BIOLOGY

Overview & Learning Goals

Learning Goals

General Competencies and Goals

The mission of Bowdoin College's biology department is to offer an educational program that informs, challenges, and stimulates undergraduates in a broad range of biological inquiry at many levels of organization, from biochemistry and molecular biology through population and ecosystem ecology. In addition to covering current and historical concepts and controversies in biology, the curriculum is designed to give students critical analytical, problem-solving, quantitative, and writing skills, thereby preparing them for further study in biology and related fields at the graduate level, in the health professions, in scientific education, or in other areas, depending upon the students' interests. Courses in the biology department also meet the needs of non-majors and contribute to general scientific literacy.

The goals of our curriculum are for students to acquire the ability to: (1) interpret biological knowledge; (2) undertake self-designed research through courses or independent research; (3) communicate outcomes of research; (4) apply biological concepts to novel situations; (5) apply knowledge from multiple fields to biological questions and vice versa.

Fundamental Concepts

Integrative Biology

1. Bioenergetics (from the level of molecules and cells to ecosystems)
2. Structure and function (compartmentalization, chemical basis of life, central dogma, emergent properties)
3. Balance of forces and trade-offs
4. Homeostasis and regulation (from signaling pathways to population regulation)
5. Evolution (phylogenetics, heredity, mechanisms of evolutionary change)
6. Ecology (species interactions, population biology, ecosystem processes, natural history)
7. Influence of biology on social issues (conservation, research practices, bioethics)

Ecology, Evolution, and Marine Biology

1. Environmental determinants of organismal structure and function
2. Energy flow through ecosystems
3. The regulation of populations
4. Population interactions
5. Structure, assembly, and dynamics of communities
6. Micro-evolutionary processes—from molecules to phenotypic traits
7. Macro-evolutionary processes—history of life, role of extinction, phylogenetic relationships
8. The relationship between genotype and phenotype
9. Applying ecological and evolutionary concepts to contemporary environmental and social issues

Molecular and Cellular Biology

1. Bioenergetics
2. Structure and function (cellular compartmentalization, the chemical basis of life, emergent properties in biological systems)
3. The manner in which information is stored in the genome and retrieved
4. Balance of forces and trade-offs
5. Homeostasis and regulation
6. Evolution (phylogenetics, heredity, mechanisms of evolutionary change)
7. Bioethics and social issues

Core Skills

1. Understanding and using the primary literature in support of research
2. Asking questions and generating testable hypotheses
3. Hypothesis testing and experimental design
4. Laboratory and field data collection
5. Data analysis, including statistical and quantitative analyses
6. Data interpretation
7. Written and oral communication and presentations

Options for Majoring or Minoring in the Department

Students may elect to major in biology or to coordinate a major in biology with digital and computational studies, education, or environmental studies. Students pursuing a coordinate major may not normally elect a second major. Non-majors may elect to minor in biology, with the exception of biochemistry and neuroscience majors.

Department Website (https://www.bowdoin.edu/biology/)

Faculty

Barry A. Logan, *Department Chair*
Rachel Reuling, *Department Coordinator*

Professors: Jack R. Bateman, David B. Carlon, Manuel Diaz-Rios (Neuroscience), Hadley Wilson Horch‡ (Neuroscience), Amy S. Johnson, Bruce D. Kohorn* (Biochemistry), Barry A. Logan, Michael F. Palopoli
Associate Professors: Vladimir Douhovnikoff, William R. Jackman, Anne E. McBride‡ (Biochemistry)
Assistant Professors: Patricia L. Jones, Daniel Powell (Neuroscience), Mary Rogalski (Environmental Studies)
Director of Bowdoin Scientific Station on Kent Island: Patricia Jones
Director of Schiller Coastal Studies Center: Holly Parker
Postdoctoral Scholar: Katherine DuBois
Adjunct Lecturer: Patsy Dickinson (spring semester)
Visiting Faculty: Jacob Muscato
Laboratory Instructors: Pamela J. Bryer, Shana Stewart Deeds, Aimee M. Eldridge, Kate R. Farnham, Anja Forche, Sandra Fussell, Janet Gannon, Stephen A. Hauptman, Kyle Martin, Bethany Whalon

Faculty/Staff Website (https://www.bowdoin.edu/biology/faculty-and-staff/)

Requirements
Biology Major

Students majoring in biology can meet their major requirements by completing either the Integrative Biology concentration, the Ecology, Evolution, and Marine Biology concentration, or the Molecular and Cellular Biology concentration. Each concentration consists of twelve courses, including at least eight courses in the department, exclusive of independent study or honors projects and courses below 1100.

