

BIOLOGY (Div III)

Chair: Professor Lois Banta

- Lois M. Banta, Halvorsen Professor for Distinguished Teaching and Research of Biology; on leave Spring 2024
- Charlotte L. Barkan, Assistant Professor of Biology
- Caitlyn E. Bowman-Cornelius, Assistant Professor of Biology
- Janis E. Bravo, Lecturer in Biology
- Deborah L. Carlisle, Instructor in Biology
- Matt E. Carter, Associate Professor of Biology; Faculty Director, Rice Center for Teaching; affiliated with: Biology, Neuroscience
- Pei-Wen Chen, Associate Professor of Biology; on leave Fall 2023
- Derek Dean, Senior Lecturer in Biology; on leave Spring 2024
- Joan Edwards, Samuel Fessenden Clarke Professor of Biology
- Allison L. Gill, Assistant Professor of Biology; on leave 2023-2024
- Cynthia K. Holland, Assistant Professor of Biology; on leave 2023-2024
- Tim J. Lebestky, Associate Professor of Biology, Chair of Neuroscience Program; affiliated with: Biology, Neuroscience
- David W. Loehlin, Assistant Professor of Biology
- Luana S. Maroja, Professor of Biology, Chair of Biochemistry & Molecular Biology Program; affiliated with: Biology, BIMO (Biochemistry and Molecular Biology)
- Manuel A. Morales, Professor of Biology
- Robert M. Savage, Chair of Biology and Charles L. MacMillan Professor in Natural Sciences
- Gordon P. Smith, Visiting Assistant Professor of Biology
- Steven J. Swoap, Howard B. Schow '50 and Nan W. Schow Professor of Biology
- Claire S. Ting, Professor of Biology
- Damian Turner, Assistant Professor of Biology
- Heather Williams, William Dwight Whitney Professor of Biology; affiliated with: Biology, Neuroscience

The Biology curriculum has been designed to provide students with a broad base for understanding principles governing life processes at all levels, from biochemistry and cell biology to physiology to ecology and behavior. Courses emphasize fundamentals common to all sub-disciplines including the coupling of structure to function, the transfer of energy in living systems, communication, and the molding of diversity by the evolutionary process. In upper-level courses and in independent and honors research, students have the opportunity to investigate areas at the frontiers of modern biology.

Although the Biology major is specifically designed to provide a balanced curriculum in the broader context of the liberal arts, it is also excellent preparation for graduate studies in the life sciences and in the health professions.

MAJOR REQUIREMENTS

In order to make the major accessible to students with diverse interests, required courses are kept to a minimum. The Biology major is satisfied by nine courses, as follows:

BIOL 101 The Cell

BIOL 102 The Organism

Any two 200-level electives with labs in which at least one faculty member is a member of the Williams College Biology Department. (Tutorials may not be used to fulfill this requirement.)

Any two 300-level electives. (Both of these must have an associated lab component).

Any one 400-level seminar course. (Honors thesis BIOL 493-494 do not fulfill this requirement).

Any two more courses which can be at the 200-, 300- or 400-level, OR one such course plus two semesters of Organic Chemistry (CHEM 156 and 251) OR General Chemistry II and Organic Chemistry I (CHEM 200 and 201).

Students who are off-cycle members of the Class of 2024 who have already declared the Biology major may choose to fulfill either the major requirements above OR the previous major requirements:

- BIOL 101 The Cell
- BIOL 102 The Organism
- BIOL 202 Genetics
- Any two 300-level courses. Two 300-level electives (Both of these must have an associated lab component).
- One 400-level seminar course (Honors thesis BIOL 493-494 do not fulfill this requirement)
- Any three additional courses, which can be at the 200-, 300- or 400-level, OR any two such courses plus two semesters of Organic Chemistry (CHEM 156/251).

In order to ensure that majors in the Class of 2024 who choose to fulfill the previous major requirements broaden their knowledge of biology, one of their elective courses for the major must include an upper-level (200+) course covering biological processes at levels of organization above the cell. Courses that satisfy this distribution requirement are indicated in the individual course description.

Note: Independent study courses and AMS 311 (same as Biology 231) do not fulfill the 300-level or 400-level course requirements. WIOX 316 Biology: Evolution, in the Williams Oxford Program qualifies for major credit at the 200-level.

COURSE SELECTION AND PLACEMENT

It is preferable for students who plan to major in biology, or think they may be interested in doing so, to take Biology 101, 102 during their first year at Williams. It is also possible to begin the Biology major during the sophomore year, although students should understand that it may require taking two or more biology courses during several semesters.

Students interested in biology, whether or not they intend to major in it, are encouraged to take Biology 101, 102. It is also possible, with permission of the instructor, to take Biology 203 Ecology, Biology 204 Animal Behavior and Biology 220 Field Botany without prerequisite. Other 100-level biology courses are designed specifically for students who do not intend to take additional upper-level courses in biology. All of these courses satisfy the Division III distribution requirement.

Beginning students should normally enroll in Biology 101 and 102. With permission of the instructor, students may take Biology 102 prior to taking Biology 101. Students with unusually strong backgrounds in biology, such as those with outstanding performance on the College Board Biology Advanced Placement Test, may be permitted to elect a sophomore-level course in lieu of Biology 101 and/or Biology 102 upon successful completion of a departmental qualifying exam, administered during First Days.

The Biology Department encourages majors to have breadth in their course selections. Biology encompasses a wide spectrum of disciplines and uses different methodologies to approach research questions. Yet advances in each discipline of biology increasingly inform thinking throughout the field. We encourage biology majors to gain exposure to diverse conceptual frameworks and methodologies through their choice of courses.

COURSES RELATED TO THE BIOLOGY MAJOR

Students planning to pursue their interest in biology and related fields after completing their undergraduate degrees are strongly encouraged to take one year of chemistry, at least one semester of mathematics (a course in statistics is recommended), and one semester of physics. Students may wish to check the requirements for graduate admission at relevant universities, and are also encouraged to consult with the Biology Department's graduate school advisor about prerequisites for admission to graduate programs.

BIOCHEMISTRY AND MOLECULAR BIOLOGY

Students interested in Biochemistry and Molecular Biology (BIMO) should consult the general statement under Biochemistry and Molecular Biology.

BIOINFORMATICS, GENOMICS AND PROTEOMICS

Students interested in Bioinformatics, Genomics and Proteomics (BiGP) should consult the general statement under Bioinformatics, Genomics and Proteomics. Biology majors interested in this field are strongly encouraged to enroll in Integrative Bioinformatics, Genomics, and Proteomics (Biology 319).

NEUROSCIENCE

Students interested in Neuroscience (NSCI) should consult the general statement under Neuroscience.

PUBLIC HEALTH

Students interested in Public Health (PH) should consult the general statement under Public Health.

ENVIRONMENTAL STUDIES

Students interested in Environmental Studies (ENVI) should consult with Biology faculty members associated with the program and the general statement under Environmental Studies.

THE DEGREE WITH HONORS IN BIOLOGY

In order to be recommended for the degree with honors, a Biology major is normally expected to have completed the equivalent of two semesters and a winter study (031) of independent research culminating in a thesis which demonstrates outstanding achievement of an original and innovative nature. Although the presentation of a thesis and associated oral presentation in the fall and poster defense in the spring are required for consideration for a degree with honors, their completion should not be interpreted as a guarantee of a degree with honors. The principal considerations in admitting a student to the program of independent honors research will be mastery of fundamental material and skills, ability to pursue independent study successfully, and demonstrated interest and motivation. Students interested in participating in the honors program should consult with the department early in the winter study semester of the junior year; approval must be received before spring registration in the junior year. The number of Biology Department faculty available to mentor research students and the number of students each can accommodate in her/his lab vary from year to year. Although the department will make every effort to provide an opportunity for students to conduct Honors research, you should be aware that it may not be possible to assign all applicants to a laboratory.

The minimum course requirements for a degree with honors in Biology are Biology 101, Biology 102, two 200-level biology courses with labs, two 300-level biology courses (each of which must have a laboratory associated with it), one 400-level biology course, Biology 493, Biology 494, WSP 031, and any other two courses in biology (or any other one course and two semesters of Chemistry: Chemistry 200/201 or Chemistry 156/251). Note: A student who has a double major cannot count any course twice. For example, if a student is a Biology and Chemistry major, Organic Chemistry can only be counted in one of the two majors.

In addition to the normal honors route, which includes two semesters (Biology 493-494) and a winter study of research (WSP 031) during senior year, students have the option, subject to the approval of their thesis advisor, to begin the honors research during winter study junior year or during the second semester junior year. In general, thesis students who start during WSP or spring semester of their junior year are working on a project that requires winter or spring field work. Students beginning honors in winter study of junior year would take Biology 494 in the spring of their junior year followed by Biology 493 in the fall of their senior year; students beginning honors during the second semester of junior year would take Biology 494 that semester, followed by Biology 493 in the fall of senior year and winter study research in the winter of the senior year.

STUDY ABROAD

Students planning on majoring in Biology are strongly advised to take Biology 202 and/or Biology 203 and/or Biology 212 before going abroad, since these courses are prerequisites for many upper-level courses. Biology majors studying abroad may receive credit toward the major for at most two 200-level electives. Students should meet with the Department's study abroad advisor to discuss study abroad options.

FAQ

Students MUST contact departments/programs BEFORE assuming study away credit will be granted toward the major or concentration.

Can your department or program typically pre-approve courses for major/concentration credit?

Yes, in many cases, if appropriate course information is available in advance (e.g. syllabi and/or course descriptions), though students should be sure to contact the department. We usually want to see a syllabus.

What criteria will typically be used/required to determine whether a student may receive major/concentration credit for a course taken while on study away?

Course title and description, ideally complete syllabus including readings/assignments.

Does your department/program place restrictions on the number of major/concentration credits that a student might earn through study away?

Yes. Only two of the nine major course credits can be taken somewhere other than Williams.

Does your department/program place restrictions on the types of courses that can be awarded credit towards your major?

Yes. Courses taken for major credit anywhere other than Williams will only count as 200-level elective credit, regardless of the level or format of the course.

Are there specific major requirements that cannot be fulfilled while on study away?

Yes. Two 200-level lab courses, 300-level lab courses, and 400-level senior seminar.

Are there specific major requirements in your department/program that students should be particularly aware of when weighing study away options? (Some examples might include a required course that is always taught in one semester, laboratory requirements.)

Yes. Biology 202, Biology 203 and Biology 212 are only offered in the fall. Those late to the major need to be aware of this as these courses are prerequisites for most upper division courses.

Give examples in which students thought or assumed that courses taken away would count toward the major or concentration and then learned they wouldn't:

Courses that are focused on clinical areas of study, and courses in environmental studies that focus on policy or sociology rather than biology, would not be granted credit in biology.

CREDIT FOR COURSES AT OTHER INSTITUTIONS

Students who enroll in study away programs may receive credit for up to two 200-level electives towards the biology major. Courses must be pre-approved by the Biology Department Study Away Advisor.

Students wishing to satisfy prerequisites for courses offered by the Biology Department with courses taken at other institutions should consult, in person, with a member of the Biology Department, prior to registering for the course that requires a prerequisite. Such consultations will include a review of the course syllabi and the transcripts of the relevant previous college work, and students should bring these materials with them.

RESEARCH AND THESIS COURSES

Individual research projects must be approved by the department. Application should be made to the department prior to spring registration.

Note: Senior thesis and independent study courses do not count as 300-level or 400-level course requirements for the major. Only one research course (i.e., BIOL 297, BIOL 298, or the combination of BIOL 493 and BIOL 494) may be counted towards the major requirements.

BIOL 100 (W) Biology of Exercise and Nutrition

This class, intended for the non-scientist, focuses on the impact of exercise and nutrition on the human body. We will discuss topics such as how different types of training influence exercise performance; the changes that occur in the cardiovascular system during an exercise routine; an examination of the inherent limits of the body to perform aerobic and anaerobic tasks; and long-term health consequences of a lifetime of activity or inactivity. We will also examine how nutrition and metabolism affect body composition. For example, we will rigorously and scientifically scrutinize the use of "fad" diets as a means to lose weight.

