trips are required in addition to the weekly laboratory. Previous experience with fungi is not required. Grades are based on a collection, a project, and presentations. Intro course in Biology or Plant Biology, recommended.

Equivalent(s): PBIO 852

Grade Mode: Letter Grading

Special Fee: Yes

BIOL 855 - Biological Oceanography

Credits: 3

Biological processes of the oceans, including primary and secondary production, trophodynamics, plankton diversity, zooplankt ecology, ecosystems and global ocean dynamics. One year of general biology recommended.

Equivalent(s): ESCI 850, ZOOL 850

Grade Mode: Letter Grading

BIOL 873 - Physiology of Fishes

Credits: 4

Investigates the physiological processes responsible for maintaining homeostasis in fishes. Focuses on the function and regulatio of the major organ systems during stress and environmental adaptation. Topics include reproduction, osmoregulation, digestion endocrinology, and sensory perception.

Equivalent(s): ZOOL 873

Grade Mode: Letter Grading

Special Fee: Yes

BIOL 895 - Advanced Studies

Credits: 1-4

Advanced research or seminar, supervised by a faculty member.

Grade Mode: Letter Grading

BIOL 899 - Master's Thesis

Credits: 1-10
Master's thesis research.
Repeat Rule: May be repeated for a maximum of 10 credits.
Grade Mode: Graduate Credit/Fail grading

BIOL 901 - Introductory Graduate Seminar

Credits: 2
This seminar provides an introduction to the Biological Sciences Graduate Program, offering students an overview of program structure and requirements, introducing faculty research and campus resources, and helping participants develop skills and strategies useful in graduate school. Requirements include preparation of a written research proposal and a brief oral presentation.
Equivalent(s): ZOOL 901
Grade Mode: Graduate Credit/Fail grading

BIOL 902 - Writing and Publishing Science

Credits: 2
Participants in this seminar (1) make significant progress on one or more of their current academic writing projects; (2) increase their understanding of the genres, protocols, and mechanisms of scientific writing and publishing; and (3) develop strategies anc skills for getting professional writing done efficiently and well, in graduate school and beyond.
Repeat Rule: May be repeated for a maximum of 6 credits.
Grade Mode: Graduate Credit/Fail grading

BIOL 950 - Scientific Communication

Credits: 2
Professional success in science depends on the ability to communicate, both by publishing in professional journals and by explaining the implications of research to a broad audience. This course covers a wide range of topics related to scientific communication. Students work on multiple forms of communication, practice communicating science to the public, strengthen peer reviewing skills, explore online scientific communities, and enhance awareness of relevant economic, legal, and ethical issues.
Equivalent(s): LSA 950
Grade Mode: Graduate Credit/Fail grading

BIOL 999 - Doctoral Dissertation Research

Credits: 0
Doctoral dissertation research.
Grade Mode: Graduate Credit/Fail grading
Special Fee: Yes

Marine, Estuarine and Freshwater Biology (MEFB)

MEFB 817 - Lake Ecology

Credits: 4
Introduction to the ecology of freshwater systems with emphasis on lakes. Origins of lakes and the effects of watersheds on lake chemistry and nutrient cycling are explored. Other topics include the impact of human disturbances on productivity and aquatic food webs and methods used for the management and restoration of lakes. Comparisons are made of the structure and function of lake ecosystems found in temperate, tropical and arctic regions.
Equivalent(s): PBIO 817, ZOOL 817
Grade Mode: Letter Grading

MEFB 847 - Aquatic Plants in Restoration/Management

Credits: 4
A field-intensive class focusing upon freshwater and marine vascular plants with an emphasis on species commonly associated

with ecological restoration, the identification and conservation of rare species, and the adaptations and management of invasive species of aquatic habitats in New England. Field trips emphasize the flora of various wetland habitats, including open water and vegetated fresh water wetlands, as well as coastal and estuarine habitats. Lectures and readings examine the current trends in research and management focusing upon specific taxa and pertinent facets of their taxonomy, physiology, and natural history.
Equivalent(s): PBIO 847
Grade Mode: Letter Grading
Special Fee: Yes

Natural Resources (NR)

NR 803 - Watershed Water Quality Management

Credits: 4
Principles of land use as they relate to water quality and quantity. Lectures focus on biogeochemical cycles and the watershed approach to land and water resource management. Labs and field trips focus on methods of water sampling and analysis. One year of chemistry is recommended. Lab/field trips.
Equivalent(s): WARM 803
Grade Mode: Letter Grading
Special Fee: Yes

