

## **BIOLOGY (Div III)**

**Chair: Professor Lois Banta**

- Sonya K. Auer, Visiting Assistant Professor of Biology
- Lois M. Banta, Chair and Halvorsen Professor for Distinguished Teaching and Research of Biology
- Ron D. Bassar, Assistant Professor of Biology
- Janis Bravo, Instructor in Biology
- Deborah L. Carlisle, Instructor in Biology
- Matt E. Carter, Associate Professor of Biology; affiliated with: Neuroscience Program; on leave Fall 2021
- Pei-Wen Chen, Assistant Professor of Biology
- Derek Dean, Senior Lecturer in Biology
- Joan Edwards, Samuel Fessenden Clarke Professor of Biology
- Allison L. Gill, Assistant Professor of Biology
- Cynthia K. Holland, Assistant Professor of Biology
- Tim J. Lebestky, Associate Professor of Biology, Chair of Neuroscience Program; affiliated with: Neuroscience Program
- David W. Loehlin, Assistant Professor of Biology
- Luana S. Maroja, Associate Professor of Biology, Chair of Biochemistry & Molecular Biology Program; affiliated with: Biochemistry&Molecular Bio Pgr; on leave Fall 2021
- Manuel A. Morales, Professor of Biology
- Robert M. Savage, Charles L. MacMillan Professor in Natural Sciences
- Steven J. Swoap, Howard B. Schow '50 and Nan W. Schow Professor of Biology and Director of the Williams-Exeter Programme at Oxford University; affiliated with: Williams-Exeter Prg at Oxford
- Claire S. Ting, Professor of Biology
- Damian Turner, Assistant Professor of Biology
- Vincent van der Vinne, Visiting Assistant Professor of Biology
- Heather Williams, William Dwight Whitney Professor of Biology; affiliated with: Neuroscience Program; on leave Spring 2022

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:

Biology 101 The Cell

Biology 102 The Organism

Biology 202 Genetics

Any two 300-level courses, each of which must have a laboratory associated with it

Any one 400-level course other than 493-494

Any other three courses or any other two courses and two semesters of Organic Chemistry

**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.

### **Distribution Requirement**

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

### **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. 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 spring 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, Biology 202, 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 Organic Chemistry). 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 before going abroad, since Biology 202 is required for the major and is a prerequisite for many upper-level courses; a Genetics course taken while studying away cannot substitute for Biology 202. Biology majors studying abroad may receive credit toward the major for at most two 200-level electives; the departmental distribution requirement can be satisfied through an appropriate course taken during study abroad. 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 credit, regardless of the level or format of the course.

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

Yes. BIOL 202 Genetics, 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. Genetics is only offered in the fall. Those late to the major need to be aware of this as Genetics is a prerequisite 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, BIOL 493, or BIOL 494) may be counted towards the major requirements.

### BIOL 100 (W) Biology Through the Media Intensive

Biology Through The Media explores the foundational concepts examined in the Department's introductory series (Biology 101 and Biology 102) by using the 'greatest hits' of stories that have made their way into the news outlets, television and film media. The first section of the course investigates cell structure and function in terms of energy needs and how information is conveyed in a cell. The last half the course will focus upon 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 any background in biology. As this class counts as both a semester course and winter study course, the students are expected to attend class and to spend a significant time on the course. The students should dedicate approximately 50 hours per week to this class. The number of topics we will cover is numerous and wide-ranging and will be done so at a faster rate than what is observed during a regular semester. Each afternoon, the TAs and myself will be available to support student learning of the material.

**Class Format:** Daily 10am- noon and 2-4pm (about 70 contact hours, plus 6 hours for quizzes and exams).

**Requirements/Evaluation:** Problem sets will be assigned daily. The students are expected to spend a significant amount of time on the homework problems each afternoon and to hand in their assigned work. Evaluation will be based on papers, quizzes and exams. Quizzes, exams and papers must be completed by the student alone, however, students may work together on the problem sets and in-class exercises.

**Prerequisites:** Permission of a dean.

**Enrollment Limit:** no limit

**Enrollment Preferences:** students who need to make up a deficiency

**Expected Class Size:** 20

**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)

Winter 2022

LEC Section: 01 M-F 10:00 am - 12:00 pm M-F 2:00 pm - 4:00 pm Robert M. Savage

### 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, cell signaling, cell trafficking, 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)

**Attributes:** BIMO Required Courses NSCI Required Courses

Fall 2021

LEC Section: 01 MWF 10:00 am - 10:50 am Damian Turner  
LEC Section: 02 MWF 11:00 am - 11:50 am Damian Turner  
LEC Section: 03 TR 9:55 am - 11:10 am Cynthia K. Holland  
LEC Section: 04 TR 11:20 am - 12:35 pm Cynthia K. Holland  
LAB Section: 05 M 1:00 pm - 4:00 pm Janis E. Bravo  
LAB Section: 06 T 1:00 pm - 4:00 pm Janis E. Bravo  
LAB Section: 07 W 1:00 pm - 4:00 pm Janis E. Bravo  
LAB Section: 08 R 1:00 pm - 4:00 pm Janis E. Bravo  
LAB Section: 09 T 1:00 pm - 4:00 pm Deborah L. Carlisle  
LAB Section: 10 W 1:00 pm - 4:00 pm Deborah L. Carlisle  
LAB Section: 11 R 1:00 pm - 4:00 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:** none

**Enrollment Preferences:** none

**Expected Class Size:** 152

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

**Distributions:** (D3)

**Attributes:** BIMO Required Courses

Spring 2022

LEC Section: 01 MWF 9:00 am - 9:50 am Ron D. Bassar  
LEC Section: 02 TR 9:55 am - 11:10 am Allison L. Gill  
LEC Section: 03 MWF 10:00 am - 10:50 am Robert M. Savage  
LEC Section: 04 MWF 11:00 am - 11:50 am Robert M. Savage  
LAB Section: 05 M 1:00 pm - 4:00 pm Derek Dean  
LAB Section: 06 T 1:00 pm - 4:00 pm Derek Dean  
LAB Section: 07 W 1:00 pm - 4:00 pm Derek Dean  
LAB Section: 08 R 1:00 pm - 4:00 pm Derek Dean  
LAB Section: 09 T 1:00 pm - 4:00 pm Deborah L. Carlisle  
LAB Section: 10 W 1:00 pm - 4:00 pm Deborah L. Carlisle