Integrative Biology Concentration

Code	Title	Credits
Required Courses		
BIOL 1102	Biological Principles II	1
or BIOL 1109	Scientific Reasoning in Biology	
Select one of the following:		*1*
CHEM 1092	Introductory Chemistry and Quantitative Reasoning II	
CHEM 1102	Introductory Chemistry II	
CHEM 1109	General Chemistry	
any other CHEM course above 1109		
Select two courses higher than 1100 from any two of the following departments: [a]		**2**
computer science, earth and oceanographic science, physics, or MATH 1300 or higher.		
Select one 2000-level course (or above) in any of the natural sciences:		**1**
including biology (division a courses), or one course in MATH 1300 or higher.		
Select one core course from each of the three groups below: [b]		**3**
Group 1		
BIOL 2112	Genetics and Molecular Biology	
BIOL 2118	Microbiology	
BIOL 2124	Biochemistry and Cell Biology	
BIOL 2135	Neurobiology	
BIOL 2175	Developmental Biology	
Group 2		
BIOL 2135	Neurobiology	
BIOL 2175	Developmental Biology	
BIOL 2210	Plant Ecophysiology	
BIOL 2214	Comparative Animal and Human Physiology	
Group 3		
BIOL 2316	Evolution	
BIOL 2319	Biology of Marine Organisms	
BIOL 2327	Ecology	
Select four elective biology courses above 1100. [c]		**4**

a PSYC 2520 Data Analysis may also satisfy this requirement in place of MATH 1300 Biostatistics, or higher.

b Courses listed in more than one group may not be double-counted between groups.

c Two of the elective courses must be numbered higher than 2499.

Ecology, Evolution, and Marine Biology Concentration

Code	Title	Credits
Required Courses		
BIOL 1102	Biological Principles II	1
or BIOL 1109	Scientific Reasoning in Biology	
BIOL 3308	Research in Ecology, Evolution, and Marine Biology	1
Select one of the following:		*1*
CHEM 1092	Introductory Chemistry and Quantitative Reasoning II	
CHEM 1102	Introductory Chemistry II	
CHEM 1109	General Chemistry	
any other CHEM course above 1109		
Select one of the following:		*1*
a mathematics course 1300 or higher		
PSYC 2520	Data Analysis	
Foundation in Ecology, Evolution, and Marine Biology		
Select two of the following:		*2*
BIOL 2327	Ecology	
BIOL 2316	Evolution	
BIOL 2319	Biology of Marine Organisms	
or BIOL 2333	Benthic Ecology	
Breadth in the biological sciences		
Select one from each of the following groups:		*2*
Molecular and Cellular Biology		
BIOL 2112	Genetics and Molecular Biology	
BIOL 2118	Microbiology	
BIOL 2124	Biochemistry and Cell Biology	
BIOL 2175	Developmental Biology	
Integrative Physiology		
BIOL 2210	Plant Ecophysiology	
BIOL 2214	Comparative Animal and Human Physiology	
BIOL 2135	Neurobiology	
Advanced topics in Ecology, Evolution, and Marine Biology		
Select two from the advanced topics options:		*2*
BIOL 2503	Methods in Ocean Change Ecology	
BIOL 2557	Immunology	
BIOL 2581	Forest Ecology and Conservation	
BIOL 3280	Plant Responses to the Environment	
BIOL 3117	Current Topics and Research in Marine Science	
BIOL 3307	Evolutionary Developmental Biology	
BIOL 3309	Ecotoxicology: Pollution Impacts on Ecosystems and Human Health	
BIOL 3317	Molecular Evolution	
BIOL 3381	Ecological Genetics	
BIOL 3554	Biomechanics	
Natural and Computational Science		
Select two of the following:		*2*
BIOL 1101	Biological Principles I	
BIOL 1174	Biomathematics	
BIOL 2210	Plant Ecophysiology (if not used to meet another requirement)	
BIOL 2319	Biology of Marine Organisms (if not used to meet another requirement)	