NR 806 - Soil Ecology

Credits: 4
Examines the ecological relationships between soil microorganisms and their biotic and abiotic environment, with emphasis on the role of soil microorganisms in biogeochemical cycling. Specific objectives are to examine the biodiversity present in soil systems, factors controlling microbial community composition and diversity, and linkages between soil microbial communities, soil physical properties, and soil organic matter and nutrient cycling dynamics. Lab.
Equivalent(s): SOIL 806
Grade Mode: Letter Grading
Special Fee: Yes

NR 807 - Environmental Modeling

Credits: 4
Environmental Modeling introduces students to a range of key mathematical and computer modeling concepts and the ways the can be used to address important scientific questions. The course is divided into four topical sections: Population and Communi Ecology, Hydrology, Biogeochemistry, and Ecosystems. In each section, modeling concepts and skills are presented together with environmental information to emphasize the linkage between quantitative methods and relevant scientific results.
Equivalent(s): EOS 807
Grade Mode: Letter Grading

NR 808 - Environmental Economics

Credits: 4
Environmental pollution, the market economy, and optimal resource allocation; alternative control procedures; levels of environmental protection and public policy; property right issues.
Equivalent(s): RECO 808
Grade Mode: Letter Grading

NR 820 - International Environmental Politics and Policies for the 21st Century

Credits: 4
Students examine policies for managing human activities to sustain the health of regional ecosystems and planetary life-support systems. Selected problems of the international commons (oceans, marine resources, atmosphere, migratory species); global an regional carrying capacity (population, resource consumption), internationally shared ecosystems (trans-boundary watersheds, water-bodies, tropical forests); and the relevant international institutions and politics for policy formation, conflict resolution, ar implementation. Using a policy-analytic framework, students develop case studies to assess international policies and institutional arrangements to achieve the objectives of Agenda 21--Earth Summit Strategy to Save the Planet.
Equivalent(s): EC 820

Grade Mode: Letter Grading

NR 824 - Resolving Environmental Conflicts

Credits: 4

Theories and practices of environmental dispute settlement. Roles of public, non-governmental and governmental organizations Effectiveness of public participation initiatives in influencing public policy decisions and/or resolving environmental conflicts. Alternative approaches to consensus (policy dialogues, joint problem solving; strategic planning; negotiation, mediation) as well as litigation. Specific cases are critiqued and evaluated; conflict resolution skills are developed. Students observe and/or participate in ongoing local decision processes. Lab.

Equivalent(s): EC 824

Grade Mode: Letter Grading

Special Fee: Yes

NR 829 - Silviculture

Credits: 4

The science and art of establishing, growing, and tending forests to meet multiple objectives. Basics of forest stand dynamics applied to the problems of timber management, wildlife habitat, water quality, and carbon sequestration.

Grade Mode: Letter Grading

Special Fee: Yes

NR 830 - Terrestrial Ecosystems

Credits: 4

Processes controlling the energy, water, and nutrient dynamics of terrestrial ecosystems; concepts of study at the ecosystem leve controls on primary production, transpiration, decomposition, herbivory; links to Earth-system science, acid deposition, agriculture.

Equivalent(s): EOS 830

Grade Mode: Letter Grading

NR 831 - Agriculture and Environmental Change: Challenges and Solutions

Credits: 4

Agriculture is the foundation of civilization, providing the food, fuel and fiber needed to sustain a growing human population. Fr the original land clearing to today, agriculture has profoundly impacted the environment and is now recognized as a major contributor to soil and water degradation and climate change. At the same time, climate change and other large-scale environmental changes are forcing adaptation of agricultural practices. This course examines interactions between agricultural systems and global environmental processes, including climate change, carbon cycling, nitrogen pollution and water resources. Students will develop an in-depth understanding of how agricultural practices contribute to environmental changes from local t global scales and the underlying biogeochemical drivers of change. We will evaluate frameworks like agroecology, regenerative agriculture, agroforestry, and climate-smart agriculture for their potential to mitigate environmental impacts. Students will learn to apply interdisciplinary thinking to develop solutions that balance crop productivity and environmental sustainability in a changing world. The course emphasizes biogeochemical understanding across spatial and temporal scales and couples to agroecosystem management frameworks to consider solutions.