### **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)

Fall 2021

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

### **BIOL 133 (F) 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; the inherent limits of the body to perform aerobic and anaerobic tasks; and the 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:** three hours per week

**Requirements/Evaluation:** exams and bi-weekly laboratory exercises and laboratory report

**Prerequisites:** none

**Enrollment Limit:** 90

**Enrollment Preferences:** seniors, juniors, sophomores, then first-year students

**Expected Class Size:** 90

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

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

**Distributions:** (D3)

**Attributes:** PHLH Biomedical Determinants of Health

Not offered current academic year

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

**Cross-listings:** BIOL 134 ENVI 134

Primary Cross-listing

Biology and Social Issues of the Tropics explores the biological dimensions of social issues in tropical societies, and focuses specifically on the peoples of tropical regions in Africa, Asia, Latin America, Oceania, and the Caribbean. Tropical issues have become prominent on a global scale, and many social issues in the tropics are inextricably bound to human ecology and the tropical environment. Each section provides the science behind the issues and ends with possible solutions. The course highlights differences between the tropics and areas at higher latitudes. It begins with a survey of the tropical environment, including a global climate model, variation in tropical climates and the amazing diversity 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 climate change. This course fulfills the DPE requirement. Through lectures, debates and readings, students confront social 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:** 60

**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:** 60

**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:**

BIOL 134 (D3) ENVI 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.

**Attributes:** ENVI Natural World Electives EVST Living Systems Courses GBST African Studies Electives PHLH Biomedical Determinants of Health

Fall 2021

LEC Section: 01 MWF 11:00 am - 11:50 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. Includes a trip to the American Museum of Natural History in NYC.

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

**Enrollment Limit:** 60

**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:** ENVI 265 BIOL 165 MAST 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, offered remotely, 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.

**Class Format:** Remote, including Zoom seminar meetings twice a week

**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:**

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

**Attributes:** ENVI Natural World Electives

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, integrating multiple streams of evidence to map a mutation to the genome, 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

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

**Distributions:** (D3) (QFR)

**Quantative/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.

**Attributes:** BIGP Courses BIMO Required Courses

Fall 2021

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

LAB Section: 02 M 1:00 pm - 4:00 pm Derek Dean

LAB Section: 03 T 1:00 pm - 4:00 pm Derek Dean

LAB Section: 04 W 1:00 pm - 4:00 pm Derek Dean

LAB Section: 05 R 1:00 pm - 4:00 pm Derek Dean

### **BIOL 203 (F) Ecology (QFR)**

**Cross-listings:** ENVI 203 BIOL 203



### Primary Cross-listing

This course combines lectures & discussion with field and indoor laboratory exercises 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 help students build skills in data analysis and scientific writing.

**Class Format:** Six hours per week. Students will view pre-class lecture videos; class meetings will focus on discussion, synthesis, and application of course content.

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

**Prerequisites:** BIOL 102, or ENVI 101 or 102, or permission of instructor

**Enrollment Limit:** 30

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

**Expected Class Size:** 30

**Grading:** no pass/fail option, no 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:**

ENVI 203 (D3) BIOL 203 (D3)

**Quantative/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.

**Attributes:** ENVI Natural World Electives EVST Environmental Science EVST Living Systems Courses

Fall 2021

LEC Section: 01 MWF 10:00 am - 10:50 am Allison L. Gill

LAB Section: 02 T 1:00 pm - 4:00 pm Allison L. Gill

LAB Section: 03 W 1:00 pm - 4:00 pm Allison L. Gill

LAB Section: 04 R 1:00 pm - 4:00 pm Allison L. Gill

### 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:** examinations, lab reports, and a research paper

**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)

**Attributes:** COGS Interdepartmental Electives NSCI Group C Electives

Spring 2022

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

LAB Section: 02 T 1:00 pm - 4:00 pm Manuel A. Morales

LAB Section: 03 W 1:00 pm - 4:00 pm Manuel A. Morales

### **BIOL 205 (S) Physiology**

This lecture-based course examines principles, patterns, and mechanisms of biological function from the level of cells and tissues to the whole organism. The themes of the course include structure and function, mechanisms of regulation, control and integration, and adaptation to the environment. Examples of these themes are taken from a wide variety of organisms with a focus on vertebrates. Laboratories provide practical experience in measurement and experimental elucidation of physiological phenomena and functional analysis of gross structure.

**Class Format:** This year's offering will feature in-person lectures and labs.

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

**Prerequisites:** BIOL 101 and 102; open to first-year students with permission of the Biology department

**Enrollment Limit:** 60

**Enrollment Preferences:** Seniors, then juniors, then sophomores.

**Expected Class Size:** 60

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

**Unit Notes:** satisfies the distribution requirement for the Biology major

**Distributions:** (D3)

Spring 2022

LEC Section: 01 MWF 9:00 am - 9:50 am Vincent van der Vinne

LAB Section: 02 Cancelled

LAB Section: 03 T 1:00 pm - 4:00 pm Vincent van der Vinne

LAB Section: 04 Cancelled

LAB Section: 05 R 1:00 pm - 4:00 pm Deborah L. Carlisle

### **BIOL 210 (F) Mathematical Biology (QFR)**

**Cross-listings:** BIOL 210 MATH 310

**Secondary Cross-listing**

This course will provide an introduction to the many ways in which mathematics can be used to understand, analyze, and predict biological dynamics. We will learn how to construct mathematical models that capture essential properties of biological processes while maintaining analytic tractability. Analytic techniques, such as stability and bifurcation analysis, will be introduced in the context of both continuous and discrete time models. Additionally, students will couple these analytic tools with numerical simulation to gain a more global picture of the biological dynamics. Possible biological applications include, but are not limited to, single and multi-species population dynamics, neural and biological oscillators, tumor cell growth, and infectious disease dynamics.

**Class Format:** Unless circumstances change, students will have the option of taking the course in person or remotely

**Requirements/Evaluation:** problem sets, quizzes/exams, participation, final project and paper

**Prerequisites:** MATH 250 and MATH 309, or permission of instructor

**Enrollment Limit:** 20

**Enrollment Preferences:** if over-enrolled, will have students submit reasons for taking class; preference to those with interest in both subjects

**Expected Class Size:** 20

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

**Distributions:** (D3) (QFR)

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

BIOL 210 (D3) MATH 310 (D3)

**Quantative/Formal Reasoning Notes:** The course will introduce methods for developing and analyzing mathematical models.