BIOL 2333	Benthic Ecology (if not used to meet another requirement)	
BIOL 3314	Advanced Genetics and Epigenetics	
CHEM 2050	Environmental Chemistry	
CHEM 2250	Organic Chemistry I	
CSCI 1101	Introduction to Computer Science (or higher)	
ENVS 2004	GIS and Remote Sensing: Understanding Place	
ENVS 2201	Perspectives in Environmental Science	
EOS 1505	Oceanography	
EOS 2005	Biogeochemistry: An Analysis of Global Change	
EOS 2525	Marine Biogeochemistry	
PHYS 1130	Introductory Physics I	
or PHYS 114	Introductory Physics II	

Molecular and Cellular Biology Concentration

Code	Title	Credits
Required Courses [d]		
BIOL 1102	Biological Principles II	
or BIOL 1109	Scientific Reasoning in Biology	
Foundation in Molecular and Cellular Biology		**4**
BIOL 2112	Genetics and Molecular Biology	
BIOL 2124	Biochemistry and Cell Biology	
BIOL 2118	Microbiology	
or BIOL 2175	Developmental Biology	
BIOL 2316	Evolution	
BIOL 2130	Population Genomics	
Advanced Topics in Molecular and Cellular Biology		**1**
Select one of the following:		
BIOL 2551	Molecular Ecology	
BIOL 2553	Neurophysiology	
BIOL 2566	Molecular Neurobiology	
BIOL 2557	Immunology	
BIOL 3304	The RNA World	
BIOL 3307	Evolutionary Developmental Biology	
BIOL 3314	Advanced Genetics and Epigenetics	
BIOL 3317	Molecular Evolution	
BIOL 3333	Advanced Cell and Molecular Biology	
Seminar in Molecular and Cellular Biology		**1**
Select one from the following:		
BIOL 3304	The RNA World	
BIOL 3307	Evolutionary Developmental Biology	
BIOL 3314	Advanced Genetics and Epigenetics	
BIOL 3317	Molecular Evolution	
BIOL 3333	Advanced Cell and Molecular Biology	
Other Natural and Computational Science courses		
Select one of the following:		*1*
CHEM 1092	Introductory Chemistry and Quantitative Reasoning II	
CHEM 1102	Introductory Chemistry II	
CHEM 1109	General Chemistry	
Any other CHEM course above the introductory level		
CHEM 2250	Organic Chemistry I	1
Select two physical, mathematical, statistical, or computational courses, each from a different group below:		**2**
Computer Science above 1100		
Physics above 1100		
Math above 1299 or PSYC 2520		
Select one of the following:		**1**
BIOL 1101	Biological Principles I	
Any BIOL course numbered 2000 or higher		
CHEM 2320	Biochemistry	

[d] Courses listed in more than one requirement may not be double-counted between requirements.

Biology Minor

The minor consists of five courses within the department, exclusive of independent study and courses below the 1100 level.

Code	Title	Credits
Required Courses		
BIOL 1102	Biological Principles II	1
or BIOL 1109	Scientific Reasoning in Biology	
Select two core courses. [e,f,g]		2
Select two elective biology courses above 1100.		2

[e] To focus on integrative biology, take one course from two different core groups of the Integrative Biology core course group list.

[f] To focus on ecology, evolution, and marine biology, take two courses from the Foundation in Ecology, Evolution, and Marine Biology requirement list.

[g] To focus on molecular and cellular biology, take two courses from the Foundation in Molecular and Cellular Biology requirement list.

Additional Information

Additional Information and Department Policies

Students are advised to complete BIOL 1102 Biological Principles II or BIOL 1109 Scientific Reasoning in Biology and courses in chemistry for the major by the end of the sophomore year. Students planning postgraduate education in science or the health professions should note that graduate and professional schools may have additional admissions requirements in chemistry, mathematics, and physics. It is strongly advised that students consult with faculty on the design of their major and discuss the options of research projects through independent studies, fellowship-funded summer research, and honors projects. Students planning careers in the health professions should contact Seth Ramus (https://www.bowdoin.edu/profiles/staff/sramus/), director of health professions advising.