Grade Mode: Letter Grading

› **View Course Learning Outcomes**

NR 834 - Tropical Ecology

Credits: 4

This course introduces students to the ecology of different tropical ecosystems, and involves students in analyzing and interpreting ecological field data and remotely sensed data. An important emphasis is to understand patterns and processes across scales - from individual plants to ecosystems and landscapes. The also addresses important global issues in the tropics, including climate change, land use change, diverse ecosystem services, and sustainable resource management. Completion of a general ecology course is required prior to taking this course.

Grade Mode: Letter Grading

› **View Course Learning Outcomes**

NR 840 - Inventory and Monitoring of Ecological Communities

Credits: 4

Provides an introduction to the major concepts associated with monitoring change in ecological communities. Students develop an appreciation for such issues as: identification of appropriate baselines for comparison; use of indicator species; the tools used to inventory common, rare, and secretive species; how trend data are analyzed; and the implications of failing to detect an indicator species. Restricted to senior wildlife majors others by permission. Lab.

Grade Mode: Letter Grading

Special Fee: Yes

NR 843 - Addressing Arctic Challenges I

Credits: 4

Students will gain knowledge on the effect of climate change on Arctic environmental, social, and built systems, and apply transdisciplinary approaches to addressing arctic challenges. This course employs inquiry-based, peer-to-peer, and self-driven approaches. Students will tackle a research project, including in-depth data analysis in R, with the aim of contributing new knowledge in the form of a proposal, peer-reviewed publication, policy brief, outreach product, or other.

Grade Mode: Letter Grading

NR 844 - Biogeochemistry

Credits: 4

Examines the influence of biological and physical processes on elemental cycling and geochemical transformations from the molecular to the global scale, involving microorganisms, higher plants and animals and whole ecosystems; factors that regulate element cycles including soils, climate, disturbance and human activities; interactions among the biosphere, hydrosphere, lithosphere, and atmosphere; transformations of C, N, S, and trace elements.

Equivalent(s): EOS 813, EOS 844

Grade Mode: Letter Grading

NR 845 - Forest Management

Credits: 4

Forest land ownership; management objectives; forest inventory regulation and policy; forest administration; professional responsibilities and opportunities. Restricted to Natural Resources majors. Lab.

Equivalent(s): FOR 845

Grade Mode: Letter Grading

Special Fee: Yes

NR 849 - Forest Inventory and Modeling

Credits: 4

Applied sampling and statistical techniques for assessing current forest conditions and predicting future growth, yield, and structure. Topics include plot and point sampling, ecological inventory, and evaluation of site quality and stand density.

Grade Mode: Letter Grading

Special Fee: Yes

NR 851 - Aquatic Ecosystems

Credits: 4

Energy flow and nutrient cycling in streams, rivers and lakes, with an emphasis on understanding the control of primary productivity, decomposition and community structure by both hydrologic and biotic drivers. Role of aquatic ecosystems in carbon and nitrogen budgets at watershed, regional, and global scales. Impacts of environmental changes such as global climate change and suburbanization on aquatic ecosystems. Lab.

Grade Mode: Letter Grading

NR 857 - Remote Sensing of the Environment

Credits: 4

Practical and conceptual presentation of the use of remote sensing and other geospatial technologies for mapping and monitoring the environment. This course begins with the use of aerial photographs (photogrammetry, and photo interpretation) and include

measures of photo scale and area, parallax and stereo viewing, object heights, flight planning, photo geometry, the electromagnetic spectrum, camera systems and vegetation/land cover mapping. The course concludes with an introduction to other geospatial technologies including digital image analysis, global positioning (GPS), and geographic information systems (GI Conceptual lectures are augmented with practical homework assignments and hands-on lab exercises. Lab.
Grade Mode: Letter Grading
Special Fee: Yes

NR 859 - Digital Image Processing for Natural Resources

Credits: 4
Introduction to digital remote sensing, including multispectral scanners (Landsat and SPOT) radar, and thermal imagery. Hands- image processing including filtering, image display, ratios, classification, registration, and accuracy assessment. GIS as it applies image processing. Discussion of practical applications. Use of ERDAS image-processing software. Knowledge of PCs required.
Prerequisite(s): NR 857 with a minimum grade of B-.
Grade Mode: Letter Grading

NR 860 - Geographic Information Systems in Natural Resources

Credits: 4
This course in geographic information systems (GIS), covers advanced theory, concepts, and applications of GIS for natural resource and related disciplines. Discussion of database structures, data sources, spatial data manipulation/analysis/modeling, data quality and assessment. Students conduct a project of their design exploring aspects of GIS most useful to them. Lecture emphasizes concepts and applications through a text and selected peer-reviewed articles. Lab uses the latest version of ArcGIS software and provides hands-on experience.
Prerequisite(s): NR 658 with a minimum grade of D-.
Grade Mode: Letter Grading