Class Format: Daily 10:15am-noon and 1:30-3:30pm

Requirements/Evaluation: Two examinations will make up 1/2 of the grade, with the other 1/2 of the grade from laboratory assignments. Laboratory assignments include pre-lab questions and post-lab data analysis.

Prerequisites: Permission of a dean.

Enrollment Limit: 15

Enrollment Preferences: students who need to make up a deficiency

Expected Class Size: 15

Grading: no pass/fail option, no fifth course option

Unit Notes: This course is designed to count for both full semester and Winter Study credit. Once a dean approves enrollment, the Registrar's Office will register students in both BIOL 100 and BIOL 41.

Distributions: (D3)

Not offered current academic year

BIOL 101 (F) The Cell

This course investigates cell structure and function as a consequence of evolutionary processes, and it stresses the dynamic properties of living systems. Topics include an introduction to biological molecules and enzyme action, membrane structure and function, energy exchange and design of metabolic systems, expression of genetic information, protein trafficking, cell signaling, the cell cycle, and cancer. Student-designed laboratory experiments and discussions based on primary biology literature will highlight how biological knowledge is created and understood.

Class Format: 3 hours of lecture per week and one laboratory/discussion per week (3 hours).

Requirements/Evaluation: hour tests, a final exam, lab reports, discussion assignments, and discussion participation

Prerequisites: none

Enrollment Limit: 45/lecture

Enrollment Preferences: first-year students

Expected Class Size: 180

Grading: no pass/fail option, no fifth course option

Distributions: (D3)

Fall 2023

LEC Section: 01 TR 8:30 am - 9:45 am Tim J. Lebestky
LEC Section: 02 TR 9:55 am - 11:10 am Tim J. Lebestky
LEC Section: 03 MWF 9:00 am - 9:50 am Steven J. Swoap
LEC Section: 04 MWF 10:00 am - 10:50 am Steven J. Swoap
LAB Section: 05 M 1:10 pm - 3:50 pm Janis E. Bravo
LAB Section: 06 T 1:00 pm - 3:50 pm Janis E. Bravo
LAB Section: 07 W 1:00 pm - 3:50 pm Janis E. Bravo
LAB Section: 08 R 1:00 pm - 3:50 pm Caitlyn E. Bowman-Cornelius
LAB Section: 09 T 1:00 pm - 3:50 pm Deborah L. Carlisle
LAB Section: 10 W 1:00 pm - 3:50 pm Deborah L. Carlisle
LAB Section: 11 R 1:00 pm - 3:50 pm Deborah L. Carlisle

BIOL 102 (S) The Organism

This course focuses upon the developmental and evolutionary processes that have given rise to a wide diversity of multicellular organisms. We consider many levels of biological organization, from molecular and cellular to individuals and populations in our examination of evolutionary concepts. Topics include meiosis and sexual reproduction, developmental and evolutionary mechanisms, and speciation with representative examples from a diversity of plants and animals. Readings are drawn from a variety of sources, including the recent primary literature.

Requirements/Evaluation: hour tests, a final exam and laboratory reports

Prerequisites: BIOL 101 or permission of instructor

Enrollment Limit: 56/section

Enrollment Preferences: first year students

Expected Class Size: 152

Grading: no pass/fail option, yes fifth course option

Distributions: (D3)

Spring 2024

LEC Section: 01 TR 9:55 am - 11:10 am Robert M. Savage
LEC Section: 02 TR 11:20 am - 12:35 pm Robert M. Savage
LEC Section: 03 MWF 11:00 am - 11:50 am Luana S. Maroja
LAB Section: 04 T 1:00 pm - 3:50 pm Deborah L. Carlisle
LAB Section: 05 W 1:00 pm - 3:50 pm Janis E. Bravo
LAB Section: 06 R 1:00 pm - 3:50 pm Deborah L. Carlisle
LAB Section: 07 T 1:00 pm - 3:50 pm Gordon P. Smith
LAB Section: 08 W 1:00 pm - 3:50 pm Luana S. Maroja
LAB Section: 09 R 1:00 pm - 3:50 pm Gordon P. Smith

BIOL 120 (F) Biology Through The Media

This course explores the foundational concepts examined in Williams's Introduction to Biology series through their expression in mass media: news outlets, television and feature films. Each topic will be presented through the lens of a "media story," either based in fact or fictional. The first half of the

course investigates cell structure and function, paying special attention to how information is conveyed in a cell. The focus then shifts to the developmental and evolutionary processes that have given rise to the diversity of life. This is a qualitative-focused, non-majors course and, as such, the students are not expected to have much, if any, background in biology.

Requirements/Evaluation: midterm, two short papers, film screenings as a group outside of class and a final exam

Prerequisites: no prerequisites and may not be taken as credit towards the Biology major

Enrollment Limit: 80

Enrollment Preferences: Senior, juniors, sophomores and first-year students in that order

Expected Class Size: 40-60

Grading: yes pass/fail option, yes fifth course option

Distributions: (D3)

Not offered current academic year

BIOL 134 (F) The Tropics: Biology and Social Issues (DPE)

Cross-listings: ENVI 134

Primary Cross-listing

Biology and Social Issues of the Tropics explores the biological dimensions of social and environmental issues in tropical societies, focusing specifically on the tropics of Africa, Asia, Latin America, Oceania, and the Caribbean. Social issues are inextricably bound to human ecologies and their environmental settings. Each section of the course provides the science behind the issues and ends with options for possible solutions, which are debated by the class. The course highlights differences between the tropics and areas at higher latitudes while also emphasizing global interconnectedness. It begins with a survey of the tropical environment, including a global climate model, variation in tropical climates and the amazing biodiversity of tropical biomes. The next section focuses on human population biology, and emphasizes demography and the role of disease particularly malaria, AIDS and Covid-19 (SARS-CoV-2). The final part of the course covers the place of human societies in local and global ecosystems including the challenges of tropical food production, the interaction of humans with their supporting ecological environment, and global climate change. This course fulfills the DPE requirement. Through lectures, debates and readings, students confront social and environmental issues and policies from the perspective of biologists. This builds a framework for lifelong exploration of human diversity in terms of difference, power and equity.

Class Format: Debate

Requirements/Evaluation: two hour exams, a short paper, debate presentation, and a final exam

Prerequisites: none

Enrollment Limit: 62

Enrollment Preferences: Preference will be given to Environmental Studies majors/concentrators, students in need of a Division III or DPE requirement, and then Seniors, Juniors, Sophomores, and First Year students.

Expected Class Size: 62

Grading: no pass/fail option, no fifth course option

Unit Notes: Does not count for credit in the Biology major.

Distributions: (D3) (DPE)

This course is cross-listed and the prefixes carry the following divisional credit:

ENVI 134(D3) BIOL 134(D3)

Difference, Power, and Equity Notes: This course highlights differences between the tropics and higher latitudes. For each section we focus on difference--different natural habitats and biodiversity, different patterns of population growth, different human disease profiles, different types of agriculture and different contributions to and impacts of climate change. For each section we highlight differences in power and the inequities of resource distribution. We then debate potential solutions to ameliorate these inequities.

Fall 2023

LEC Section: 01 MWF 10:00 am - 10:50 am Joan Edwards

BIOL 135 (F) Evolution as Fact and Theory

This course examines evolution as a science and its current and historical importance. Lectures focus on the evidence for evolution, the main evolutionary forces (natural selection and others) and the diversification processes that generate biodiversity. We will also explore recent evolutionary trends and discussions such as human evolution, heritability, personalized genomics, antibiotic and pesticide resistance, climate change, and the conflict between creationists and evolutionists. The course has a required day trip to the American Museum of Natural History in NYC.

Requirements/Evaluation: exams, panel discussion, short papers and participation

Prerequisites: none

Enrollment Limit: 60

Enrollment Preferences: Non biology majors, 1st year students

Expected Class Size: 60

Grading: yes pass/fail option, yes fifth course option

Unit Notes: may not be taken as credit towards the Biology major; not open to students who took BIOL 305

Distributions: (D3)

Not offered current academic year

BIOL 165 (F) Coral Reefs: Ecology, Threats, & Conservation

Cross-listings: MAST 265 / ENVI 265

Secondary Cross-listing

Coral reefs are a fascinating ecosystem found throughout the world's tropical oceans. Corals can thrive in nutrient-poor oceans because of the mutualistic relationship with algal symbionts. And as a foundational species, corals provide a habitat for numerous species, possibly the highest diversity found on the planet. However, these complex and beautiful ecosystems are declining worldwide from a variety of local and global threats. In this course, we will explore coral reef ecology through an in-depth examination of the biotic and abiotic factors contributing to the ecosystem's functioning. We will also investigate the causes and consequences of threats to coral reefs, such as ocean warming, ocean acidification, and resource extraction. Finally, we will identify the many efforts worldwide to conserve coral reefs and promote their resilience. In this seminar course, you will demonstrate your proficiency through knowledge assessments, short writing reflections, a virtual coral fragmentation experiment, and a creative advocacy project. This course aims to deepen your awareness of the complex species interactions on coral reefs and the physical factors affecting coral survival while fostering hope through current conservation efforts.

Requirements/Evaluation: Four 1-paragraph discussion board post, One 20-question knowledge assessment (quiz), Three 2-page writing reflections, One lab results and discussion write-up 2-3 pages figures included, and a creative (medium is student choice) advocacy project.

Prerequisites: none, open to all students

Enrollment Limit: 20

Enrollment Preferences: 1. First-Year, 2. Sophomores

Expected Class Size: 16

Grading: yes pass/fail option, yes fifth course option

Unit Notes: Does not count for Biology major credit.

Distributions: (D3)

This course is cross-listed and the prefixes carry the following divisional credit:

MAST 265(D2) BIOL 165(D3) ENVI 265(D2)

Not offered current academic year

BIOL 202 (F) Genetics (QFR)

Genetics, classically defined as the study of heredity, is today a multidisciplinary field whose principles provide critical insight and tools to most areas of biology and medicine. This course covers the experimental basis for our current understanding of the inheritance, structures, and functions of genes. It introduces approaches used by contemporary geneticists and molecular biologists to explore questions in areas of biology ranging from evolution to medicine. A primary focus of the course is on students developing familiarity with problem solving, the logic and quantitative reasoning required to understand how genetic mechanisms lead to biological patterns. The laboratory part of the course provides an experimental introduction to modern genetic analysis as well as introductions to interpreting genetic reasoning in the primary research literature. Laboratory experiments include

investigating chromosome structure using microscopy, mapping a mutation to the genome by integrating multiple streams of evidence, and determining the structure of a DNA plasmid using molecular tools.

Class Format: Lecture: three hours per week, Lab: three hours per week.

Requirements/Evaluation: bi-weekly problem sets; weekly laboratory exercises and laboratory reports; three exams

Prerequisites: BIOL 101 and 102

Enrollment Limit: 120

Enrollment Preferences: students interested in the Biology major

Expected Class Size: 60

Grading: no pass/fail option, no fifth course option

Distributions: (D3) (QFR)

Quantitative/Formal Reasoning Notes: This course develops quantitative skills through solving problems. Students learn to apply basic calculations and logic to predict the outcomes of biological systems, for example, describing the likelihood that an individual will be affected by an inherited disease. Application of quantitative and logical analysis contributes to a large component of the in-class work and the graded material for the class, in the form of problem sets, exams, and data analysis for lab reports.