The biology department participates in the biochemistry (https://bowdoin-public.courseleaf.com/departments-programs/biochemistry/), environmental studies, (https://bowdoin-public.courseleaf.com/departments-programs/environmental-studies/) and neuroscience (https://bowdoin-public.courseleaf.com/departments-programs/neuroscience/) programs. Students majoring or minoring in biology may not also major in biochemistry or neuroscience.

With departmental approval, students are allowed to count courses taken at a different college or university toward the major. Normally no more

than two transfer credits can be applied to the biology major and no more than one transfer credit can be applied to the biology minor.

Advanced Placement or International Baccalaureate credits may not be used to fulfill any of the course requirements for the major.

Electives for the biology major or minor may be double-counted in a second department or program.

Grade Requirements

Only one D grade is allowed in courses required for the major or minor. This D must be offset by a grade of B or higher in another course also required for the major or minor. Courses that count toward the major or minor must be taken for regular letter grades (not Credit/D/Fail).

Information for Incoming Students (p. 4)

Most students interested in exploring biology at Bowdoin start by taking either BIOL 1101 Biological Principles I or BIOL 1109 Scientific Reasoning in Biology. BIOL 1101 Biological Principles I is the first of a two-semester introductory biology sequence. Each year BIOL 1101 Biological Principles I is offered in the fall semester and BIOL 1102 Biological Principles II is offered in the spring semester, allowing students to explore 2000-level biology courses in the following year. BIOL 1109 Scientific Reasoning in Biology is a one-semester introductory biology course that prepares students to explore 2000-level courses in subsequent semesters. BIOL 1109 Scientific Reasoning in Biology is offered every semester.

Incoming first-year students who complete the biology placement exam and the quantitative reasoning (QR) exam receive one of the four recommendations below:

- Enroll in BIOL 1101 Biological Principles I
- Contact Pamela Bryer (https://www.bowdoin.edu/profiles/staff/pbryer/) to discuss placement (this category is reserved for those on the boundary of a recommendation of BIOL 1101 Biological Principles I or BIOL 1109 Scientific Reasoning in Biology)
- Enroll in BIOL 1109 Scientific Reasoning in Biology
- Enroll in a 2000-level biology course (a small number of students receive this placement; students seeking this placement should contact Professor Barry Logan (https://www.bowdoin.edu/profiles/faculty/blogan/))

Incoming first-year students should take the biology placement and QR exams in the summer prior to matriculation. AP/IB scores are considered in combination with information from biology placement and QR exams in recommending placements. A placement recommendation is required for a student to request a biology course numbered above 1099 during course registration.

If a student did not complete these exams in the summer prior to matriculation but wishes to enroll in a biology department course, they should complete the biology placement test immediately and inform Pamela Bryer (https://www.bowdoin.edu/profiles/staff/pbryer/) once completed so that a recommendation can be made for them.

Courses

BIOL 1023 (a) Personal Genomes
Non-Standard Rotation. Enrollment limit: 16.

An introduction to the field of genetics and its impact on the modern world. As the cost of DNA sequence analysis plummets, many believe that sequencing entire genomes of individuals will soon become part of routine preventative health care. How can information gleaned from genome affect decisions about health? Beyond medical applications, how might personal genetic information be used in other areas of life, and society as a whole? What ethical, legal, and social issues are raised by widespread use of genetic information? These questions are explored through readings, discussion, and writing assignments.

Previous terms offered: Fall 2020.

BIOL 1026 (a) Approaches to Neuroscience
Non-Standard Rotation. Enrollment limit: 16.

Students will be introduced to the basics of neurobiology, and begin to understand the challenges inherent to studying the brain. Topics will include basic neuronal function, animal behavior, mutations and mental illness, drugs and addiction, neuroethics, and consciousness. Readings from journal articles, websites, and popular press science books will be used. Critical thinking skills will be practiced through several writing assignments as well as in-class discussions and debates.