**Attributes:** PHLH Methods in Public Health

Not offered current academic year

### **BIOL 211 (S) Paleobiology**

**Cross-listings:** GEOS 212 BIOL 211

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 project with a written and oral presentation component.

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

**Enrollment Limit:** 24

**Enrollment Preferences:** sophomore 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:**

GEOS 212 (D3) BIOL 211 (D3)

**Attributes:** EXPE Experiential Education Courses GEOS Group B Electives - Sediments + Life MAST Interdepartmental Electives

Spring 2022

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 W 1:00 pm - 4:00 pm Phoebe A. Cohen

### **BIOL 212 (F) Neuroscience**

**Cross-listings:** BIOL 212 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, two 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

**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 212 (D3) PSYC 212 (D3) NSCI 201 (D3)

**Attributes:** COGS Interdepartmental Electives NSCI Required Courses PSYC 200-level Courses

Fall 2021

LEC Section: 01 TR 9:55 am - 11:10 am Tim J. Lebestky, Victor A. Cazares

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.

**Attributes:** PHLH Biomedical Determinants of Health

Not offered current academic year

### **BIOL 220 (S) Field Botany and Plant Natural History**

**Cross-listings:** ENVI 220 BIOL 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, characteristics of plant families, the cultural and economic uses of plants and how plants have shaped our world. 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; the sketchbook and hand lens can be self-provided or purchased from the department

**Distributions:** (D3)

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

ENVI 220 (D3) BIOL 220 (D3)

**Attributes:** ENVI Natural World Electives EVST Living Systems Courses EXPE Experiential Education Courses PHLH Nutrition, Food Security+Environmental Health

Spring 2022

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

LAB Section: 02 T 1:00 pm - 4:00 pm Joan Edwards

LAB Section: 03 W 1:00 pm - 4:00 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)

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

Spring 2022

LEC Section: 01 TR 9:55 am - 11:10 am Pei-Wen Chen

LAB Section: 02 T 1:00 pm - 4:00 pm Pei-Wen Chen

LAB Section: 03 W 1:00 pm - 4:00 pm Pei-Wen Chen

### **BIOL 225 (F) Sustainable Food & Agriculture**

**Cross-listings:** BIOL 225 ENVI 225

#### **Primary Cross-listing**

A tutorial course investigating patterns, processes, and stability in human-dominated, food production systems. The course will examine sustainable food and agriculture from an ecological perspective. Topics will include: changes in diversity, concentration, and scale, flows of energy, circulation (or not) of fertilizer nutrients, carbon balances in soils, and stability of food production, processing, and distribution ecosystems. A day-long field experience will take place on a local farm.

**Requirements/Evaluation:** writing assignments, tutorial presentation, performance in the role of paper critic, and course participation

**Prerequisites:** BIOL 102 or ENVI 102

**Enrollment Limit:** 10

**Enrollment Preferences:** open to sophomores, juniors, and seniors, with preference given to sophomores over juniors and seniors

**Expected Class Size:** 8

**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 225 (D3) ENVI 225 (D3)

**Attributes:** ENVI Natural World Electives

**Not offered current academic year**

### **BIOL 231 (F)(S) Marine Ecology**

**Cross-listings:** MAST 311 BIOL 231

#### **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)

**Attributes:** ENVI Natural World Electives EVST Living Systems Courses EXPE Experiential Education Courses

Fall 2021

LEC Section: 01 TR 11:00 am - 12:15 pm Tim J. Pusack

LAB Section: 02 R 1:30 pm - 5:00 pm Tim J. Pusack

Spring 2022

LEC Section: 01 TR 11:00 am - 12:15 pm Tim J. Pusack

LAB Section: 02 R 1:30 pm - 5:00 pm Tim J. Pusack

### **BIOL 234 (S) Biology of our Sexes: The Genetic and Epigenetic Regulation of Sex Determination**

Many physical and behavioral characteristics that are associated with male and female anatomy, physiology, and behavior are initially the products molecular choices arising from the action of our chromosomes in early development. The embryonic assignment of sex can also lead to intersex or hermaphroditic outcomes in many different organisms with extraordinary and illuminating biological effects. We will explore the molecular mechanisms and evolutionary basis of sex determination in both plants and animals, as well as the physical and behavioral expression of sex by the organism discussed, and experiments that create and characterize traits and behavior of mosaic/intersex organisms. Additionally, the epigenetic regulation of the X chromosome in mammals has a canonical role in our understanding of sex determination, but whole genome studies and investigations of autosomes and the Y chromosome have raised new layers of complexity for understanding the molecular basis of human sex and sexuality.

**Requirements/Evaluation:** six 5-page papers; six 1-page response papers; tutorial presentations; discussion skills/investment

**Prerequisites:** BIOL 202 (Genetics), or permission of instructor

**Enrollment Limit:** 10

**Enrollment Preferences:** sophomores and juniors, with preference to Biology majors

**Expected Class Size:** 10

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

**Distributions:** (D3)

Not offered current academic year

### **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.

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

**Distributions:** (D3)

Fall 2021

IND Section: 01 TBA Lois M. Banta

### **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.

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

**Distributions:** (D3)

Spring 2022

IND Section: 01 TBA Lois M. Banta

### **BIOL 302 (F) Communities and Ecosystems (QFR)**

**Cross-listings:** ENVI 312 BIOL 302

#### **Primary Cross-listing**

An advanced ecology course that examines how species interact with each other and their environment and how communities are assembled. This course emphasizes phenomena that emerge in complex ecological systems, building on the fundamental concepts of population biology, community ecology, and ecosystem science. This foundation will be used to understand specific topics relevant to conservation including invasibility and the functional significance of diversity for ecosystem stability and processes. Lectures and labs will explore how to characterize the emergent properties of communities and ecosystems, and how theoretical, comparative, and experimental approaches are used to understand their structure and function. The lab component of this course will emphasize hypothesis-oriented field experiments as well as "big-data" analyses using existing data sets. The laboratory component of the course will culminate with a self-designed independent or group project.