Fall 2023

LEC Section: 01 MWF 11:00 am - 11:50 am David W. Loehlin

LAB Section: 02 T 1:00 pm - 3:50 pm Derek Dean

LAB Section: 03 W 1:00 pm - 3:50 pm Derek Dean

LAB Section: 04 R 1:00 pm - 3:50 pm Derek Dean

LAB Section: 05 M 1:00 pm - 3:50 pm Derek Dean

BIOL 203 (F) Ecology (QFR)

Cross-listings: ENVI 203

Primary Cross-listing

This course combines lectures & discussion with field and indoor laboratory activities to explore factors that determine the distribution and abundance of plants and animals in natural systems. The course begins with an overview of global environmental patterns and then builds from the population to ecosystem level. Throughout the course, we will emphasize the connection between basic ecological principles and current environmental issues. Selected topics include population dynamics (competition, predation, mutualism); community interactions (succession, food chains and diversity) and ecosystem function (biogeochemical cycles, energy flow). Laboratory activities are designed to engage students in the natural history of the region and build skills in data analysis and scientific writing.

Requirements/Evaluation: pre-class quizzes, lab reports, two mid-term exams, and a final exam

Prerequisites: BIOL 102, or ENVI 102, or permission of instructor

Enrollment Limit: 30

Enrollment Preferences: students planning to pursue Biology and/or ENVI

Expected Class Size: 30

Grading: yes pass/fail option, yes fifth course option

Unit Notes: satisfies the distribution requirement for the Biology major

Distributions: (D3) (QFR)

This course is cross-listed and the prefixes carry the following divisional credit:

BIOL 203(D3) ENVI 203(D3)

Quantitative/Formal Reasoning Notes: Much of the material in this course centers on the interpretation and application of mathematical models used to describe ecological systems. The laboratory section of this course also contains a large data analysis component (based in R). Students are introduced to t-tests, chi-square analysis, and regression.

Fall 2023

LEC Section: 01 TR 8:30 am - 9:45 am Manuel A. Morales

LAB Section: 02 T 1:00 pm - 3:50 pm Manuel A. Morales

LAB Section: 03 W 1:00 pm - 3:50 pm Manuel A. Morales

BIOL 204 (S) Animal Behavior

Making sense of what we see while watching animals closely is both an enthralling pastime and a discipline that draws on many aspects of biology. Explanations can be found on many levels: evolutionary theory tells us why certain patterns have come to exist, molecular biology can help us understand how those patterns are implemented, neuroscience gives insights as to how the world appears to the behaving animal, endocrinology provides information on how suites of behaviors are regulated. The first part of the course focuses upon how descriptive studies provide the basis for formulating questions about behavior as well as the statistical methods used to evaluate the answers to these questions. We then consider the behavior of individuals, both as it is mediated by biological mechanisms and as it appears from an evolutionary perspective. The second half of the course is primarily concerned with the behaviors of groups of animals from a wide variety of vertebrate and invertebrate species, concentrating upon the stimuli, responses, and internal mechanisms that maintain social systems and on the selection pressures that drive animals toward a particular social system.

Class Format: six hours per week

Requirements/Evaluation: quizzes, exams, and lab reports

Prerequisites: BIOL 102, or PSYC 101, or permission of instructor

Enrollment Limit: 32

Enrollment Preferences: Biology majors and Neuroscience concentrators

Expected Class Size: 32

Grading: yes pass/fail option, no fifth course option

Unit Notes: satisfies the distribution requirement for the Biology major

Distributions: (D3)

Spring 2024

LEC Section: 01 TR 8:30 am - 9:45 am Manuel A. Morales

LAB Section: 02 W 1:00 pm - 3:50 pm Manuel A. Morales

LAB Section: 03 R 1:00 pm - 3:50 pm Manuel A. Morales

BIOL 205 (S) Physiology

This course explores animal physiology--the principles and mechanisms by which animals live and function. Across the semester we will survey a variety of physiological processes including intracellular communication, animal movement, circulation, gas exchange, ion/water balance, digestion and metabolism, and thermoregulation. We will explore these topics from the level of cells and tissues to the whole organism, surveying a wide variety of animals with a focus on vertebrates. Laboratories provide practical experience in the experimental measurement and analysis of physiological parameters in animal models and in human subjects.

Requirements/Evaluation: Daily practice problems, midterm exams, laboratory exercises, and a final exam

Prerequisites: BIOL 101; open to first-year students only with permission of instructor

Enrollment Limit: 72

Enrollment Preferences: Seniors, then juniors, then sophomores.

Expected Class Size: 72

Grading: no pass/fail option, no fifth course option

Unit Notes: Satisfies the distribution requirement for the Biology major

Distributions: (D3)

Spring 2024

LEC Section: 01 MWF 9:00 am - 9:50 am Matt E. Carter

LAB Section: 02 M 1:00 pm - 3:50 pm Deborah L. Carlisle

LAB Section: 03 T 1:00 pm - 3:50 pm Steven J. Swoap

LAB Section: 04 W 1:00 pm - 3:50 pm Deborah L. Carlisle

LAB Section: 05 R 1:00 pm - 3:50 pm Steven J. Swoap

BIOL 206 (S) Marine Biology

The oceans impact almost all life and processes on Earth. In this course we will explore the astounding diversity of life in the world's oceans, from the smallest photosynthetic microbes on the planet to the largest animals that weigh almost 200 tons. Using an integrative approach that spans from the molecular to the organismal to the ecological levels, we will focus on the biology of marine organisms, and their interactions and interrelationships. Topics including primary production, reproduction, acclimation to stresses, adaptation, and evolution will be discussed in the context of environments such as the open oceans, coastal waters, rocky intertidal zones, coral reefs, and the deep sea. We will emphasize how recent scientific advances have revolutionized our understanding of marine organisms and explore solutions to global challenges, including climate change and ocean acidification, pollution, sustainable fishing and aquaculture, and habitat conservation.

Requirements/Evaluation: two exams, one two-page research paper, one final project with a three-page written component and an oral presentation component, participation in discussions, laboratory assignments

Prerequisites: Biology 101 and Biology 102, or permission of instructor

Enrollment Limit: 20

Enrollment Preferences: Biology majors: seniors who need a second 200-level course for the major, and then juniors who need a second 200-level course for the major

Expected Class Size: 20

Grading: no pass/fail option, yes fifth course option

Distributions: (D3)

Spring 2024

LEC Section: 01 TR 9:55 am - 11:10 am Claire S. Ting

LAB Section: 02 T 1:00 pm - 3:50 pm Claire S. Ting

LAB Section: 03 W 1:00 pm - 3:50 pm Claire S. Ting

BIOL 209 (F) Animal Communication (WS)

Cross-listings: NSCI 209

Primary Cross-listing

Animal communication systems come in as many varieties as the species that use them. What they have in common are a sender that encodes information into a physical signal and a receiver that senses the signal, extracts the information, and adjusts its subsequent behavior accordingly. This tutorial will consider all aspects of communication, using different animal systems to explore different aspects of the biology of signaling. Topics will include the use of syntax to carry meaning in chickadee calls, the "piracy" of signaling system by fireflies, statements of identity and affiliation in the form of toothed whales' signature whistles, long-distance chemical attractants that allow male moths to find the object of their desire, and cultural evolution within learned signaling systems.

Requirements/Evaluation: evaluation will be based on five 5-page papers, five short response papers, & the student's effectiveness in tutorial presentations.

Prerequisites: BIOL 101 and 102; open to sophomores, juniors, and seniors

Enrollment Limit: 10

Enrollment Preferences: Biology majors and senior Neuroscience concentrators who need a Biology elective to complete the concentration

Expected Class Size: 10

Grading: no pass/fail option, no fifth course option

Distributions: (D3) (WS)

This course is cross-listed and the prefixes carry the following divisional credit:

BIOL 209(D3) NSCI 209(D3)

Writing Skills Notes: This course is a tutorial, and each student will write five position papers and five response papers, and may rewrite any of them.

Fall 2023

TUT Section: T1 TBA Heather Williams

BIOL 211 (S) Paleobiology

Cross-listings: GEOS 212

Secondary Cross-listing

The fossil record is a direct window into the history of life on Earth and contains a wealth of information on evolution, biodiversity, and climate change. This course investigates the record of ancient life forms, from single-celled algae to snails to dinosaurs. We will explore how, why, when, and where fossils form and learn about the major groups of fossilized organisms and how they have changed through time. In addition, we will cover a range of topics central to modern paleobiology. These include: how the fossil record informs our understanding of evolutionary processes including speciation; the causes and consequences of mass extinctions; how fossils help us tell time and reconstruct the Earth's climactic and tectonic history; statistical analysis of the fossil record to reconstruct biodiversity through time; analysis of fossil morphology to recreate the biomechanics of extinct organisms; and using fossil communities to reconstruct past ecosystems. Laboratory exercises will take advantage of Williams' fossil collections as well as published datasets to provide a broad understanding of fossils and the methods we use to study the history of life on Earth, including using the programming language R (no previous experience is required). We will also view a diversity of fossils in their geologic and paleo-environmental context on our field trip to Eastern New York. This course is in the Sediments and Life group for the Geosciences major.

Class Format: One day field trip to the the Paleozoic of New York State

Requirements/Evaluation: Weekly lab assignments, frequent short quizzes and writing assignments, and a final research project presented in poster form.

Prerequisites: any 100-level GEOS course or BIOL 102, 203 or 205

Enrollment Limit: 24

Enrollment Preferences: sophomores, and junior GEOS majors

Expected Class Size: 20

Grading: no pass/fail option, no fifth course option

Unit Notes: does not satisfy the distribution requirement for the Biology major

Distributions: (D3)

This course is cross-listed and the prefixes carry the following divisional credit:

BIOL 211(D3) GEOS 212(D3)

Spring 2024

LEC Section: 01 TR 9:55 am - 11:10 am Phoebe A. Cohen

LAB Section: 02 T 1:00 pm - 4:00 pm Phoebe A. Cohen

LAB Section: 03 R 1:00 pm - 4:00 pm Phoebe A. Cohen

BIOL 212 (F) Neuroscience

Cross-listings: PSYC 212 / NSCI 201

Secondary Cross-listing

This course is designed to give an overview of the field of neuroscience progressing from a molecular level onwards to individual neurons, neural circuits, and ultimately regulated output behaviors of the nervous system. Topics include a survey of the structure and function of the nervous system, basic neurophysiology and neurochemistry, development, learning and memory, sensory and motor systems, and clinical disorders. Throughout the course, many examples from current research in neuroscience are used to illustrate the concepts being considered. The lab portion of the course will emphasize a) practical hands-on exercises that amplify the material presented in class; b) interpreting and analyzing data; c) presenting the results in written form and placing them in the context of published work; and d) reading and critiquing scientific papers.

Requirements/Evaluation: Evaluation will be based on participation in discussion groups, exercises, problem sets and quizzes performed in small

groups, lab reports, midterm exams, and a final exam.

Prerequisites: PSYC 101 or BIOL 101; open to first-year students only with permission of instructor

Enrollment Limit: 72

Enrollment Preferences: Sophomores and Biology and Psychology majors

Expected Class Size: 72

Grading: yes pass/fail option, no fifth course option

Distributions: (D3)

This course is cross-listed and the prefixes carry the following divisional credit:

PSYC 212(D3) NSCI 201(D3) BIOL 212(D3)

Fall 2023

LEC Section: 01 TR 9:55 am - 11:10 am Matt E. Carter, Shivon A. Robinson

LAB Section: 02 M 1:00 pm - 4:00 pm Martha J. Marvin

LAB Section: 03 T 1:00 pm - 4:00 pm Martha J. Marvin

LAB Section: 04 W 1:00 pm - 4:00 pm Martha J. Marvin

BIOL 219 (F) Dangerous Exposures: Environment, Immunity, and Infectious Disease (WS)

Global reports of emerging infectious diseases and old diseases with new pathogenic properties incite fears for personal safety as well as national security. The specter of a contagious pandemic has captured the public imagination through the mass news media, movies, and even popular online and board games. In this tutorial course, we will explore the ecology and evolution of several recently emergent diseases such as Ebola hemorrhagic fever, dengue, and AIDS. Topics to be considered include transmission dynamics, epidemiological modeling of vaccination strategies, and wildlife reservoirs that contribute to human virus exposure. We will examine progress in preventing the parasitic disease malaria and why such diseases have proven so refractory. We will also discuss the science behind the recent development of the vaccine against the human papillomavirus, which causes cervical cancer, and the intriguing and highly unusual transmissible cancers in dogs and Tasmanian devils. Finally, we will think about the contributions of inadequate diagnostic capacities world-wide and broader issues of resource shortages in driving the global emergence of drug resistance in tuberculosis and other diseases. One common theme in each of these case studies will be the interplay between the host immune response and the evolution of the pathogen. Although the primary focus of the course is on biology rather than policy, each week's readings will have implications for public health and/or conservation biology.