Previous terms offered: Fall 2022, Fall 2020, Fall 2019.

BIOL 1027 (a) Evolutionary Links
William Jackman.
Non-Standard Rotation. Spring 2024. Enrollment limit: 16.

Seminar exploring our deep evolutionary history from the first multicellular animals to Homo sapiens. Emphasizes the living and fossil species that illustrate important transitions that resulted in the evolution of new anatomical features, physiology, and behavior. Includes an embryo observation unit with data collection and analysis. Readings from online media, popular science books, and primary scientific articles. Frequent writing with an emphasis on styles used in modern biology.

BIOL 1056 (a, INS) Ecology and Society
Vladimir Douhovnikoff.
Non-Standard Rotation. Fall 2023. Enrollment limit: 50.

Explores the basic principles of ecology and environmental science to better understand the interactions between humans and their environment (biotic and abiotic). Weekly readings and labs using ecosystem simulators will be used to explore ecological dynamics and the application of the scientific method. Class discussions will focus on the application of ecological principles to the understanding of societal issues. The relevance of ecology to society will be an area of concentration, with emphasis on natural resource use, conservation, and public health. Professionals in a broad range of relevant fields will join us for discussions. (Same as: ENVS 1056)

Previous terms offered: Spring 2023, Spring 2022, Fall 2021, Fall 2020.

BIOL 1060 (a, INS, MCSR) Prove It!: The Power of Data to Address Questions You Care About
Mary Rogalski.
Non-Standard Rotation. Spring 2024. Enrollment limit: 24.

Climate change, biodiversity loss, pollution, and other environmental issues present significant threats to ecological integrity, human health, and social justice. An overwhelming amount of information exists on these topics, from a variety of perspectives—some reliable, some not. Strategies are required for processing this information and drawing conclusions. Students develop skills in accessing reliable information, data analysis, and interpretation, as well as science communication. (Same as: ENVS 1060)

Previous terms offered: Spring 2022.

BIOL 1061 (a, INS) Life in Changing Seas
Non-Standard Rotation. Enrollment limit: 50.

Discover the living worlds in the oceans and estuaries of our planet. Life in the sea is incredibly diverse, and iconic marine ecosystems (e.g., kelp forests and coral reefs) support complex communities of marine species. Life in the sea is also increasingly important to supporting human populations through food provision and mitigation of climate change. This course, intended for non-science majors, will build a broad knowledge base of different marine ecosystems. Special attention will also be given to Maine's marine ecosystems and connections between Maine's modern economy and the sea, as well as traditional use of Maine's coastal habitats by Native peoples. It will also overview important ocean-based ecosystem services and how these are threatened by climate change and overexploitation. This course will include lecture, discussions, and hands-on exploration of local marine life.

Previous terms offered: Spring 2021.

BIOL 1066 (a, INS) The Molecules of Life
Every Other Spring. Enrollment limit: 50.

An exploration of the basic molecules of life. Starting with DNA we will explore how cells use and pass on this stored information to produce a variety of products used to form cells and organisms. This basic science will be related to every-day examples of biology, health, agriculture, and social issues arising from these applications; genetic modification for health and food production, drug and vaccine development, C02 and our warming the planet. Hands-on experience with DNA, protein, lipids and complex carbohydrates will be included in the regular class meeting time. The class will be a combination of lecture, discussion and exploration in a lab setting and outdoors.

Previous terms offered: Spring 2021, Spring 2020.

BIOL 1068 (a, INS) Cancer Biology
Non-Standard Rotation. Enrollment limit: 32.

Examines the biological basis of cancer, including the role of oncogenes and tumor suppressors in regulating how the cell divides, how environmental agents and viruses can induce DNA mutations leading to cancerous growth, and the genetic basis of cancerous cells. Examines diagnostic procedures and explores emerging technologies that are developing new treatments based on cancer cell characteristics.

Previous terms offered: Fall 2020, Spring 2020, Fall 2019.

BIOL 1069 (a, INS) The Microbial World: Small Creatures, Big Impacts
Non-Standard Rotation. Enrollment limit: 50.