**Class Format:** six hours per week

**Requirements/Evaluation:** lab reports, a midterm exam, a term project presentation, and a final project paper

**Prerequisites:** BIOL/ENVI 203 or 220

**Enrollment Limit:** 28

**Enrollment Preferences:** Biology majors and Environmental Studies majors and concentrators

**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)

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

ENVI 312 (D3) BIOL 302 (D3)

**Attributes:** ENVI Natural World Electives EVST Living Systems Courses EXPE Experiential Education Courses

**Not offered current academic year**

### **BIOL 305 (S) 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 202

**Enrollment Limit:** 22

**Enrollment Preferences:** Seniors and biology majors

**Expected Class Size:** 22

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

**Unit Notes:** satisfies the distribution requirement for the Biology major

**Distributions:** (D3) (QFR)

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

**Attributes:** BIGP Courses BIMO Interdepartmental Electives COGS Related Courses

Spring 2022

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



LAB Section: 02 W 1:00 pm - 4:00 pm Luana S. Maroja

LAB Section: 03 R 1:00 pm - 4:00 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:** lab reports, a term paper, 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

**Unit Notes:** satisfies the distribution requirement for the Biology major

**Distributions:** (D3)

**Attributes:** BIMO Interdepartmental Electives PHLH Nutrition, Food Security+Environmental Health

Spring 2022

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

LAB Section: 02 T 1:00 pm - 4:00 pm Claire S. Ting

LAB Section: 03 W 1:00 pm - 4:00 pm Claire S. Ting

### **BIOL 311 (F) Neural Systems and Circuits**

**Cross-listings:** BIOL 311 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.

**Class Format:** In Fall 2020, this course will be offered in a hybrid format, with in-person experiences for students on campus, as well as the ability to complete discussions/labs remotely. Exact details to be announced prior to the first day of the course.

**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:** 12

**Enrollment Preferences:** Biology majors and Neuroscience concentrators

**Expected Class Size:** 12

**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 311 (D3) NSCI 311 (D3)

**Attributes:** NSCI Group A Electives

Not offered current academic year

### **BIOL 312 (F) Sensory Biology**

**Cross-listings:** NSCI 312 BIOL 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 research project (proposal, followed by results/discussion), presentation about a non-standard sensory system, short 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

**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 312 (D3) BIOL 312 (D3)

**Attributes:** BIMO Interdepartmental Electives NSCI Group A Electives

Fall 2021

LEC Section: 01 TR 8:30 am - 9:45 am Heather Williams

LAB Section: 02 T 1:00 pm - 4:00 pm Heather Williams

LAB Section: 03 R 1:00 pm - 4:00 pm Heather Williams

### **BIOL 313 (S) 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. Laboratory two hours a week

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

**Prerequisites:** BIOL 202

**Enrollment Limit:** 12

**Enrollment Preferences:** senior and then junior Biology majors

**Expected Class Size:** 12

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

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

**Distributions:** (D3)

**Attributes:** BIMO Interdepartmental Electives PHLH Biomedical Determinants of Health

Not offered current academic year

### **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)

**Attributes:** BIMO Interdepartmental Electives PHLH Biomedical Determinants of Health

Spring 2022

LEC Section: 01 MWF 9:00 am - 9:50 am Lois M. Banta

LAB Section: 02 T 1:00 pm - 4:00 pm Lois M. Banta

LAB Section: 03 R 1:00 pm - 4:00 pm Lois M. Banta

LAB Section: 04 W 1:00 pm - 4:00 pm Janis E. Bravo

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

**Cross-listings:** MATH 319 CHEM 319 BIOL 319 PHYS 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:** two afternoons of lab, with one hour of lecture, per week. In most weeks, we will meet one day for lecture discussions.

**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, yes fifth course option

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

**Distributions:** (D3) (QFR)

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

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

**Quantative/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.

**Attributes:** BIGP Courses BIMO Interdepartmental Electives

Not offered current academic year

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

**Cross-listings:** BIMO 321 BIOL 321 CHEM 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 in-person laboratory provides further opportunity to study macromolecules and to learn the fundamental experimental techniques of biochemistry including electrophoresis, chromatography, and principles of enzymatic assays. A laboratory section will also be provided for remote students, which will examine similar topics and techniques through literature and data analysis.

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

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

**Prerequisites:** BIOL 101 and CHEM 251/255 and CHEM 155/256

**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:** does not satisfy the distribution requirement for the Biology major; 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:**

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

**Quantative/Formal Reasoning Notes:** This course fulfills the QFR requirement with regular problem sets in which quantitative/formal reasoning skills

are practiced.

**Attributes:** BIGP Courses BIMO Required Courses

Fall 2021

LEC Section: 01 MWF 10:00 am - 10:50 am Ben W. Thuronyi

LAB Section: 02 M 1:00 pm - 5:00 pm Ben W. Thuronyi

LAB Section: 03 T 1:00 pm - 5:00 pm Ben W. Thuronyi

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

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

**Cross-listings:** BIOL 322 BIMO 322 CHEM 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 two 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 and CHEM 251/255 or permission of instructor

**Enrollment Limit:** 60

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

**Expected Class Size:** 60

**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 BIOL 222

**Distributions:** (D3) (QFR)

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

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

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

**Attributes:** BIGP Courses BIMO Required Courses

Spring 2022

LEC Section: 01 TR 9:55 am - 11:10 am Cynthia K. Holland

LAB Section: 02 T 1:00 pm - 4:00 pm Janis E. Bravo

LAB Section: 03 W 1:00 pm - 4:00 pm Cynthia K. Holland

LAB Section: 04 R 1:00 pm - 4:00 pm Janis E. Bravo

### **BIOL 326 (F) 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

**Enrollment Limit:** 12

**Enrollment Preferences:** senior and junior Biology majors

**Expected Class Size:** 12

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

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

**Distributions:** (D3)

**Attributes:** BIMO Interdepartmental Electives

Fall 2021

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

LAB Section: 02 W 1:00 pm - 4:00 pm Pei-Wen Chen

### **BIOL 329 (F) Conservation Biology (QFR)**

**Cross-listings:** ENVI 339 BIOL 329

#### **Primary Cross-listing**

This course examines the application of population genetics, population ecology, community ecology, and systematics to the conservation of biological diversity. The overarching theme of the course is on the role of stochastic processes for small populations. Lecture/discussion topics will include extinction, the genetics of small populations, metapopulations, and importantly, conservation strategies. Labs will include a mixture of computer and lab projects.