Requirements/Evaluation: six 4- to 5-page papers; tutorial presentations, and the student's progress towards intellectual independence and creativity as a presenter and a respondent

Prerequisites: BIOL 101 and 102

Enrollment Limit: 10

Enrollment Preferences: sophomores who have taken BIOL 202, students interested in public health

Expected Class Size: 10

Grading: no pass/fail option, no fifth course option

Unit Notes: does not satisfy the distribution requirement for the Biology major

Distributions: (D3) (WS)

Writing Skills Notes: We work deliberately throughout the semester on writing skills including construction of a written argument and logical flow as well as mechanics. Students write six 4-5-page papers, alternating weekly between papers and written critiques of their partner's writing. Based on substantive feedback from the instructor as well as their partner, students revise and resubmit two of their six papers.

Not offered current academic year

BIOL 220 (S) Field Botany and Plant Natural History

Cross-listings: ENVI 220

Primary Cross-listing

This field-lecture course covers the evolutionary and ecological relationships among plant groups represented in our local and regional flora. Lectures

focus on the evolution of the land plants, the most recent and revolutionary developments in plant systematics and phylogeny, the cultural and economic uses of plants and how plants shape our world. The course covers the role of plants in ameliorating global climate change, their importance in contributing to sustainable food production and providing solutions to pressing environmental problems. Throughout we emphasize the critical role of biodiversity and its conservation. The labs cover field identification, natural history and the ecology of local species.

Class Format: both field and indoor laboratories

Requirements/Evaluation: Based on two hour exams, field quizzes, a final project, and a final exam

Prerequisites: none

Enrollment Limit: 30

Enrollment Preferences: Biology majors, and Environmental Studies majors & concentrators

Expected Class Size: 24

Grading: no pass/fail option, yes fifth course option

Unit Notes: satisfies the distribution requirement for the Biology major

Materials/Lab Fee: There is a charge for the lab manual (\$25); the sketchbook (\$7) and hand lens (\$23) can be self-provided or purchased from the department.

Distributions: (D3)

This course is cross-listed and the prefixes carry the following divisional credit:

BIOL 220(D3) ENVI 220(D3)

Spring 2024

LEC Section: 01 MWF 10:00 am - 10:50 am Joan Edwards

LAB Section: 02 T 1:00 pm - 3:50 pm Joan Edwards

LAB Section: 03 W 1:00 pm - 3:50 pm Joan Edwards

BIOL 222 (S) Essentials of Biochemistry (QFR)

This course will explore the biochemistry of cellular processes and contextualize these processes in healthy and diseased states. Lecture topics in this one semester course will include the structure and function of proteins (enzymes and non-enzymatic proteins), lipids, and carbohydrates. Lectures will also survey the major metabolic pathways (carbohydrates, lipids, and amino acids) with particular attention to enzyme regulation and the integration of metabolism in different tissues and under different metabolic conditions. In the discussion/laboratory component of the course a combination of primary literature, hypothesis-driven exercises, problem solving, and bench work will be used to illustrate how particular techniques and experimental approaches are used in biochemical fields.

Class Format: in-person lecture and lab

Requirements/Evaluation: Four exams, in-class discussion of papers, short writing assignments and lab reports.

Prerequisites: BIOL 101 and CHEM 156; not open to students who have taken BIOL 321 or BIOL 322

Enrollment Limit: 18

Enrollment Preferences: seniors who need to fulfill the biochemistry requirement for premedical school

Expected Class Size: 18

Grading: no pass/fail option, no fifth course option

Unit Notes: does not satisfy the distribution requirement for the Biology major; cannot be counted towards the biology major in addition to either BIOL 321 or BIOL 322; cannot be counted towards the BIMO concentration

Distributions: (D3) (QFR)

Quantitative/Formal Reasoning Notes: The laboratory program is quantitative covering data analyses, numerical transformations, graphical displays.

Not offered current academic year

BIOL 231 (F)(S) Marine Ecology

Cross-listings: MAST 311

Secondary Cross-listing

We have explored only a fraction of the ocean, with about 10% of marine species classified and 20% of the ocean mapped. Many discoveries remain to be made, and marine ecology is one technique to uncover new insights. The field of marine ecology, rooted in the theory of evolution, describes the mechanisms and processes that drive the diversity, abundance, and distribution of marine organisms. The goal is to document natural patterns and make predictions about how species will respond to environmental changes by investigating the relationship between the abiotic environment and biotic interactions. This course will take a deep dive into the unique challenges to life in the ocean. You will compare and contrast different marine ecosystems, such as coral reefs, kelp forests, and the deep sea. You will also practice a marine ecologist's skillset as you design, carry out, and analyze your own research project, which will improve your scientific writing, data analysis, and communication skills. Importantly, you will connect your research and course topics to larger marine conservation issues and broader societal impacts.

Class Format: including coastal and near-shore field trips, 10 days offshore, and a laboratory or field research project

Requirements/Evaluation: two tests, a research project, and a presentation

Prerequisites: BIOL 101 or GEOS/MAST 104, or permission of instructor

Enrollment Limit: 16

Enrollment Preferences: none

Expected Class Size: 12

Grading: yes pass/fail option, yes fifth course option

Unit Notes: This course is only offered through the Williams-Mystic Maritime Studies Program located in Mystic, CT. satisfies the distribution requirement for the Biology major.

Distributions: (D3)

This course is cross-listed and the prefixes carry the following divisional credit:

MAST 311(D3) BIOL 231(D3)

Fall 2023

LEC Section: 01 TR 10:30 am - 11:45 am Tim J. Pusack

LAB Section: 02 R 1:00 pm - 4:30 pm Tim J. Pusack

Spring 2024

LEC Section: 01 TR 10:30 am - 11:45 am Tim J. Pusack

LAB Section: 02 R 1:00 pm - 4:30 pm Tim J. Pusack

BIOL 297 (F) Independent Study: Biology

Biology 200-level independent study. Each student carries out independent field or laboratory research under the supervision of a member of the department.

Requirements/Evaluation: 10-page paper

Prerequisites: Students must have found a faculty member who is willing to mentor them in the lab before enrolling in this course.

Enrollment Limit: 5

Enrollment Preferences: None.

Expected Class Size: 3

Grading: no pass/fail option, yes fifth course option

Distributions: (D3)

Fall 2023

IND Section: 01 TBA Robert M. Savage

BIOL 298 (S) Independent Study: Biology

Biology 200-level independent study. Each student carries out independent field or laboratory research under the supervision of a member of the department.

Requirements/Evaluation: 10 page paper

Prerequisites: Students must have found a faculty member who is willing to mentor them in the lab before enrolling in this course.

Enrollment Limit: N/A

Enrollment Preferences: None

Expected Class Size: N/A

Grading: no pass/fail option, yes fifth course option

Distributions: (D3)

Spring 2024

IND Section: 01 TBA Robert M. Savage

BIOL 305 (F) Evolution (QFR)

This course offers a critical analysis of contemporary concepts in biological evolution. We focus on the relation of evolutionary mechanisms (e.g., selection, drift, and migration) to long term evolutionary patterns (e.g., evolutionary innovations, origin of major groups, and adaptation). Topics include micro-evolutionary models, natural and sexual selection, speciation, the inference of evolutionary history, evolutionary medicine among others.

Requirements/Evaluation: independent research project, problem sets, participation in discussions and exams

Prerequisites: BIOL 102 and one 200 level BIOL course

Enrollment Limit: 24

Enrollment Preferences: Seniors and biology majors

Expected Class Size: 24

Grading: yes pass/fail option, yes fifth course option

Unit Notes: satisfies the distribution requirement for the Biology major

Distributions: (D3) (QFR)

Quantitative/Formal Reasoning Notes: We will use mathematical models to study population genetics.

Fall 2023

LEC Section: 01 MWF 11:00 am - 11:50 am Luana S. Maroja

LAB Section: 02 T 1:00 pm - 3:50 pm Luana S. Maroja

LAB Section: 03 W 1:00 pm - 3:50 pm Luana S. Maroja

BIOL 308 (S) Integrative Plant Biology: Fundamentals and New Frontiers

Plants are one of the most successful groups of organisms on Earth and have a profound impact on all life. Successful use of plants in addressing global problems and understanding their role in natural ecosystems depends on fundamental knowledge of the molecular mechanisms by which they grow, develop, and respond to their environment. This course will examine the molecular physiology of plants using an integrative approach that considers plants as dynamic, functional units in their environment. Major emphasis will be on understanding fundamental plant processes, such as photosynthesis, growth and development, water transport, hormone physiology, and flowering, from the molecular to the organismal level. Environmental effects on these processes will be addressed in topics including photomorphogenesis, stress physiology, mineral nutrition, and plant-microbe interactions. Discussions of original research papers will examine the mechanisms plants use to perform these processes and explore advances in the genetic engineering of plants for agricultural, environmental, and medical purposes. Laboratory activities stress modern approaches and techniques used in investigating plant physiological processes.

Class Format: six hours per week

Requirements/Evaluation: short papers, lab reports and exams

Prerequisites: BIOL 101 and BIOL 102, or permission of instructor

Enrollment Limit: 24

Enrollment Preferences: Biology majors

Expected Class Size: 24

Grading: no pass/fail option, yes fifth course option

Distributions: (D3)

Not offered current academic year

BIOL 311 (F) Neural Systems and Circuits

Cross-listings: NSCI 311

Primary Cross-listing

This course will examine the functional organization of the mammalian brain, emphasizing both neuroanatomy and neurophysiology. How do specific populations of neurons and their connections encode sensory information, form perceptions of the external and internal environment, make cognitive decisions, and execute movements? How does the brain produce feelings of reward/motivation and aversion/pain? How does the nervous system regulate homeostatic functions such as sleep, food intake, and thirst? We will explore these questions using a holistic, integrative approach, considering molecular/cellular mechanisms, physiological characterizations of neurons, and connectivity among brain systems. Journal article discussions will complement course topics, providing experience in reading, understanding, and critiquing primary research papers. Writing an original literature review article will provide experience in expository writing and anonymous peer review. Laboratory sessions will provide experience in examining macroscopic and microscopic neural structures, as well as performing experiments to elucidate the structure and function of neural systems using classical and cutting-edge techniques.

Requirements/Evaluation: Class participation, completion of labs, literature review assignment, hour exams, a final exam

Prerequisites: BIOL 212 (same as PSYC 212 or NSCI 201) or BIOL 205

Enrollment Limit: 24

Enrollment Preferences: Biology majors and Neuroscience concentrators

Expected Class Size: 24

Grading: no pass/fail option, no fifth course option

Unit Notes: does not satisfy the distribution requirement for the Biology major

Distributions: (D3)

This course is cross-listed and the prefixes carry the following divisional credit:

NSCI 311(D3) BIOL 311(D3)

Not offered current academic year

BIOL 312 (F) Sensory Biology

Cross-listings: NSCI 312

Primary Cross-listing

How do animals sense properties of the physical world? How do they convert physical or chemical energy to a signal within a cell that carries information? How is that information represented? What are the limits on what can be sensed? We will look for answers to these questions by investigating the molecular and cellular mechanisms of sensory transduction and how these mechanisms constrain the types of information that the nervous system encodes and processes. We will also ask how natural selection shapes the type of sensory information that animals extract from the world, and what adaptations allow some species to have "special" senses. Some of the examples we will consider are: bat echolocation (hair cells in the ear), detecting visual motion (amacrine cells in the mammalian retina), the constant reshaping of the olfactory system (chemical mapping of odors), what makes a touch stimulus noxious, and enhanced color vision (in birds, bees, and shrimp). Laboratory exercises will focus on the nematode *C. elegans*, an important model system, to explore and extend how we understand touch, temperature sensation, chemosensation, and light sensation.