Microscopic organisms, microbes, are found in soil, water, air, the human body, and practically every other habitat imaginable. They play central roles in causing and controlling disease, shaping the environment, producing important foods and medicines, and countless other processes on Earth. Examines the diverse ways in which microbes shape the world with emphasis on molecular mechanisms, microbial evolution, and scientific techniques. Enhances understanding of the natural world and the scientific process using primary and secondary literature, data-focused problem solving, and guided research projects. Assumes no background in science.

Previous terms offered: Fall 2022.

BIOL 1090 (a, INS) Understanding Climate Change
Every Spring. Enrollment limit: 20.

Why is the global climate changing and how will biological systems respond? Includes sections on climate systems and climate change, reconstructing ancient climates and past biological responses, predicting future climates and biological responses, climate policy, the energy crisis, and potential solutions. Incorporates a few field trips and laboratories designed to illustrate approaches to climate change science at the cellular, physiological, and ecological levels. (Same as: ENVS 1090)

Previous terms offered: Spring 2021.

BIOL 1095 (a, INS) Perspectives in Ecology: Seeking Solutions to Challenging Problems
Non-Standard Rotation. Enrollment limit: 50.

In this era of climate change, human impacts on ecosystems and questions of how to protect and restore ecosystems are at the forefront of ecology. In this course, we will explore human-environment relationships and topics of human-induced ecological disturbance, such as climate change, land-use change, and development through data analysis, lectures, and readings. We will read fantasy, science-fiction, nonfiction, op-eds, and journalism pieces written from a diverse range of perspectives and use these readings as a framework for understanding the current state of ecology with a specific focus on ecosystem restoration and climate change. Students will develop written and verbal communication skills in addition to broadening their understanding of ecology and scientific rigor, with a goal of understanding the issues in modern ecology and seeking and validating solutions.

Previous terms offered: Spring 2021.

BIOL 1099 (a, INS) Brains in Motion: Exploring the Interface between Mind and Body
Manuel Diaz-Rios.
Every Fall. Fall 2023. Enrollment limit: 24.

This course is an introductory exploration of the nervous system as it relates to bodily functions. It explores neurons as the basic building blocks of brain and behavior. Through lectures and classroom experiments, students would learn how electrochemical nerve signals control body movement, cardiovascular function, reflexes, and brain activity. Further, students explore how the nervous system can interact with machine interfaces, including prosthetics. (Same as: NEUR 1099)

Previous terms offered: Fall 2022, Fall 2021, Spring 2021, Fall 2020.

BIOL 1101 (a, INS, MCSR) Biological Principles I
Kate Farnham; Jack Bateman.
Every Fall. Fall 2023. Enrollment limit: 35.

The first in a two-semester introductory biology sequence. Topics include fundamental principles of cellular and molecular biology with an emphasis on providing a problem-solving approach to an understanding of genes, RNA, proteins, and cell structure and communication. Focuses on developing quantitative skills, as well as critical thinking and problem solving skills. Lecture and weekly laboratory/discussion groups. To ensure proper placement, students must take the biology placement examination and must be recommended for placement in Biology 1101. Students continuing in biology will take Biology 1102 , not Biology 1109 , as their next biology course.

Prerequisites: Placement in BIOL 1101.

Previous terms offered: Fall 2022, Fall 2021, Fall 2020, Fall 2019.

BIOL 1102 (a, INS, MCSR) Biological Principles II
Amy Johnson; Barry Logan.
Every Spring. Spring 2024. Enrollment limit: 35.

The second in a two-semester introductory biology sequence. Emphasizes fundamental biological principles extending from the physiological to the ecosystem level of living organisms. Topics include physiology, ecology, and evolutionary biology, with a focus on developing quantitative skills as well as critical thinking and problem solving skills. Lecture and weekly laboratory/discussion groups.

Prerequisites: BIOL 1101.

Previous terms offered: Spring 2023, Spring 2022, Spring 2021, Spring 2020.

BIOL 1109 (a, INS, MCSR) Scientific Reasoning in Biology
Pamela Bryer; Bruce Kohorn; Patricia Jones; Michael Palopoli; Barry Logan.
Every Semester. Fall 2023; Spring 2024. Enrollment limit: 40.