**Class Format:** lecture and discussion, 3 hours per week; lab, 1.25 hours per week. students will be assigned to a lab section (block AA - either W or F from 1:30-2:45) during the first week of class.

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

**Prerequisites:** BIOL 203/ENVI 203, or BIOL 305, or permission of instructor

**Enrollment Limit:** 12

**Enrollment Preferences:** Biology majors, seniors, and juniors

**Expected Class Size:** 12

**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:**

ENVI 339 (D3) BIOL 329 (D3)

**Quantative/Formal Reasoning Notes:** This course uses quantitative and statistical analyses in both the laboratory and lecture portion of the course. In lectures mathematical models will be covered to understand conservation dynamics. In lab, students will collect and analyze data and present results in graphical and statistical forms.

**Attributes:** ENVI Natural World Electives

**Not offered current academic year**

### **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:** 12

**Enrollment Preferences:** Biology majors

**Expected Class Size:** 12

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

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

**Distributions:** (D3)

**Attributes:** BIMO Interdepartmental Electives

Spring 2022

LEC Section: 01 TR 11:20 am - 12:35 pm David W. Loehlin

LAB Section: 02 M 1:00 pm - 4:00 pm David W. Loehlin

### **BIOL 335 (F) Chronobiology**

Internal clocks control nearly all aspects of physiology and behavior and allow organisms to anticipate the dramatic environmental changes between day and night. In this course we will focus on the organization of internal clocks at the molecular, organ and physiological levels. We will explore fundamental properties of biological clocks, how internal rhythms are synchronized with the environment and the means by which clocks drive physiological rhythms. Subsequently, we will investigate how endogenous clocks help organisms cope with rhythmic changes in our environment, and how disruption of our internal rhythms compromises health and wellbeing. Lectures will alternate with discussions of primary literature. During laboratory sessions we will explore the characteristics of the circadian system in a group of mice, followed by the design and execution of a research project in a small group of students. Working with mice will require time outside of regular scheduled class times, including the weekends. Grading will be based on 2 reports and 2 presentations of the lab components as well as 2 intermediate and 1 final exam.

**Requirements/Evaluation:** Evaluation will be based on three exams, two or three oral presentations, and two lab reports.

**Prerequisites:** BIOL 205 or BIOL 212/NSCI201

**Enrollment Limit:** 18

**Enrollment Preferences:** Senior, then junior biology majors and NSCI concentrators

**Expected Class Size:** 18

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

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

**Distributions:** (D3)

**Attributes:** NSCI Group C Electives

Fall 2021

LEC Section: 01 MWF 10:00 am - 10:50 am Vincent van der Vinne

LAB Section: 02 M 1:00 pm - 4:00 pm Vincent van der Vinne

LAB Section: 03 T 1:00 pm - 4:00 pm Vincent van der Vinne

### **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 and discussion participation.

**Prerequisites:** BIOL 102, 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)

**Quantative/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

Fall 2021

LEC Section: 01 TR 11:20 am - 12:35 pm Ron D. Bassar

LAB Section: 02 W 1:00 pm - 4:00 pm Ron D. Bassar

LAB Section: 03 R 1:00 pm - 4:00 pm Ron D. Bassar

### **BIOL 402 (S) Rapid Evolution in Ecology**

Darwin believed that evolution was a slow process. Until recently, the impact of evolutionary changes on short-term ecological studies was considered to be minimal. However, empirical documentation of rapid, directly observed evolution has changed this view and has led to an increased focus on the joint dynamics of evolution and ecology including community genetics, niche construction, and evolutionary rescue. In this course, we first focus on the literature presenting the evidence for rapid evolutionary change in natural and experimental populations. Then, we explore the consequences of rapid evolutionary change for our understanding of population, community, and ecosystem ecology including the impacts that evolutionary changes have for conservation efforts and predicting the response of organisms to global environmental and climate change.

**Requirements/Evaluation:** participation in discussions, several short papers and presentations

**Prerequisites:** BIOL 202

**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

**Unit Notes:** satisfies the distribution requirement for the Biology major

**Distributions:** (D3)

Not offered current academic year

### **BIOL 407 (S) Neurobiology of Emotion**

**Cross-listings:** BIOL 407 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 experience, 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 mouse studies, as well as new opti-genetic methods for investigating neural circuit function in order to gain an understanding of the central circuits and neurotransmitter systems that are implicated in emotional processing and mood disorders.

**Class Format:** three hours per week

**Requirements/Evaluation:** class participation and several short papers

**Prerequisites:** BIOL 202 and 212; open to juniors and seniors

**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:** yes pass/fail option, yes 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 407 (D3) NSCI 347 (D3)

**Attributes:** BIMO Interdepartmental Electives NSCI Group A Electives

Spring 2022

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 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.

**Class Format:** The course will have two sections: one is in-person and the other is remote. In-person discussion or via ZOOM, three hours per week

**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)

**Attributes:** BIMO Interdepartmental Electives

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)

**Attributes:** BIMO Interdepartmental Electives

Not offered current academic year

### **BIOL 412 (S) Neural and Hormonal Basis of Hunger**

**Cross-listings:** BIOL 412 NSCI 342

#### **Primary Cross-listing**

Hunger and satiety are highly regulated behavioral states that maintain energy homeostasis in animals. This course will focus on readings from the primary literature to track numerous recent advances in how the brain and endocrine systems regulate appetite. Topics include how organ systems communicate with the brain to regulate appetite, how different populations of neurons in the brain interact to regulate appetite, how brain systems that regulate appetite affect other behaviors, and how the neural and hormonal basis of hunger compare with brain systems that regulate other homeostatic systems such as thirst. By tracing the advances in appetite regulation within the past decade, we will also trace the advent of cutting-edge molecular, genetic, and optical-based tools that are transforming multiple fields within physiology and neuroscience. Students in this class will have the opportunity to improve skills in written and oral scientific presentation.