Requirements/Evaluation: Four take-home exams, an independent group research project (proposal, followed by results/discussion), presentation about a non-standard sensory system, many short online quizzes, and lab + class participation.

Prerequisites: BIOL 101 and either BIOL 212/NSCI 201 or BIOL 205

Enrollment Limit: 24

Enrollment Preferences: Preference to senior Biology majors who need a 300-level course; then to senior Neuroscience concentrators who need a Group A elective; then to Biology majors. Not open to students who have taken Biology 213.

Expected Class Size: 20

Grading: no pass/fail option, no fifth course option

Distributions: (D3)

This course is cross-listed and the prefixes carry the following divisional credit:

BIOL 312(D3) NSCI 312(D3)

Not offered current academic year

BIOL 313 (F) Immunology

The rapidly evolving field of immunology examines the complex network of interacting molecules and cells that function to recognize and respond to agents foreign to the individual. In this course, we will focus on the biochemical mechanisms that act to regulate the development and function of the immune system and how alterations in different system components can cause disease. Textbook readings will be supplemented with current literature.

Class Format: Video lectures with in class discussions. Three hour laboratory each week

Requirements/Evaluation: exams, laboratory reports, and a research paper

Prerequisites: BIOL 102

Enrollment Limit: 24

Enrollment Preferences: Senior and then junior Biology majors

Expected Class Size: 24

Grading: no pass/fail option, no fifth course option

Distributions: (D3)

Fall 2023

LEC Section: 01 MWF 10:00 am - 10:50 am Damian Turner

LAB Section: 02 M 1:00 pm - 3:50 pm Damian Turner

LAB Section: 03 T 1:00 pm - 3:50 pm Damian Turner

BIOL 314 (S) Neuroethology

Cross-listings: NSCI 324

Primary Cross-listing

How does an animal experience its environment? What mechanisms allow an animal to select and generate behaviors? In this course we will use a comparative approach to examine how nervous systems have evolved to solve problems inherent to an animal's natural environment. We will discuss how animals sense physical and chemical properties of their surroundings and convert this information to a signal encoded in their brain. We will explore how nervous systems of diverse species are adapted to extract sensory information that is relevant to their survival--such as sound, light, and smell. We will also examine how neural circuits control muscles to generate motor behaviors such as locomotion and vocalization and how sensory information is integrated to influence behavior. To highlight the discovery process, we will read and discuss primary research articles that complement course content. During labs we will use a variety of approaches such as electrophysiology, optogenetics, behavior, and data analysis to understand sensory and motor systems in several different organisms.

Requirements/Evaluation: Participation in class and lab, several take-home exams, independent group research project and presentation, and short written class and lab assignments.

Prerequisites: BIOL 212 or BIOL 205

Enrollment Limit: 24

Enrollment Preferences: Senior, then junior, Biology majors and NSCI concentrators who need a 300-level course or a NSCI elective

Expected Class Size: 24

Grading: no pass/fail option, yes fifth course option

Distributions: (D3)

This course is cross-listed and the prefixes carry the following divisional credit:

NSCI 324(D3) BIOL 314(D3)

Spring 2024

LEC Section: 01 MW 11:00 am - 12:15 pm Charlotte L. Barkan

LAB Section: 02 T 1:00 pm - 3:50 pm Charlotte L. Barkan

LAB Section: 03 W 1:00 pm - 3:50 pm Charlotte L. Barkan

BIOL 315 (S) Microbiology: Diversity, Cellular Physiology, and Interactions

The Covid pandemic and the alarming spread of antibiotic resistant bacteria are but two of the reasons for the resurgence of interest in the biology of viruses and microorganisms. This course will examine microbes from the perspectives of cell structure and function, genomics, and evolution. A central theme will be the adaptation of bacteria as they evolve to fill specific ecological niches, with an emphasis on microbe: host interactions that lead to pathogenesis. We will consider communication among bacteria as well as between bacteria and their environment. Topics include: microbial development, population dynamics, metagenomics, bioremediation, plant and animal defenses against infection, and bacterial strategies to subvert the immune system. We will also discuss a few viral examples, including SARS-CoV2, in the context of pathogen-host co-evolution and the immune system. In the lab, major projects will focus on the mammalian gut microbiome and the isolation and characterization of bacteria from natural environments. The lab experience will culminate in multi-week independent investigations. Readings will be comprised primarily of articles from the primary literature.

Class Format: lectures three hours a week and laboratory three hours a week

Requirements/Evaluation: three exams/writing assignments, responses to thought questions on readings, a lab report/notebook, and an oral presentation

Prerequisites: BIOL 202 or 203

Enrollment Limit: 24

Enrollment Preferences: senior and then junior Biology majors

Expected Class Size: 24

Grading: no pass/fail option, no fifth course option

Unit Notes: does not satisfy the distribution requirement for the Biology major

Distributions: (D3)

Not offered current academic year

BIOL 319 (S) Integrative Bioinformatics, Genomics, and Proteomics Lab (QFR)

Cross-listings: PHYS 319 / MATH 319 / CHEM 319 / CSCI 319

Primary Cross-listing

What can computational biology teach us about cancer? In this lab-intensive experience for the Genomics, Proteomics, and Bioinformatics program, computational analysis and wet-lab investigations will inform each other, as students majoring in biology, chemistry, computer science, mathematics/statistics, and physics contribute their own expertise to explore how ever-growing gene and protein data-sets can provide key insights into human disease. In this course, we will take advantage of one well-studied system, the highly conserved Ras-related family of proteins, which play a central role in numerous fundamental processes within the cell. The course will integrate bioinformatics and molecular biology, using database searching, alignments and pattern matching, and phylogenetics to reconstruct the evolution of gene families by focusing on the gene duplication events and gene rearrangements that have occurred over the course of eukaryotic speciation. By utilizing high through-put approaches to investigate genes involved in the inflammatory and MAPK signal transduction pathways in human colon cancer cell lines, students will uncover regulatory mechanisms that are aberrantly altered by siRNA knockdown of putative regulatory components. This functional genomic strategy will be coupled with independent projects using phosphorylation-state specific antisera to test our hypotheses. Proteomic analysis will introduce the students to de novo structural prediction and threading algorithms, as well as data-mining approaches and Bayesian modeling of protein network dynamics in single cells. Flow cytometry and mass spectrometry may also be used to study networks of interacting proteins in colon tumor cells.

Class Format: The lab for this course will meet for two afternoons per week. Some lab sessions will be shorter than 3 hours.

Requirements/Evaluation: lab participation, several short homework assignments, one lab report, a programming project, and a grant proposal

Prerequisites: BIOL 202; students who have not taken BIOL 202 but have taken BIOL 101 and a CSCI course, or CSCI/PHYS 315, may enroll with permission of instructor. No prior computer programming experience is required.

Enrollment Limit: 12

Enrollment Preferences: seniors, then juniors, then sophomores

Expected Class Size: 12

Grading: yes pass/fail option, no fifth course option

Distributions: (D3) (QFR)

This course is cross-listed and the prefixes carry the following divisional credit:

PHYS 319(D3) MATH 319(D3) BIOL 319(D3) CHEM 319(D3) CSCI 319(D3)

Quantitative/Formal Reasoning Notes: Through lab work, homework sets and a major project, students will learn or further develop their skills in programming in Python, and about the basis of Bayesian approaches to phylogenetic tree estimation.

Not offered current academic year

BIOL 321 (F) Biochemistry I: Structure and Function of Biological Molecules (QFR)

Cross-listings: CHEM 321 / BIMO 321

Secondary Cross-listing

This course introduces the foundational concepts of biochemistry with an emphasis on the structure and function of biological macromolecules. Specifically, the structure of proteins and nucleic acids are examined in detail in order to determine how their chemical properties and their biological behavior result from those structures. Other topics covered include catalysis, enzyme kinetics, mechanism and regulation; the molecular organization of biomembranes; and the flow of information from nucleic acids to proteins. In addition, the principles and applications of the methods used to characterize macromolecules in solution and the interactions between macromolecules are discussed. The laboratory provides a hands-on opportunity to study macromolecules and to learn the fundamental experimental techniques of biochemistry including electrophoresis, chromatography, and principles of enzymatic assays.

Class Format: lecture, three times per week and laboratory, four hours per week

Requirements/Evaluation: quizzes, a midterm exam, a final exam, problem sets and performance in the laboratories including lab reports

Prerequisites: BIOL 101, CHEM 200 and CHEM 201; or either CHEM 155 or 256 and CHEM 251

Enrollment Limit: 16/lab

Enrollment Preferences: junior and senior Biology and Chemistry majors and BIMO concentrators

Expected Class Size: 48

Grading: no pass/fail option, no fifth course option

Unit Notes: Cannot be counted towards the Biology major in addition to BIOL 222

Distributions: (D3) (QFR)

This course is cross-listed and the prefixes carry the following divisional credit:

CHEM 321(D3) BIOL 321(D3) BIMO 321(D3)

Quantitative/Formal Reasoning Notes: This course fulfills the QFR requirement with regular problem sets in which quantitative/formal reasoning skills are practiced.

Fall 2023

LEC Section: 01 MWF 10:00 am - 10:50 am B Thuronyi

LAB Section: 02 T 1:00 pm - 5:00 pm B Thuronyi

LAB Section: 03 W 1:00 pm - 5:00 pm Jenna L. MacIntire

LAB Section: 04 R 1:00 pm - 5:00 pm Jenna L. MacIntire

BIOL 322 (S) Biochemistry II: Metabolism (QFR)

Cross-listings: CHEM 322 / BIMO 322

Secondary Cross-listing

This lecture course provides an in-depth presentation of the complex metabolic reactions that are central to life. Emphasis is placed on the biological flow of energy including alternative modes of energy generation (aerobic, anaerobic, photosynthetic); the regulation and integration of the metabolic pathways including compartmentalization and the transport of metabolites; and biochemical reaction mechanisms including the structures and mechanisms of coenzymes. This comprehensive study also includes the biosynthesis and catabolism of small molecules (carbohydrates, lipids, amino

acids, and nucleotides). Laboratory experiments introduce the principles and procedures used to study enzymatic reactions, bioenergetics, and metabolic pathways.

Class Format: Lecture three hours per week and laboratory three hours per week.

Requirements/Evaluation: several exams and performance in the laboratories including lab reports that emphasize conceptual and quantitative and/or graphic analysis of data

Prerequisites: BIOL 101, plus either: CHEM 156 and CHEM 256, or CHEM 155 and CHEM 156, or CHEM 200 and CHEM 201, or permission of instructor

Enrollment Limit: 48

Enrollment Preferences: junior and senior Biology and Chemistry majors and BIMO concentrators

Expected Class Size: 48

Grading: no pass/fail option, no fifth course option

Unit Notes: cannot be counted towards the Biology major in addition to BIOL 222

Distributions: (D3) (QFR)

This course is cross-listed and the prefixes carry the following divisional credit:

CHEM 322(D3) BIOL 322(D3) BIMO 322(D3)

Quantitative/Formal Reasoning Notes: The laboratory program is quantitative covering data analyses, numerical transformations, graphical displays.

Spring 2024

LEC Section: 01 TR 11:20 am - 12:35 pm Caitlyn E. Bowman-Cornelius

LAB Section: 02 T 1:00 pm - 3:50 pm Janis E. Bravo

LAB Section: 03 W 1:00 pm - 3:50 pm Caitlyn E. Bowman-Cornelius

LAB Section: 04 R 1:00 pm - 3:50 pm Janis E. Bravo

BIOL 326 (S) Cellular Assembly and Movement

This course will focus on how multi-protein complexes are assembled to control key cellular processes in eukaryotic systems: 1) protein sorting and trafficking, 2) establishment and maintenance of cell architecture, and 3) mitosis, cell migration and tissue morphogenesis that require coordination of the membrane transport and cytoskeleton. The course will highlight involvement of these processes in pathological conditions. Laboratories will use mammalian tissue culture as a model system to study cellular functions. Important techniques in cell biology will be introduced in the first half of the semester; in the second half of the term, students will conduct a multi-week independent project. Textbook readings will be supplemented with primary literature.