NR 861 - Environmental Soil Chemistry

Credits: 4
Chemical transformations in soils are the basis for soil fertility and plant productivity in natural and managed ecosystems, and al influence key ecosystem processes including soil organic matter turnover and soil-atmosphere exchange of trace gases. This clas will explore soil chemistry processes and transformations related to soil nutrient cycling, plant nutrient acquisition, and other critical environmental services.
Grade Mode: Letter Grading

NR 881 - Agroforestry

Credits: 4
This course introduces students to the principles and practice of agroforestry—the integration of trees with crops and/or livestoc to provide multiple benefits. Students gain knowledge of Indigenous and modern agroforestry systems, their global distribution and characteristics, the scientific principles underlying interactions between trees, crops, and livestock, and their management t optimize benefits. Students explore the potential for agroforestry to serve as a climate-smart, sustainable strategy for enhancing food production and ecosystem services, and gain practical field experience in designing agroforestry systems appropriate for Ne England.
Grade Mode: Letter Grading
Special Fee: Yes

› **View Course Learning Outcomes**

NR 882 - Forest Health

Credits: 4
Forests cover over 30% of the land surface of the Earth and are incredibly important ecologically, economically, and to the health of the planet. While forests show great capacity to withstand disturbance, these ecosystems are increasingly threatened worldwi by climate change, native and introduced insects and disease, poor management practices, land clearing, drought, fire, and pollution. This course offers an overview of the dominant threats to forests, their causes and consequences, and options for monitoring, management, and mitigation.
Grade Mode: Letter Grading
Special Fee: Yes

NR 887 - Advanced Topics in Sustainable Energy

Credits: 4

This course will engage students in advanced topics in sustainable energy. Course reviews basic structure of our energy system, energy markets and economics, and the environmental, economic and technological of our energy landscape. Focus will be on electricity and building use with introductions to the transportation system. Students will gain the knowledge to evaluate innovations in technology, policy and financing necessary to implement sustainable energy goals from conservation and efficien to renewables and energy storage.

Grade Mode: Letter Grading

Special Fee: Yes

NR 899 - Master's Thesis

Credits: 1-10

Master's Thesis. Usually 6 credits, but up to 10 credits when the problem warrants.

Repeat Rule: May be repeated for a maximum of 10 credits.

Grade Mode: Graduate Credit/Fail grading

NR 900 - Teaching Assistantship Practicum

Credits: 0

This course covers best practices, norms, and expectations in performing the duties of a teaching assistant. Strategies for effectiv grading, communication with students and instructors, and institutional policies are explored and reinforced.

Grade Mode: Graduate Credit/Fail grading

NR 903 - Approach to Research

Credits: 2

Provides incoming graduate students with an overview of the scientific method, peer review, and various research approaches a methods. Ethics, institutional and individual responsibilities, and effective communication are also addressed in a seminar and discussion format.

Grade Mode: Graduate Credit/Fail grading

NR 905 - Grant Writing

Credits: 2

The ability to secure financial support for research and outreach activities is becoming increasingly important. This course is intended for graduate and post-graduate level students who need to write proposals for their graduate work or to gain external funding from government agencies. Students will gain in-depth understanding of the proposal writing process through class discussions, insights shared by UNH faculty, and by writing a research proposal following the entire process.

Equivalent(s): SOIL 905, WARM 905

Grade Mode: Graduate Credit/Fail grading

NR 909 - Analysis of Ecological Communities and Complex Data

Credits: 4

This course introduces you to a suite of tools appropriate for analyzing and interpreting multivariate data arising from agroecological (and other ecological) research. In this course we cover a variety of multivariate analyses, including clustering, ordination (principle components analysis, nonmetric multidimensional scaling, correspondence analysis), group comparisons (multi-response permutation procedures, PerMANOVA, indicator species analysis, discriminant analysis, mantel test), and other hypothesis-driven techniques, including structural equation modeling.

Grade Mode: Letter Grading

NR 911 - Natural and Environmental Resource Management

Credits: 4

Fundamental economic, aesthetic, and ethical principles involved in the management of natural resources. Ways to apply these principles in the formulation and evaluation of resource management policies, including the management of specific renewable resources, soils, water, forests, and wildlife. (Offered every other year.)