Lectures examine fundamental biological principles, from the sub-cellular to the ecosystem level with an emphasis on critical thinking and the scientific method. Laboratory sessions will help develop a deeper understanding of the techniques and methods used in the biological science by requiring students to design and conduct their own experiments. Lecture and weekly laboratory/discussion groups. To ensure proper placement, students must take the biology placement examination and must be recommended for placement in Biology 1109.

Prerequisites: Placement in BIOL 1109.

Previous terms offered: Spring 2023, Fall 2022, Spring 2022, Fall 2021, Spring 2021, Fall 2020, Spring 2020, Fall 2019.

BIOL 1158 (a, INS, MCSR) Perspectives in Environmental Science
Phil Camill; Brandon Tate; Shana Stewart Deeds.
Every Spring. Spring 2024. Enrollment limit: 35.

Understanding environmental challenges requires scientific knowledge about the different spheres of the Earth -- land, water, air, and life -- and how they interact. Presents integrated perspectives across the fields of biology, chemistry, and earth and oceanographic science to examine the scientific basis for environmental change from the molecular to the global level. Foundational principles are developed to address major course themes, including climate change, energy, soil/air/water pollution, chemical exposure and risk, land use change, and biodiversity loss. Laboratory sessions consist of local field trips, laboratory experiments, group research, case study exercises, and discussions of current and classic scientific literature. (Same as: ENVS 2201, CHEM 1105)

Prerequisites: BIOL 1101 or BIOL 1109 or CHEM 1091 - 2260 or PHYS 1130 or PHYS 1140 or EOS 1105 or EOS 1305 (same as ENVS 1104) or EOS 1505 (same as ENVS 1102) or EOS 2005 (same as ENVS 2221) or EOS 2115 or EOS 2335 or EOS 2345 (same as ENVS 2270) or EOS 2365 or EOS 2525 (same as ENVS 2251) or EOS 2535 or EOS 2585 (same as ENVS 2282) or ENVS 1101.

Previous terms offered: Spring 2023, Spring 2022, Spring 2021, Spring 2020.

BIOL 1174 (a, MCSR) Biomathematics
Every Fall. Enrollment limit: 30.

A study of mathematical modeling in biology, with a focus on translating back and forth between biological questions and their mathematical representation. Biological questions are drawn from a broad range of topics, including disease, ecology, genetics, population dynamics, and neurobiology. Mathematical methods include discrete and continuous (ODE) models and simulation, box models, linearization, stability analysis, attractors, oscillations, limiting behavior, feedback, and multiple time-scales. Within the biology major, this course may count as the mathematics credit or as biology credit, but not both. Students are expected to have taken a year of high school or college biology prior to this course. (Same as: MATH 1808)

Prerequisites: MATH 1600 or higher or Placement in MATH 1700 (M) or Placement in MATH 1750 (M) or Placement in MATH 1800 (M) or Placement in 2000, 2020, 2206 (M) or Placement in MATH 2020 or 2206 (M).

Previous terms offered: Spring 2023, Spring 2022, Fall 2020, Fall 2019.

BIOL 2024 Science Communication
Non-Standard Rotation. Enrollment limit: 20.

Scientists are communicators, using images, graphical representations, written and spoken words to convey their findings. Those findings achieve their greatest impact through dissemination; a research project is not complete until it has been described for others. Mindfulness of the intended audience and the goals of communication dictate the most suitable forms. Explores and develops effective communication with peer scientists, potential funders (i.e., grant proposals), non-specialist scientists, children and adult lay audiences through written work, presentations, posters, displays, podcasts, short videos and documentary films. Involves individual and group projects, critiques, site visits, and engagement with scientists and communication professionals (including journalists, filmmakers and museum curators).

Prerequisites: BIOL 1100 - 2969 or BIOL 3000 or higher or CHEM 1100 - 2969 or CHEM 3000 or higher or EOS 1100 - 2969 or EOS 3000 or higher or PHYS 1100 - 2969 or PHYS 3000 or higher.

Previous terms offered: Fall 2022, Spring 2021.

BIOL 2112 (a, INS, MCSR) Genetics and Molecular Biology
Jack Bateman; Aimee Eldridge.
Every Spring. Spring 2024. Enrollment limit: 35.