Class Format: lectures, three hours a week; laboratory, three hours a week. The laboratory projects will require additional time outside of class hours.

Requirements/Evaluation: three exams, in-class discussion of papers, lab reports, an oral presentation and research paper based on an independent lab research project

Prerequisites: BIOL 202 or BIOL 212 or BIOL 222

Enrollment Limit: 24

Enrollment Preferences: senior and junior Biology majors

Expected Class Size: 24

Grading: no pass/fail option, yes fifth course option

Distributions: (D3)

Spring 2024

LEC Section: 01 MWF 9:00 am - 9:50 am Pei-Wen Chen

LAB Section: 02 T 1:00 pm - 3:50 pm Pei-Wen Chen

LAB Section: 03 W 1:00 pm - 3:50 pm Pei-Wen Chen

BIOL 329 (F) Conservation Biology

Cross-listings: ENVI 339

Primary Cross-listing

Conservation Biology focuses on protection of the Earth's biodiversity. This course starts with an overview of biodiversity including patterns of species richness, causes of species loss (extinction), and the critical contributions of biodiversity to ecosystem function and human welfare. Then we analyze ways to conserve biodiversity at the genetic, population, species and community/ecosystem levels. Labs are field oriented, and focus on local New England communities and ecosystems. Labs emphasize knowing the dominant species in each system; they also stress how to collect and analyze the field data on ecological community structure and function that are critical to test hypotheses that relate to different conservation goals.

Class Format: lectures, discussions, and a weekly lab.

Requirements/Evaluation: Evaluation will be based on lab assignments and reports, discussion participation, two exams and an independent project.

Prerequisites: BIOL 203/ENVI 203 or BIOL 220 or BIOL 305 or permission of instructor.

Enrollment Limit: 24

Enrollment Preferences: Biology majors, Environmental Studies majors, seniors, and juniors

Expected Class Size: 15

Grading: no pass/fail option, no fifth course option

Distributions: (D3)

This course is cross-listed and the prefixes carry the following divisional credit:

ENVI 339(D3) BIOL 329(D3)

Fall 2023

LEC Section: 01 MWF 9:00 am - 9:50 am Gordon P. Smith

LAB Section: 02 W 1:00 pm - 3:50 pm Gordon P. Smith

LAB Section: 03 R 1:00 pm - 3:50 pm Gordon P. Smith

BIOL 330 (S) Genomes: Structure, Function, Evolution

Genome sequencing technologies have opened the "book of life" to biologists. But making sense of genomes is still a work in progress. This course will examine central features of genomes, their evolution, and their contribution to human diseases such as cancer. Genome biology is a new field, and this presents the opportunity to learn science as it is being done. Biologists working today started out knowing nothing about core features of genomes, such as why most of the DNA is repetitive, or why segments of genes get removed in the RNA, or why silenced genes wake up in cancer cells. They began to find meaning by adopting dual perspectives of function and neutral evolution. Students will learn to walk these same paths and learn to evaluate for themselves what genome complexity means. In lab, students will develop hands-on and computational skills for investigating genome structural variation, then apply them in the second half of the semester in independent lab investigations.

Class Format: lectures, three hours a week; laboratory, three hours a week.

Requirements/Evaluation: Written responses to readings in primary literature; three take-home written exams; two laboratory reports; oral presentation of an independent laboratory project.

Prerequisites: BIOL 202

Enrollment Limit: 24

Enrollment Preferences: Biology majors

Expected Class Size: 24

Grading: no pass/fail option, no fifth course option

Unit Notes: does not satisfy the distribution requirement for the biology major.

Distributions: (D3)

Not offered current academic year

BIOL 337 (F) Evolutionary Ecology (QFR)

Evolutionary ecology is an interdisciplinary field that integrates concepts in genetics, adaptation, and ecology to understand how evolution operates in the context of ecological communities. This course provides an overview of the discipline including foundational concepts in evolutionary demography, phenotypic plasticity, and population genetics. It also explores how breakthroughs in these topics provide a framework for advances in our understanding of the evolution of reproductive timing and ageing, interspecific interactions (e.g. competition, predation), cooperation, and altruism. The course combines lectures, readings, in-class discussion, and a lab section that includes a mixture of field, computer, and lab projects. Laboratories will give students practical, hands-on experience in how to develop, plan, and carry out evolutionary ecology research from start to finish.

Class Format: lecture, 3 hours per week; laboratory and discussion, 3 hours per week

Requirements/Evaluation: Evaluation will be based on lab assignments, two exams, discussion participation, and a written paper.

Prerequisites: BIOL 102, plus either BIOL 202 or BIOL 203 or equivalent

Enrollment Limit: 24

Enrollment Preferences: preference given to biology majors, seniors, and juniors

Expected Class Size: 24

Grading: no pass/fail option, no fifth course option

Unit Notes: Satisfies the distribution requirement for the Biology major

Distributions: (D3) (QFR)

Quantitative/Formal Reasoning Notes: Evolutionary ecology uses concepts in genetics and ecology to understand how the frequency of alleles in a population changes over time. These changes are formalized in equations that describe these processes. Students will gain experience in utilizing these equations to describe, analyze, and predict the evolutionary outcome of ecological interactions for both theoretical and experimental purposes. Thus, the students will gain experience in solving systems of equations using algebra and in stat

Not offered current academic year

BIOL 407 (S) Neurobiology of Emotion

Cross-listings: NSCI 347

Primary Cross-listing

Emotion is influenced and governed by a number of neural circuits and substrates, and emotional states can be influenced by memory, cognition, and many external stimuli. We will read and discuss articles about mammalian neuroanatomy associated with emotion as defined by classic lesion studies, pharmacology, electrophysiology, fMRI imaging, knockout and optogenetic mouse studies, for investigating neural circuit function in order to gain an understanding of the central circuits and neurotransmitter systems that are implicated in emotional processing. We will focus initially on the neural circuits involved in fear, as a model for how human and animal emotion and physiology is studied, with special sessions on emotional responses to music and art, as well as discussions about burgeoning neurobiological research into the emotion of disgust. The larger goal of the course is to give students opportunities and experience in critical evaluation and discussion of primary scientific literature, and to develop and refine strategies on how to use scientific evidence in building arguments in essays.

Requirements/Evaluation: class participation and several short papers

Prerequisites: BIOL212/NSCI201; open to juniors and seniors. Sophomores must get instructor's consent prior to enrolling.

Enrollment Limit: 12

Enrollment Preferences: senior Biology majors who have not taken a 400-level Biology course; then to eligible NSCI concentrators

Expected Class Size: 12

Grading: no pass/fail option, no fifth course option

Distributions: (D3)

This course is cross-listed and the prefixes carry the following divisional credit:

BIOL 407(D3) NSCI 347(D3)

Spring 2024

SEM Section: 01 TR 9:55 am - 11:10 am Tim J. Lebestky

SEM Section: 02 TR 11:20 am - 12:35 pm Tim J. Lebestky

BIOL 408 (S) RNA Worlds

RNA is known best as the message cells use to turn genes into proteins. Yet investigations of several unusual genetic phenomena over the past few decades did not find protein-coding genes, but instead uncovered non-coding RNAs with a cornucopia of functions. Today, biologists have begun to develop a framework for how RNA's non-coding functions play central roles in immune defense and genetic conflicts, in gene regulation and cancer. We will develop our own understanding of this middle world, of RNA's power to protect the genome and direct cellular processes, through reading and discussion of primary scientific literature. We will learn how this emerging perspective of RNA's non-coding functions helps to resolve mysteries of epigenetic inheritance and has opened the door to RNA therapeutics.

Class Format: discussion, three hours per week

Requirements/Evaluation: class participation and 4 three-page papers

Prerequisites: BIOL 202; open to juniors and seniors

Enrollment Limit: 12

Enrollment Preferences: senior Biology majors who have not taken a 400-level course

Expected Class Size: 12

Grading: no pass/fail option, yes fifth course option

Distributions: (D3)

Spring 2024

SEM Section: 01 MW 11:00 am - 12:15 pm David W. Loehlin

SEM Section: 02 TR 9:55 am - 11:10 am David W. Loehlin

BIOL 410 (S) Nanomachines in Living Systems

Through reading and discussing the primary literature, this course will explore how nanometer-sized biological molecules like proteins perform functions that require integration of information and transmission of force at much larger scales, microns and above. These nanoscale proteins will be considered as nanomachines that can transform a chemical energy into a mechanical one. We will focus on the cytoskeleton, which gives cells their shape, organizes the internal parts of cells and provides mechanical support for essential cellular processes like cell division and movement. An emphasis will be placed on how the biochemical properties of actin, actin-binding proteins and motors are used to generate mechanical force necessary for the respective biological function. Topics will include some controversial and emerging hypotheses in the field: sliding versus depolymerizing hypotheses for constriction of the contractile ring in cytokinesis, roles of cytoskeleton in pathogen entry and propagation, organelle dynamics, polarity establishment in cell migration, immunological synapse and neuronal function.

Requirements/Evaluation: class participation and several short papers

Prerequisites: BIOL 202; open to juniors and seniors

Enrollment Limit: 20

Enrollment Preferences: senior Biology majors who have not taken a 400-level course, then juniors

Expected Class Size: 20

Grading: no pass/fail option, no fifth course option

Unit Notes: does not satisfy the distribution requirement for the Biology major

Distributions: (D3)

Not offered current academic year

BIOL 411 (F) Developmental Biology: From Patterning to Pathogenesis

A small number of developmental regulators coordinate the interplay between cell proliferation and specification of cell fates during animal development. The genetic basis of many of the cancer and degenerative diseases are, in fact, due to these same developmental regulators whose expression is misregulated in the adult. Through the reading of primary literature, this course in developmental biology will examine the mechanisms of gene expression of key regulators, the biological processes they mediate in the embryo, and how they become misregulated in proliferative and degenerative diseases.

Requirements/Evaluation: bi-weekly tutorial papers, oral commentaries, and tutorial discussion

Prerequisites: BIOL 202

Enrollment Limit: 14

Enrollment Preferences: Senior Biology majors who have not taken a 400-level course followed by seniors then juniors in the major

Expected Class Size: 14

Grading: no pass/fail option, no fifth course option

Distributions: (D3)

Not offered current academic year

BIOL 414 (F) Life at Extremes: Molecular Mechanisms

All organisms face variability in their environments, and the molecular and cellular responses to stresses induced by environmental change often illuminate otherwise hidden facets of normal physiology. Moreover, many organisms have evolved unique molecular mechanisms, such as novel cellular compounds or macromolecular structural modifications, which contribute to their ability to survive continuous exposure to extreme conditions, such as high temperatures or low pH. This course will examine how chaperonins, proteases, and heat- and cold-shock proteins are regulated in response to changes in the external environment. We will then consider how these and other molecular mechanisms function to stabilize DNA and proteins- and, ultimately, cells and organisms. Other extreme environments, such as hydrothermal vents on the ocean floor, snow fields, hypersaline lakes, the intertidal zone, and acid springs provide further examples of cellular and molecular responses to extreme conditions. Biotechnological applications of these molecular mechanisms in areas such as protein engineering will also be considered. Class discussions will focus upon readings from the primary literature.

Class Format: discussion three hours per week

Requirements/Evaluation: several short papers, participation in class discussions and course notebook

Prerequisites: open to juniors and seniors who are Biology majors; all other students interested in this course should contact the professor; BIOL 202 recommended

Enrollment Limit: 12

Enrollment Preferences: senior Biology majors who have not taken a 400-level course; then junior Biology majors

Expected Class Size: 12

Grading: no pass/fail option, yes fifth course option

Distributions: (D3)

Fall 2023

SEM Section: 01 TR 9:55 am - 11:10 am Claire S. Ting

SEM Section: 02 TR 11:20 am - 12:35 pm Claire S. Ting

BIOL 417 (S) Translational Immunology: From Bench to Bedside

Recent advances in the field of immunology have led to the development of new approaches to prevent and treat diseases that affect millions of people worldwide. Drugs that modulate the body's natural immune response have become powerful tools in treating major diseases--infection, autoimmunity and cancer. This course will use readings from the primary literature to explore central themes involved in translating basic research to new clinical and therapeutic approaches. Topics will include vaccine development, autoimmunity and cancer immunotherapy.