**Requirements/Evaluation:** written assignments, oral presentations, and participation

**Prerequisites:** BIOL 205 or BIOL/PSYC 212, or permission of instructor

**Enrollment Limit:** 12

**Enrollment Preferences:** seniors who have not taken a 400-level course

**Expected Class Size:** 12

**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 412 (D3) NSCI 342 (D3)

**Attributes:** NSCI Group A Electives

Not offered current academic year

### **BIOL 413 (F) Global Change Ecology**

**Cross-listings:** ENVI 423 BIOL 413

#### **Primary Cross-listing**

Plants and animals are increasingly faced with rapid environmental change driven by human activities across the globe. How do they cope with challenges imposed by climate change, altered nutrient cycling, biological invasions, and increased urbanization? What are the impacts of organismal responses at the population and community level? This course uses an integrative approach to understand the impacts of global change at multiple levels of biological organization in both aquatic and terrestrial environments. We examine how global-scale environmental changes affect the distribution and abundance of species and alter community organization. We also consider the physiological and behavioural mechanisms underlying species responses and the role of acclimation versus adaptation in coping with rapid environmental change. Finally, we learn the analytical tools used to predict future responses to global change. Class discussions will focus on readings drawn from the primary literature.

**Class Format:** two 75-minute discussion sessions each week

**Requirements/Evaluation:** class participation and several short papers

**Prerequisites:** BIOL 203 or BIOL 305, or permission of instructor

**Enrollment Limit:** 12

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

**Expected Class Size:** 12

**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:**

ENVI 423 (D3) BIOL 413 (D3)

**Attributes:** ENVI Natural World Electives

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:** class participation and several short 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; then juniors

**Expected Class Size:** 12

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

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

**Distributions:** (D3)

**Attributes:** BIMO Interdepartmental Electives MAST Interdepartmental Electives

Fall 2021

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

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

**Distributions:** (D3)

**Attributes:** PHLH Biomedical Determinants of Health

Spring 2022

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

### **BIOL 418 (S) Signal Transduction to Cancer**

Division of normal cells is a highly regulated process based on input from both intrinsic and extrinsic signals. The cell's response to its environment affects all aspects of cell behavior: proliferation, death, differentiation and migration. The goal of the course is to understand the molecular mechanisms of signal transduction that guide normal cell behavior and how disruptions in this process can lead to cancer. We will focus on the Hedgehog-Gli signaling pathway that is activated in 30% of all known cancers. Genetic studies will serve as an introduction to the components of the pathway, followed by an examination of the molecular mechanisms of signal reception, transduction of intracellular information, scaffolding and transcriptional targets. The final section of the course will investigate how high throughput screens, medicinal chemistry studies and mouse models are used to identify small molecular inhibitors of pathway components. We will consider the effectiveness of these inhibitors in pharmacological studies, clinical trials and potential cancer treatments.

**Requirements/Evaluation:** four papers

**Prerequisites:** BIOL 202 or permission of instructor

**Enrollment Limit:** 12

**Enrollment Preferences:** senior and then junior Biology majors

**Expected Class Size:** 12

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

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

**Distributions:** (D3)

**Attributes:** BIMO Interdepartmental Electives

Not offered current academic year

### **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, how errors are introduced and corrected, and how proteins are degraded. 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 4- to 5-page papers and participation in discussions

**Prerequisites:** BIOL 202 required; recommended BIOL 222 or BIOL 321

**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, yes fifth course option

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

**Distributions:** (D3)

**Attributes:** BIMO Interdepartmental Electives

Not offered current academic year

**BIOL 421 (F) 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)

**Attributes:** NSCI Group C Electives

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.

Fall 2021

TUT Section: T1 MWF 8:00 am - 8:50 am Manuel A. Morales

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

Increases in atmospheric CO<sub>2</sub> 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 CO<sub>2</sub>-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 430 (S) Genome Sciences: At the Cutting Edge (WS)**

Research in genomics has integrated and revolutionized the field of biology, including areas of medicine, plant biology, microbiology, and evolutionary biology. Moreover, recent developments in "metagenomics" (genomic studies of entire communities of microorganisms in natural environments, such as the mammalian gut and the deep sea) and "metatranscriptomics" (studies of genome wide changes in expression and mRNA levels in natural communities of organisms) have generated unprecedented knowledge about the genomic potential of a community and the in situ biological activity of different ecological niches. In this course we will explore how research in these and related areas, including proteomics, have advanced our fundamental understanding of (1) organisms in the three domains of life, and their interactions and evolutionary relationships; (2) biological systems and environments, such as the human body, extreme environments, and the oceans; (3) strategies for solving global challenges in medicine, agriculture, energy resources, and environmental sciences. During the course, students will meet each week for one hour with a tutorial partner and the instructor. Every other week, students will present a written and oral critical analysis of the assigned research articles. On alternate weeks, students will question/critique the work of their colleague.

**Requirements/Evaluation:** five (4-5 page) papers, tutorial presentations, and the student's effectiveness as a critic

**Prerequisites:** BIOL 202

**Enrollment Limit:** 10

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

**Expected Class Size:** 10

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

**Unit Notes:** BIMO, BIGP; does not satisfy the distribution requirement for the Biology major

**Distributions:** (D3) (WS)

**Writing Skills Notes:** Weekly written assignments consisting of four-page critique papers (five total during a semester) and two-page response papers (five total during a semester). Students will receive from the instructor timely comments on their writing skills, with suggestions for improvement.

**Attributes:** BIGP Courses BIMO Interdepartmental Electives

Not offered current academic year

### **BIOL 432 (F) Evolutionary Genetics**

The synthesis of evolutionary processes with the mechanistic understanding of genetics has lent insight into many mysteries of life. The goal of this course is to explore the interface between evolution and genetics to make sense of fundamental biological processes. For example, why do we expect that male and female offspring occur in 50:50 ratios? How and why do unusual sex-ratios occur? Other topics include: conflict among genes, evolution of allelic dominance, adaptation at the molecular level, and genetics of speciation. Class discussion and written assignments will emphasize critical evaluation and synthesis of the scientific literature.

**Requirements/Evaluation:** class participation and several short papers

**Prerequisites:** BIOL 202; open to juniors and seniors

**Enrollment Limit:** 12

**Enrollment Preferences:** seniors who have not taken a 400 level course, then juniors and Biology majors

**Expected Class Size:** 12

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

**Unit Notes:** satisfies the distribution requirement for the Biology major

**Distributions:** (D3)

Not offered current academic year

### **BIOL 435 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 genetics and evolution. Subsequently, we will explore how our metabolic environment has been altered in modern society and try to figure out what 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 Permission of Instructor.