Equivalent(s): RAM 911

Grade Mode: Letter Grading

NR 913 - Hierarchical Modeling in Ecology

Credits: 4

This course uses modern Bayesian statistical modeling approaches to analyze ecological data, with an emphasis on applied hierarchical models. These models will be used to examine ecological systems and related topics including: population and community dynamics, experimental design, spatial patterns, species abundance and diversity, community organization, metapopulations, and landscape processes. To be successful in the course students should have taken a course in statistics and have working knowledge of the R programming language.

Grade Mode: Letter Grading

NR 914 - Data Analysis for Natural Resources and Ecology

Credits: 4

Principles and practices of data analysis, with application to experimental and observational studies. Topics include study desig exploration of data, principles of statistical inference, statistical hypothesis testing, and approaches to model selection.

Grade Mode: Letter Grading

› **View Course Learning Outcomes**

NR 947 - Ecosystem Science: Theory, Practice, and Management Applications for Sustainabilit

Credits: 4

This course is designed for graduate students to explore in detail the fundamental principles and practical application of ecosystem science. Emphasis will be placed on understanding historical context as well as the most recent peer-reviewed literature. Writing assignments will emphasize local, regional, and international applications of ecosystem science to address environmental sustainability.

Grade Mode: Letter Grading

NR 965 - Community Ecology

Credits: 4

This course investigates how community properties -- species richness, and abundance distribution -- are influenced by evolutionary history, landscape phenomena such as dispersal and migration, and local factors such as the physical environment disturbance, competition, predation, and positive interactions. Mechanistic models of community dynamics, including successio are discussed. The influence of species diversity on ecosystem function is discussed, and all aspects of the course are related to conservation science.

Equivalent(s): NR 865

Grade Mode: Letter Grading

NR 977 - Just Maps: Cartographies of Environmental Justice

Credits: 4

Maps are ubiquitous. We carry them in our pockets, hang them on walls. We use maps to orient ourselves and rely on them to make meaning of social-environmental information. But whose space and time to maps employ? How do maps construct knowledge and to what social and political ends? What power dynamics do maps reflect and how do they become powerful themselves? This course explores such questions with focus on environmental in/justice. Completion of a GIS/Mapping course required prior to taking this course.

Grade Mode: Letter Grading

NR 993 - Natural and Environmental Resources Seminar

Credits: 2

Presentation and discussion of recent research, literature, and policy problems in the natural and social sciences influencing resource use.

Grade Mode: Graduate Credit/Fail grading

NR 995 - Investigations

Credits: 1-4
Investigations in Natural Resources may include topics in environmental conservation, forestry, soil science, water resources, and wildlife management.
Grade Mode: Letter Grading

NR 996 - Natural Resource Education

Credits: 2
Responsibilities include set-up, teaching, and grading of one lab section per week or equivalent lecture experience. Meets the teaching requirement for M.S. degree students.
Grade Mode: Graduate Credit/Fail grading

NR 998 - Directed Research

Credits: 1-4
Student designs and conducts original research that culminates in a paper of publishable quality. Alternative to NR 899 for those choosing non-thesis degree option. IA (continuous grading).
Repeat Rule: May be repeated for a maximum of 4 credits.
Grade Mode: Graduate Credit/Fail grading

Zoology (ZOOL)

ZOOL 810 - Sharks and Bony Fishes

Credits: 4
Some fish swimming today are hundreds of years old, whereas others complete their life cycle in two months! This course provides an introduction to the diversity of fishes found across the globe, including elasmobranchs (sharks, skates, and rays) and teleosts (bony fishes). Particular attention will be paid to fishes local to New Hampshire and New England. Students will learn about fish anatomy, physiology, and ecology. Lab. (Offered in alternative years.)
Grade Mode: Letter Grading
Special Fee: Yes

ZOOL 836 - Genes and Behavior

Credits: 4
Genes and behavior examines the genetic underpinnings of animal behavior, and how behavior evolves on a genetic level. The course primarily relies on readings from the primary literature, using examples from laboratory model organisms, animals in the natural habitats, and humans. Topics include aggressiveness, social behavior, personality, parental care, communication, mating behavior, novelty seeking behavior, and foraging. This interdisciplinary course examines these behaviors at multiple levels, including genomics, population genetics, molecular genetics, epigenetics, endocrinology, and neurobiology.
Grade Mode: Letter Grading