Requirements/Evaluation: Class participation and 4 essays

Prerequisites: BIOL 202; open to juniors and seniors

Enrollment Limit: 12

Enrollment Preferences: senior biology majors who have not taken a 400-level course; then juniors

Expected Class Size: 12

Grading: no pass/fail option, no fifth course option

Distributions: (D3)

Spring 2024

SEM Section: 01 TR 9:55 am - 11:10 am Damian Turner

BIOL 419 (S) Secrets of Enzymes: Fidelity, Promiscuity, and Disease

Living organisms have spent the past 4 billion years evolving proteins and enzymes that perform basic cellular functions to support life. Over time, duplications and mutations of these enzymes have led to novel reactions, pathways, and chemistries. To gain an appreciation for these molecular catalysts, we will start by considering how enzymes are synthesized and how errors are introduced and naturally corrected. We will then analyze the effects of beneficial errors on the evolution of new function and the effects of undesirable errors in human disease. The final section of this course will focus on how enzymes such as CRISPR/Cas9 act as 'molecular scissors' to cut DNA and how these enzymes can be used to correct errors. We will explore the implications of this field in active areas of biomedical research, including antibiotic resistance and personalized medicine. Discussions and writing assignments will focus on reading and critiquing the scientific literature.

Class Format: discussion three hours per week

Requirements/Evaluation: four 3- to 4-page papers and participation in discussions

Prerequisites: BIOL 202 recommended

Enrollment Limit: 12

Enrollment Preferences: senior Biology majors that have not had a 400-level course, followed by senior Biology majors, followed by junior Biology majors

Expected Class Size: 12

Grading: no pass/fail option, yes fifth course option

Distributions: (D3)

Not offered current academic year

BIOL 421 (S) Thermoregulation: From Molecules to Organisms

Thermal physiology involves the study of molecular events, organ systems, and organism-environmental interactions that are involved with heat production and temperature maintenance. The area of thermal physiology has been around for over 100 years. However, only in the last 5-7 years has the science progressed to understanding basic fundamental mechanisms for generating and regulating heat production. This tutorial will focus on four questions: 1) how do organisms generate heat? 2) how do organisms sense the temperature in the environment? 3) how do organisms integrate information about the environment (temperature, humidity, time of day, etc.) with internal information (deep body temperature, energy stores, etc.) to regulate their metabolic production of heat? 4) how do animals make "the decision" to enter a state of torpor?

Requirements/Evaluation: five 4- to 5-page papers; five 1- to 2-page response papers; tutorial presentations; contribution to the intellectual enterprise

Prerequisites: BIOL 205 or permission of instructor

Enrollment Limit: 10

Enrollment Preferences: senior Biology majors that have not had a 400-level course, followed by senior Biology majors, followed by junior Biology majors

Expected Class Size: 10

Grading: no pass/fail option, no fifth course option

Unit Notes: does not satisfy the distribution requirement for the Biology major

Distributions: (D3)

Not offered current academic year

BIOL 425 (F) Coevolution (WS)

Coevolution, defined as reciprocal adaptation between species, is central to understanding biological phenomena ranging from global patterns of biodiversity to the molecular mechanisms of evolution. The focus of this tutorial will be on coevolution as a paradigm for understanding species diversification.

Requirements/Evaluation: Evaluation will be based on 5 (4-5-page) papers, tutorial presentations, and the student's effectiveness as a critic.

Prerequisites: BIOL 203 or 305

Enrollment Limit: 10

Enrollment Preferences: Senior biology majors

Expected Class Size: 10

Grading: no pass/fail option, no fifth course option

Unit Notes: satisfies the distribution requirement for the Biology major

Distributions: (D3) (WS)

Writing Skills Notes: Each student will write five 4- to 5-page papers on which I will provide written feedback regarding grammar, style, and argument. Each student will write five 1-page critiques of their partners' papers.

Not offered current academic year

BIOL 428 (S) Forests of the Future--Understanding Global Change through 'Big Science' Experiments

Increases in atmospheric CO₂ and warming temperatures associated with global climate change affect the growth and physiology of plants and microorganisms and the cycling and storage of carbon and nutrients within terrestrial ecosystems. These changes cross scale and encompass complex feedbacks that are challenging to predict and understand. Over the past several decades, scientists have used large-scale global change experiments to depict the future of organisms and ecosystems in a CO₂-enriched, warmer world. In this course, we will trace the progress of these experiments and evaluate our understanding of the effect of global changes on plant growth and physiology, microbial community composition and activity, and ecosystem nutrient cycling processes. We will then consider the interactive effects of multi-factor global changes and assess the promises and challenges of interpreting biological responses at the ecosystem level. Finally, we will investigate how experimental results can be integrated within models that describe and predict ecosystem function at a global scale. Throughout the course, we will consider how understanding gained from manipulative experiments can be used to inform and prioritize climate change mitigation strategies. Discussions and writing assignments will focus on reading and critiquing the scientific literature. Writing assignments will include two short writing assignments (3 pages each) and a final research proposal (6 pages), as well as formal written peer review. Students will gain experience revising scientific writing.

Requirements/Evaluation: Writing assignments will include two short writing assignments (3 pages each) and a final experimental/grant proposal (6 pages), as well as formal written peer review. Students will gain experience revising scientific writing.

Prerequisites: BIOL203 (Ecology) or BIOL302 (Communities and Ecosystems) or BIOL329 (Conservation Biology)

Enrollment Limit: 12

Enrollment Preferences: Senior Biology majors

Expected Class Size: 12

Grading: no pass/fail option, no fifth course option

Distributions: (D3)

Not offered current academic year

BIOL 435 (F) Causes of the obesity epidemic

The prevalence of a host of metabolic diseases has increased dramatically in recent decades. The causes underlying these increases remain hotly contested. During this course we will discuss primary literature to better understand the mechanisms by which our body regulates energy metabolism and how this is shaped by our brain, genetics and evolution. Subsequently, we will explore how modern society has changed our metabolic environment and try to figure out what regulatory mechanisms should be targeted to reverse the obesity epidemic.

Requirements/Evaluation: Evaluation will be based on four 4-5 page papers and class participation.

Prerequisites: BIOL 205 or BIOL 212 / NSCI 201 or Permission of Instructor.

Enrollment Limit: 24

Enrollment Preferences: Senior Biology majors who have not taken a 400-level course, then junior Biology majors.

Expected Class Size: 12

Grading: no pass/fail option, no fifth course option

Distributions: (D3)

Not offered current academic year

BIOL 436 (F) Metabolites as Messengers

Beyond the genome, transcriptome, and proteome is the metabolome, the suite of small-molecule metabolites present in a biological sample. These

molecules are not simply the products of the proteome nor a collection of cellular fuels and wastes. In this seminar, we will investigate metabolites as signals that influence cellular processes. Biochemistry and molecular biology textbooks often emphasize the proteins that mediate cellular communication. Of course, specialized metabolites like neurotransmitters and certain hormones are well known to regulate information flow between cells. But what about molecules that participate in the metabolic processes of almost every cell--how can these intermediary metabolites be used as signals? How do they communicate acutely and with specificity? What role do they play in sensing (or promoting) environmental change? And how can metabolites be regulated to override their typical fates in metabolic pathways and serve as signals? We'll examine these questions and more at the levels of inter-organellar, intercellular, and inter-organismal metabolic communication by reading the primary scientific literature together. Familiarity with typical mechanisms of cellular communication and/or physiology (BIOL 205) is recommended but not required.

Class Format: Discussion, three hours per week

Requirements/Evaluation: class participation and three to five papers of length 3-5 pages each

Prerequisites: BIOL 222 or 322; open to juniors and seniors

Enrollment Limit: 12

Enrollment Preferences: senior Biology majors who have not taken a 400-level course

Expected Class Size: 12

Grading: no pass/fail option, no fifth course option

Distributions: (D3)

Fall 2023

SEM Section: 01 TR 9:55 am - 11:10 am Caitlyn E. Bowman-Cornelius

BIOL 437 (F) Neural flexibility: plasticity, modulation and evolution

Animals must adapt their behaviors to match their environment in order to survive and reproduce. How does the nervous system mediate behavioral change that occurs in seconds, hours, months, or millions of years? In this course we will use a comparative approach to explore how neural circuits control behavioral flexibility over a range of timescales. We will first discuss circuits that control behavioral switches that occur very rapidly based on environmental and social stimuli. Next, we will consider the role that internal state and identity play in modulating neuronal circuits over an organism's lifetime to influence behavioral decisions. Finally, we will examine how evolution tinkers with neural circuits to lead to behavioral change over very long timescales. Throughout the course we will explore how modifications to neural circuits--including connectivity, synaptic plasticity, neuromodulation and neuron physiology--can lead to differences in behavior and ask if there are connections between common mechanisms underlying behavioral change across timescales. Discussions and assignments in this course will focus on reading and critically evaluating primary scientific literature.

Requirements/Evaluation: class participation and three to five papers of length 3-5 pages each

Prerequisites: BIOL 212 or BIOL 205

Enrollment Limit: 12

Enrollment Preferences: senior Biology majors who have not taken a 400-level course

Expected Class Size: 12

Grading: no pass/fail option, no fifth course option

Distributions: (D3)

Fall 2023

SEM Section: 01 MW 11:00 am - 12:15 pm Charlotte L. Barkan

BIOL 438 (S) Species Interactions Under Global Change

Anthropogenic changes to the world's ecosystems often have clear effects on the abundance and distribution of species. These effects, however, do not occur in a vacuum: changes in any given species' presence, abundance, or behavior can cascade into large and surprisingly context-dependent effects on the interactions of other organisms. In this course we will examine competitive, mutualistic, and antagonistic interactions in the Anthropocene from the species pair to community scale. We will explore the ecological and evolutionary mechanisms underlying the outcomes of these interactions, examining patterns including phenological mismatch, species invasions, and anthropogenic land use change. Classes will focus on critical evaluation of evidence from the primary literature, drawing on examples from community ecology, disease dynamics, and global change

biology.

Requirements/Evaluation: class participation and three to five papers of length 3-5 pages each

Prerequisites: BIOL 203 or BIOL 204 or BIOL 329 or permission from instructor

Enrollment Limit: 12

Enrollment Preferences: senior Biology majors who have not taken a 400-level course, open to juniors and seniors

Expected Class Size: 12

Grading: no pass/fail option, no fifth course option

Distributions: (D3)

Spring 2024

SEM Section: 01 TR 11:20 am - 12:35 pm Gordon P. Smith

BIOL 454 (F) Climate Change Physiology

Cross-listings: ENVI 454

Primary Cross-listing

Animals are increasingly faced with rapid climate change driven by human activities across the globe. How do they cope with challenges imposed by increasing temperature? And, how might physiological mechanisms at the organismal level scale up to influence population processes? This course uses an integrative approach to understand the impacts of climate change at multiple levels of biological organization in both terrestrial and aquatic environments. We examine physiological mechanisms underlying animal responses and the role of acclimation versus adaptation in coping with rapidly shifting thermal environments. We then consider the impacts of these mechanisms on whole organism performance and their consequences for population persistence. Finally, we learn the analytical tools used to incorporate physiological mechanisms into ecological models to predict future responses to global climate change. Class discussions will focus on readings drawn from the primary literature.

Requirements/Evaluation: Evaluation will be based on class participation and several short papers.

Prerequisites: BIOL 203 or BIOL 205, or permission of instructor

Enrollment Limit: 10

Enrollment Preferences: Biology seniors who have not yet taken a 400 level course

Expected Class Size: 10

Grading: no pass/fail option, no fifth course option

Unit Notes: Satisfies the distribution requirement for the Biology major.