**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:**

**Distributions:** (D3)

Not offered current academic year

### **BIOL 454 (F) Climate Change Physiology**

**Cross-listings:** BIOL 454 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.

**Class Format:** Synchronous discussions with in-person and remote option. Satisfies the distribution requirement for the Biology major.

**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

**Distributions:** (D3)

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

BIOL 454 (D3) ENVI 454 (D3)

**Attributes:** ENVI Natural World Electives

Not offered current academic year

### **BIOL 455 (S) Neural Regeneration**

**Cross-listings:** NSCI 455 BIOL 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)

**Attributes:** NSCI Group A Electives

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).

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

**Unit Notes:** senior majors and concentrators are required to participate in Biology Colloquium, which is scheduled for most Fridays at 1:10 pm

**Distributions:** (D3)

Fall 2021

HON Section: 01 F 1:10 pm - 2:25 pm Lois M. Banta

### **BIOL 494 (F)(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).

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

**Distributions:** (D3)



Fall 2021

HON Section: 01 TBA Cynthia K. Holland

Spring 2022

HON Section: 01 F 1:10 pm - 2:25 pm Lois M. Banta

### **BIOL 499 (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

Not offered current academic year

### **Winter Study -----**

### **BIOL 10 (W) The Queen's Gambit**

We live in an era of customization. Cars, shoes and even your shampoo can be customized to fit your specific needs. 3-D printing has now become a common tool for prototyping and production of complicated and precise forms that not only provide mechanical function but also joy. This course explores the language of design and creation by printing a chess set using 3-D printing and Fusion 360 software. Each student will use the Fusion 360 program to design a Pawn, Rook, Bishop, Knight, Queen and King forms in a style of their choosing. We will then work with the Makerspace to print and finish these pieces in the styling of your choice. Post-production work may include added weights, resin coating and/or painting. We will meet three times a week for 2-hour sessions in the Makerspace. The course will include in-class printing demonstrations, and digital problem solving to produce successful prints. Most printing will take place outside of class. Chess boards will be provided for research and development and playing chess will be strongly encouraged! Evaluation will be placed on the form and function of your finished chess board, as well as attendance and participation. A campus-wide chess competition will be hosted at the conclusion of the course. There is no prior experience in 3D design or playing chess required, but casually playing chess with peers is encouraged at the end of class time. Cost to Student: \$35 to cover printing and post-production supplies.

**Requirements/Evaluation:** final project or presentation

**Prerequisites:** none

**Enrollment Limit:** 12

**Enrollment Preferences:** via email

**Grading:** pass/fail only

**Unit Notes:** Kim Faler is an interdisciplinary artist, working with sculpture, painting and installation and most recently, digitally produced works. Her art focuses on the everyday experience, and the emotional weight that is tied-up in functional objects. Outside her art practice, she is the Production Manager at Knockout Designs; fabricating, designing and assembling 3-D printed PLA and metal components for beer taps throughout the country. She lives with her husband and daughter in North Adams, MA.

**Materials/Lab Fee:** \$35

Winter 2022

LEC Section: 01 MWF 10:00 am - 11:50 am Kim Faler

### **BIOL 11 (W) Teaching 3rd Grade about Zebrafish--BioEYES**

BioEYES brings tropical fish to 3rd-grade classrooms in Williamstown, Lanesborough and North Adams Elementary schools for a science teaching workshop. Elementary school students will breed fish at the school, then study their development and pigmentation throughout one week. Williams students will adapt BioEYES lesson plans to the science curriculum for the schools we visit, work with classroom teachers to introduce concepts in genetics and development, help the 3rd-grade students in the classroom, and assess elementary student learning. No zebrafish experience is necessary; during the first week, students will learn to set up fish matings and learn about embryonic development and the genetics of fish

pigmentation as well as practice teaching the 3rd-grade BioEYES lesson plans with hands-on experiments using living animals. In the subsequent three weeks, students will present lessons at the schools and review assessment data. Time commitment: Week 1--approx. 6 hours total for program training and lesson preparation with additional outside-of-class time needed to create teaching posters, dates and times TBD Weeks 2 & 3--approx. 4 hours per day, times TBD dependent on elementary school schedules during regular school day between 8:30 am and 3:00 pm. Week 4--TBD; 4 hours per day if running a school program; minimal hours if not running an elementary school program. Renee Schiek currently serves as the liaison between Lanesborough Elementary School and the Williams Elementary Outreach, where Williams students teach hands-on science lessons at area elementary schools. She is a frequent substitute at Lanesborough ES and holds a degree in mechanical engineering. Martha Marvin is a Lecturer in Neuroscience at Williams College whose research focuses on heart development and stress responses in developing zebrafish embryos. She has facilitated Project BioEyes at Williams College since 2010.

**Requirements/Evaluation:** final project or presentation

**Prerequisites:** none

**Enrollment Limit:** 14

**Enrollment Preferences:** preference to seniors

**Grading:** pass/fail only

**Materials/Lab Fee:** none

**Attributes:** EXPE Experiential Education Courses

Winter 2022

LEC Section: 01 M-F 10:00 am - 3:50 pm Renee Schiek

### **BIOL 13 (W) Introduction 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 observation skills, their knowledge and 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 through 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. The course will meet twice a week for 4- to 5-hour sessions, primarily in the field. One field trip to a nearby state forest is scheduled for the fourth or fifth class meeting day. This day may extend to 4 p.m. Students are expected to have appropriate outdoor gear for winter. Aside from class time students are expected to: create journals and site maps of their team study areas, including all major features of the landscape, flora and fauna activity; visit their study spots everyday for a minimum of 2 hour of tracking journaling and data collection; Write a 3 page paper. Topic TBA; Make a group presentation of findings from their team study area; Complete assigned readings; Complete a field test of their tracking skills

**Requirements/Evaluation:** short paper and final project or presentation; field test of animal tracking skills

**Prerequisites:** none

**Enrollment Limit:** 15

**Enrollment Preferences:** preference given to seniors

**Grading:** pass/fail only

**Unit Notes:** Dan has been teaching animal tracking and other primitive living skills for almost two decades. He holds a level 3 Track and Sign certification from Cyber tracker international and works at nature centers and schools throughout New York and Massachusetts as well as running his own wilderness programs at Tamakoce Wilderness Programs in upstate NY.