ZOOL 895 - Advanced Studies

Credits: 1-4
Independent study in various areas, including but not limited to: animal behavior; departmental biology; ecology; electron microscopy; evolution; genetics; histology; history of biology; invertebrate biology; neurobiology and behavior; physiology; teaching practices; underwater research; vertebrate biology; biological techniques. Course sections for advanced work, individual or group seminar. May include reading, laboratory work, organized seminars, and conferences.
Grade Mode: Letter Grading

Biological Sciences Department Faculty

Integrative Biology (M.S.)

https://colsa.unh.edu/biological-sciences/program/ms/integrative-biology

The Integrative and Organismal Biology (IOB) option offers a home to students interested in basic organismal biology in all of its diverse aspects (physiology, neurobiology, behavior, cell biology, genetics, evolution, ecology, systematics, etc.), in both terrestri and aquatic environments. Modern biology employs approaches and tools ranging from molecular to ecological levels to gain a deep understanding of organismal functions and adaptations. Students in IOB approach their studies with a focus on organisms, and apply whatever tools are necessary to answer thematic and specific questions. Students interested in combining hands-on biological projects with research on teaching and learning biology at the post-secondary level should choose this option. Studen completing degrees in IOB will be prepared for a wide range of professional careers in animal and/or plant biology, whether in academia, government, research, or nonprofit organizations.

M.S. Degree Requirements

Students plan a program of study in conjunction with their advisor and Master's Thesis Committee, including the required core courses and competencies. Completion of at least **30 credits**, including research credits, is required. A thesis proposal is develop within the first year. Students complete thesis research for 6 to 10 credits; the degree is completed when results are acceptable, a formal thesis presentation and defense has occurred, and the thesis is approved by the Master's Thesis Committee and accepted by the Graduate School.

Number of Credits Required

The M.S. degree requires completion of a minimum of **30 credits**, 6-10 of which may be earned for thesis research (BIOL 899 Master's Thesis). The IB Program specifies the following requirements: (BIOL 901 Introductory Graduate Seminar); 2 courses in experimental design/analysis; 1 course in writing/communication; and an ethics requirement (either RCR training and/or a graduate level class in ethics).

Up to 8 credits of graduate credit from another institution may be transferred, provided the credits were not counted toward another degree, and the course grade was a B or higher. Petitions requesting transfer credit must be supported by the advisor an graduate committee, and approved by the UNH Graduate School.

Required Courses, Competencies, and Electives

All students in the Integrative Biology Graduate Program are required to take:

1. Core Course: Introductory Graduate Seminar (BIOL 901). This first-semester course focuses on key information and skills for successful transition into the graduate program, familiarizing students with program requirements and faculty and providin an opportunity to meet others in their cohort.
2. Two courses in experimental design and analysis: This may be fulfilled by previous graduate coursework (as determined by the student's advisor and committee), or by taking two graduate-level courses.
3. One course in writing/communication: This may be fulfilled by previous graduate coursework (as determined by the student advisor and committee), or by taking one graduate-level course. Recommendations often include coursework in professiona writing and communication: Scientific Writing - Writing and Publishing Science (BIOL 902) is taught fall semester, and open t students at any stage of the program. Scientific Communication (BIOL 950) is usually taught in spring.
4. Ethics requirement: Students can fulfill this requirement by either taking the Responsible Conduct of Research training workshop or by taking a graduate level ethics course.
5. Electives: Students will work with their advisor and committee to identify additional courses appropriate for their area of specialization and their career objectives.

Additional Information/Requirements

All students in the Integrative Biology Program are expected to present their research in public seminars (including the UNH Graduate Research Conference), and acquire teaching and/or mentoring experience.

This graduate program is approved to be taken on an accelerated basis in articulation with certain undergraduate degree programs.

General Accelerated Master's policy, note that some programs have additional requirements (e.g. higher grade expectations) compared to the policy.

Please see the Graduate School website and contact the department directly for more information.

Students admitted via the Accelerated Master's (AM) process may apply up to 12 credits of prior upper-level UNH coursework in accordance with AM policies.

Program Learning Outcomes

Core Knowledge

- Demonstrate advanced knowledge of the subdiscipline relevant to their research project and general knowledge of the broad discipline of biology.

Critical Thinking

- Critique and evaluate qualitative and quantitative biological research and methods to develop novel hypotheses.

Research

- Apply knowledge of research methods and data analysis techniques to conduct a research project that addresses a gap in the field.

Communication

- Effectively communicate scientific information, concepts, theories, and methods to professional colleagues (specialists), invested parties, and the general public.

Professionalism

- Conduct research ethically and responsibly and intellectually engage with the broader scientific community.