Distributions: (D3)

This course is cross-listed and the prefixes carry the following divisional credit:

BIOL 454(D3) ENVI 454(D3)

Not offered current academic year

BIOL 455 (S) Neural Regeneration

Cross-listings: NSCI 455

Primary Cross-listing

Injury to the human nervous system can cause lasting impairment, but non-mammalian animals have prodigious capacity to regenerate neurons, regrow axons, and repair scars. What accounts for these differences? Regeneration can occur in multiple modes: replacement of injured neurons, repairs such as axonal regrowth to reconnect to a target structure, or repurposing existing neurons for new tasks through neural plasticity. We will explore the molecular foundations that underlie neuronal proliferation, neural plasticity, and inflammatory responses. We will consider the potential for translating these findings to inform treatments for humans who suffer from neural injury or neurodegenerative disease. Class discussions will focus on readings from the primary literature.

Class Format: Discussion, 3 hours per week

Requirements/Evaluation: Evaluation will be based on class participation, brief weekly responses, and four short research proposals.

Prerequisites: BIOL 212/NSCI 201 or permission of instructor.

Enrollment Limit: 10

Enrollment Preferences: Biology seniors who have not yet taken a 400 level course and Neuroscience senior concentrators who need a Group A elective.

Expected Class Size: 10

Grading: no pass/fail option, no fifth course option

Distributions: (D3)

This course is cross-listed and the prefixes carry the following divisional credit:

NSCI 455(D3) BIOL 455(D3)

Not offered current academic year

BIOL 477 (S) Evolution of Species Coexistence

How can two or more species coexist if they compete for the same resources? Or when one preys on the other? Understanding species coexistence has been central to ecology since its inception. The question is important because species diversity is a defining characteristic of natural ecosystems. This course provides an in depth look into the theoretical and empirical evidence for species coexistence. It also explores how the evolution of interacting species can change the identity and number of species in a community thereby playing a key role in determining and maintaining species diversity. Finally, the course will address how this body of theory and empirical evidence can be used to predict how we might expect diversity to change with increases in human-caused disruptions to the natural environment.

Requirements/Evaluation: Evaluation will be based on participation in discussions, several short papers, and presentations.

Prerequisites: BIOL/ENVI 203

Enrollment Limit: 12

Enrollment Preferences: Biology seniors who have not yet taken a 400 level course

Expected Class Size: 12

Grading: no pass/fail option, no fifth course option

Distributions: (D3)

Not offered current academic year

BIOL 493 (F) Senior Thesis Research: Biology

Each student prepares a thesis under the supervision of a member of the department. Thesis work can begin either in the spring of the junior or the fall of the senior year, and includes the Winter Study period of the senior year. The number of Biology Department faculty available to mentor research students and the number of students each can accommodate in their lab vary from year to year. Although the department will make every effort to provide an opportunity for students to conduct Honors research, you should be aware that it may not be possible to assign all applicants to a laboratory. This is part of a full-year thesis (493-494).

Requirements/Evaluation: Written thesis, poster presentation at the end of the year, oral presentation in October of the senior year.

Prerequisites: Students must apply during the first week in February of their junior year to pursue an Honors thesis in Biology.

Enrollment Limit: 30

Enrollment Preferences: Senior Biology majors

Expected Class Size: 25

Grading: no pass/fail option, yes fifth course option

Unit Notes: Senior majors are required to participate in Biology Colloquium, which is scheduled for most Fridays at 1:10 pm.

Distributions: (D3)

Fall 2023

HON Section: 01 TBA Robert M. Savage

BIOL 494 (S) Senior Thesis Research: Biology

Each student prepares a thesis under the supervision of a member of the department. Thesis work can begin either in the spring of the junior or the fall

of the senior year, and includes the Winter Study period of the senior year. The number of Biology Department faculty available to mentor research students and the number of students each can accommodate in her/his lab vary from year to year. Although the department will make every effort to provide an opportunity for students to conduct Honors research, you should be aware that it may not be possible to assign all applicants to a laboratory. This is part of a full-year thesis (493-494).

Requirements/Evaluation: Written thesis, poster presentation at the end of the year, oral presentation in the first semester of the thesis year.

Prerequisites: Students must apply during the first week in February of their junior year to pursue an Honors thesis in Biology.

Enrollment Limit: 30

Enrollment Preferences: Senior Biology majors

Expected Class Size: 25

Grading: no pass/fail option, yes fifth course option

Unit Notes: Senior majors are required to participate in Biology Colloquium, which is scheduled for most Fridays at 1:10 pm.

Distributions: (D3)

Spring 2024

HON Section: 01 F 1:10 pm - 2:25 pm Robert M. Savage

BIOL 499 (F)(S) Biology Colloquium

Scientists from around the country who are on the cutting edge of biological research come to talk about their work. Students of Biology at any level are welcome.

Grading: non-graded

Unit Notes: this is not a for-credit course; registration is not necessary to attend

Distributions: No divisional credit

Fall 2023

LEC Section: 01 F 1:10 pm - 2:25 pm Robert M. Savage

Spring 2024

LEC Section: 01 Cancelled

Winter Study -----

BIOL 13 (W) Intro to Animal Tracking

This course is an introduction to the ancient art and science of animal tracking, and its use for ecological inventory. Participants will deepen their skills as naturalists, their awareness of the natural world, and discover that even the greens at Williams College are abundant with wildlife. Students will have field time in class at Hopkins Forest as well as thorough independent study at a convenient outdoor location of each student's choosing. Basic concepts of animal tracking, its history and use by indigenous people throughout the world will be discussed through video and slide show.

Requirements/Evaluation: Paper(s) or report(s); Presentation(s); Performance(s); Creative project(s); Other: Field test of tracking skills

Prerequisites: None

Enrollment Limit: 15

Enrollment Preferences: seniors to freshman

Expected Class Size: NA

Grading: pass/fail only

Unit Notes: Dan Yacobellis has been working with school children, teens and adults since 1997. Dan Created Tamakoce wilderness Programs in 2006 and runs programs on topics including tracking, friction fire making and other primitive skills.

Materials/Lab Fee: \$80

Winter 2024

LEC Section: 01 TR 10:00 am - 3:00 pm Dan Yacobellis

BIOL 22 (W) Introduction to Biological Research

An experimental research project will be carried out under the supervision of the Biology Department. It is expected that the student will spend 20 hours per week in the lab at a minimum, and a 10-page written report is required. This experience is intended for, but not limited to, first-year students and sophomores, and requires the permission of the instructor.

Class Format: Independent study

Requirements/Evaluation: A 10-page paper

Prerequisites: None. Students may not register until they have a confirmed placement in a Williams Biology lab. The instructor will work with student to identify possible mentors, but it is the student's responsibility to talk to the mentor and get approval.

Enrollment Limit: 18

Enrollment Preferences: First years and sophomores

Expected Class Size: NA

Grading: pass/fail only

Winter 2024

RSC Section: 01 TBA Robert M. Savage

BIOL 23 (W) Tropical Ecology: From the Andes to the Amazon basin

One of the most striking patterns in biogeography is the increasing level of species richness as one moves from the poles to the equator. As the name implies, Ecuador straddles the equator, but perhaps less well known is that Ecuador includes an altitudinal gradient that ranges from the high Andes (over 20,000 feet) to the Amazon basin. This combination of equatorial proximity and vertical relief has generated one of the most bio-diverse regions in the world - Ecuador is home to over 23 thousand species and makes up about 6% of the world's diversity in an area approximately the size of Colorado. This course will include a 10-day trip to Ecuador where we will visit three distinct habitats - the páramo and Polylepis "forests" of the high Andes, mid-elevation tropical cloud forest, and lowland tropical rain forest. Through a combination of lectures, field trips, guest seminars, and independent exploration, this course will introduce students to the natural history and ongoing research taking place in these ecosystems. A typical day during our trip to Ecuador will involve a morning natural history hike, with opportunity for independent exploration in the afternoon. Evenings will involve either night hikes, or seminar presentations by resident researchers. During our trip, students will collect data for an independent project on self-selected topics that could include, for example, altitudinal gradients in hummingbird diversity, the pros and cons of ecotourism in Ecuador, or analysis of camera-trap data in the Amazon basin. Upon return to campus, students will complete their independent project analysis which they will use as the basis for a short report and final poster presentation.

Requirements/Evaluation: Short paper and final project or presentation.

Prerequisites: None

Enrollment Limit: 6

Enrollment Preferences: By interview with preference given to students that have taken BIOL 203

Expected Class Size: 6

Grading: pass/fail only

Materials/Lab Fee: \$3,450

Winter 2024

TVL Section: 01 TBA Manuel A. Morales

BIOL 24 (W) Introduction to Ecology and Evolutionary Biology Research

An experimental research project in ecology /evolutionary biology will be carried out under the supervision of the Biology Department. It is expected that the student will spend 20 hours per week in the lab at a minimum, and a 10-page written report is required. This experience is intended for, but not limited to, first-year students and sophomores, and requires the permission of the instructor.

Requirements/Evaluation: A 10-page paper.

Prerequisites: None. Students may not register until they have a confirmed placement in a Williams Biology lab. The instructor will work with student to identify possible mentors, but it is the student's responsibility to talk to the mentor and get approval.

Enrollment Limit: 12

Enrollment Preferences: First years and sophomores

Expected Class Size: 8

Grading: pass/fail only

Winter 2024

LAB Section: 01 TBA Lois M. Banta

BIOL 27 (W) Introduction to Molecular and Cell Biology and Biochemistry Research

An experimental research project in molecular or cellular biology/biochemistry will be carried out under the supervision of the Biology Department. It is expected that the student will spend 20 hours per week in the lab at a minimum, and a 10-page written report is required. This experience is intended for, but not limited to, first-year students and sophomores, and requires the permission of the instructor.

Requirements/Evaluation: A 10-page paper.

Prerequisites: None. Students may not register until they have a confirmed placement in a Williams Biology lab. The instructor will work with student to identify possible mentors, but it is the student's responsibility to talk to the mentor and get approval.

Enrollment Limit: 12

Enrollment Preferences: First years and sophomores

Expected Class Size: 8

Grading: pass/fail only

Winter 2024

LAB Section: 01 TBA Lois M. Banta

BIOL 28 (W) Introduction to Research in Neuroscience and Organismal Biology

An experimental research project in neurobiology/organismal biology will be carried out under the supervision of the Biology Department. It is expected that the student will spend 20 hours per week in the lab at a minimum, and a 10-page written report is required. This experience is intended for, but not limited to, first-year students and sophomores, and requires the permission of the instructor.

Requirements/Evaluation: A 10-page paper.

Prerequisites: None. Students may not register until they have a confirmed placement in a Williams Biology lab. The instructor will work with student to identify possible mentors, but it is the student's responsibility to talk to the mentor and get approval.

Enrollment Limit: 12

Enrollment Preferences: First years and sophomores.

Expected Class Size: 8

Grading: pass/fail only

Winter 2024

LAB Section: 01 TBA Lois M. Banta

BIOL 31 (W) Senior Thesis: Biology

Continuation of Senior Honors thesis research. Required of all thesis students.

Requirements/Evaluation: Ongoing writing of honors thesis.

Prerequisites: Honors thesis student

Enrollment Limit: 33

Enrollment Preferences: To be taken by students registered for Biology 493, 494.

Expected Class Size: NA

Grading: pass/fail only

Winter 2024

HON Section: 01 TBA Robert M. Savage

BIOL 99 (W) Independent Study: Biology

Open to upperclass students. Students interested in doing an independent project (99) during Winter Study must make prior arrangements with a faculty sponsor. The student and professor then complete the independent study proposal form available online. The deadline is typically in late September. Proposals are reviewed by the pertinent department and the Winter Study Committee. Students will be notified if their proposal is approved prior to the Winter Study registration period.

Class Format: independent study

Grading: pass/fail only

Winter 2024

IND Section: 01 TBA Robert M. Savage