**Materials/Lab Fee:** \$15

**Attributes:** EXPE Experiential Education Courses

Winter 2022

LEC Section: 01 TR 10:00 am - 2:50 pm Dan Yacobellis

### **BIOL 21 (W) Science Beyond Williams**

Science Beyond Williams allows upperclassman to pursue scientific research off-campus at a non-profit organization, government agency, medical school, or research university. In consultation with faculty, the student will find a mentor in whose lab s/he will work in WSP and a Williams faculty

member who will offer guidance before and during WSP.

**Class Format:** WSP Project

**Requirements/Evaluation:** 10-page paper and post-WSP public presentation to a relevant department or program on the goals and accomplishments of the project

**Prerequisites:** two semesters of relevant course work in science and/or mathematics

**Enrollment Limit:** 10

**Grading:** pass/fail only

Not offered current academic year

### **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

**Prerequisites:** none

**Enrollment Limit:** POI

**Grading:** pass/fail only

Winter 2022

RSC Section: 01 M-F Lois M. Banta

### **BIOL 25 (W) Tropical Marine Conservation**

**Cross-listings:** ENVI 25 BIOL 25

#### **Primary Cross-listing**

Tropical marine ecosystems such as coral reefs and mangrove forests are biodiversity 'hotspots'; they are home to an astounding variety of marine organisms, provide critical support for the livelihoods and food sources of millions of people, but are also highly vulnerable to human impacts such as climate change and overfishing. This winter study travel course will offer a unique combination of classroom, laboratory, and hands-on experiences in the scientific study, management, and restoration of tropical marine ecosystems using the Bahamian island of Eleuthera as a case study. Eleuthera is rich in marine diversity but still in the process of implementing management policies and practices for its many fisheries. As such, it presents a unique opportunity for students to experience conservation-in-action. Students will gain an understanding of the structure, function, and major threats facing tropical marine ecosystems. They will develop practical skills in conducting field surveys of tropical marine species and in implementing management and restoration strategies on the Island. They will also engage with the local community to understand the social and economic impacts of marine conservation policy and to explore alternative sustainable development strategies for subsistence fisheries that rely on these marine ecosystems. Students are expected to participate in 2 days travel and 13 days of research on the Island. The daily schedule will include field research and independent study. Students are expected to devote time each day to researching and writing a final paper that integrates their field studies, interviews, and policy research. Students will also use this time to prepare and deliver an oral slide presentation on their research the last two days of the trip.

**Requirements/Evaluation:** oral presentation and 5-page research paper

**Prerequisites:** BIOL 203 or ENVI 101 or ENVI 102 or MAST 311 or permission of instructors

**Enrollment Limit:** 8

**Enrollment Preferences:** preference will be given to BIOL and ENVI majors and concentrators

**Grading:** pass/fail only

**Materials/Lab Fee:** none

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

ENVI 25 BIOL 25

**Attributes:** EXPE Experiential Education Courses TRVL Winter Study Travel Course

Winter 2022

TVL Section: 01 Cancelled

### **BIOL 26 (W) Modern Marine Science**

**Cross-listings:** MATH 25 BIOL 26

#### **Secondary Cross-listing**

This travel course will be on site in Woods Hole, MA, home to three world renowned marine science centers: the National Oceanic and Atmospheric Administration (NOAA), the Marine Biological Laboratory (MBL) and the Woods Hole Oceanographic Institution (WHOI). Time will be spent shadowing professionals in their line of work, assisting research when possible (or watching), and also listening to lectures on different topics given by this adjunct professor or other experts.

**Requirements/Evaluation:** short paper and final project or presentation

**Prerequisites:** none (Or perhaps an intro biology course credit?)

**Enrollment Limit:** 8

**Enrollment Preferences:** students interested in a career in marine science will be preferred; then, students in the life sciences or other directly related field (ecological statistics, etc)

**Grading:** pass/fail only

**Unit Notes:** Jennifer Turek has a Master's in Zoology from the University of Otago in Dunedin, New Zealand studying the endangered and endemic Hector's dolphin. Recently, she has continued these marine mammal studies working with NOAA in Woods Hole, MA studying marine mammal acoustics, specifically the highly endangered North Atlantic Right Whale. She also manages the North Atlantic annual stock assessment reports as required by the Marine Mammal Protection Act and other Protected Species Branch efforts.

**Materials/Lab Fee:** \$1,500

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

MATH 25 BIOL 26

**Attributes:** TRVL Winter Study Travel Course

Winter 2022

TVL Section: 01 TBA Jennifer L. Wallace

### **BIOL 31 (W) Senior Thesis: Biology**

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

**Class Format:** independent study

**Grading:** pass/fail only

Winter 2022

HON Section: 01 TBA Lois M. Banta

### **BIOL 41 (W) Biology Through the Media Intensive**

Biology Through The Media explores the foundational concepts examined in the Department's introductory series (Biology 101 and Biology 102) by using the 'greatest hits' of stories that have made their way into the news outlets, television and film media. The first section of the course investigates cell structure and function in terms of energy needs and how information is conveyed in a cell. The last half the course will focus upon 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 any background in biology. As this class counts as both a semester course and winter study course, the students are expected to attend class and to spend a significant time on the course. The students should dedicate approximately 50 hours per week to this class. The number of topics we will cover is numerous and wide-ranging and will be done so at a faster rate than what is observed during a regular semester. Each afternoon, the TAs and myself will be available to support student learning of the material.

**Class Format:** Daily 10am- noon and 2-4pm (about 70 contact hours, plus 6 hours for quizzes and exams).

**Requirements/Evaluation:** Problem sets will be assigned daily. The students are expected to spend a significant amount of time on the homework problems each afternoon and to hand in their assigned work. Evaluation will be based on papers, quizzes and exams. Quizzes, exams and papers must be completed by the student alone, however, students may work together on the problem sets and in-class exercises.

**Prerequisites:** Permission of a dean.

**Enrollment Limit:** no limit

**Enrollment Preferences:** students who need to make up a deficiency

**Expected Class Size:** 20

**Grading:** pass/fail only

**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.

Winter 2022

LEC Section: 01 M-F 10:00 am - 12:00 pm M-F 2:00 pm - 4:00 pm 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 2022

IND Section: 01 TBA Lois M. Banta