Integrated coverage of organismic and molecular levels of genetic systems. Topics include modes of inheritance, the structure and function of chromosomes, the mechanisms and control of gene expression, recombination, mutagenesis, techniques of molecular biology, and human genetic variation. Laboratory sessions are scheduled.

Prerequisites: BIOL 1102 or BIOL 1109 or Placement in BIOL 2000 level.

Previous terms offered: Spring 2023, Spring 2022, Spring 2021, Spring 2020.

BIOL 2118 (a, INS) Microbiology
Jake Muscato; Sandra Fussell.
Every Spring. Spring 2024. Enrollment limit: 35.

An examination of the structure and function of microorganisms, from viruses to bacteria to fungi, with an emphasis on molecular descriptions. Subjects covered include microbial structure, metabolism, and genetics. Control of microorganisms and environmental interactions are also discussed. Laboratory sessions every week.

Prerequisites: BIOL 1102 or BIOL 1109 or Placement in BIOL 2000 level.

Previous terms offered: Spring 2023, Spring 2022, Spring 2021, Spring 2020.

BIOL 2124 (a, INS, MCSR) Biochemistry and Cell Biology
Jake Muscato; Aimee Eldridge.
Every Fall. Fall 2023. Enrollment limit: 35.

Focuses on the structure and function of cells as we have come to know them through the interpretation of direct observations and experimental results. Emphasis is on the scientific (thought) processes that have allowed us to understand what we know today, emphasizing the use of genetic, biochemical, and optical analysis to understand fundamental biological processes. Covers details of the organization and expression of genetic information, and the biosynthesis, sorting, and function of cellular components within the cell. Concludes with examples of how cells perceive signals from other cells within cell populations, tissues, organisms, and the environment. Three hours of lab each week. Not open to students who have credit for Biology 2423. (Same as: BIOC 2124)

Prerequisites: BIOL 1102 or BIOL 1109 or Placement in BIOL 2000 level.

Previous terms offered: Fall 2022, Fall 2021, Fall 2020, Fall 2019.

BIOL 2130 (a, INS, MCSR) Population Genomics
David Carlon.
Every Year. Fall 2023. Enrollment limit: 35.

An exploration of the major processes that explain how genomic variation is organized within and between populations. Central topics include the molecular description of genetic variation, the organization of genetic variation within populations, mutation and gene conversion, migration, natural selection, genetic drift, using genomes to study population genetics, and the population genomics of complex traits. Lectures and discussions will develop theory and demonstrate applications of theory to a broad diversity of organisms. Laboratories will develop hands-on skills in the generation of genetic and genomic data sets and teach the analysis of genomic data sets. Familiarity with computer programming and/or the language R is strongly recommended.

Prerequisites: Two of: either BIOL 1102 or BIOL 1109 and either MATH 1300 - 2969 or MATH 3000 or higher.

BIOL 2135 (a, INS, MCSR) Neurobiology
Stephen Hauptman; Michael Fine.
Every Fall. Fall 2023. Enrollment limit: 35.

Examines fundamental concepts in neurobiology from the molecular to the systems level. Topics include neuronal communication, gene regulation, morphology, neuronal development, axon guidance, mechanisms of neuronal plasticity, sensory systems, and the molecular basis of behavior and disease. Weekly lab sessions introduce a wide range of methods used to examine neurons and neuronal systems. (Same as: NEUR 2135)

Prerequisites: BIOL 1102 or BIOL 1109 or Placement in BIOL 2000 level.

Previous terms offered: Fall 2022, Fall 2021, Fall 2020, Fall 2019.

BIOL 2175 (a, INS, MCSR) Developmental Biology
William Jackman; Sandra Fussell.
Every Fall. Fall 2023. Enrollment limit: 35.

An examination of current concepts of embryonic development, with an emphasis on experimental design. Topics include cell fate specification, morphogenetic movements, cell signaling, differential gene expression and regulation, organogenesis, and the evolutionary context of model systems. Project-oriented laboratory work emphasizes experimental methods. Lectures and three hours of laboratory per week.

Prerequisites: BIOL 1102 or BIOL 1109 or Placement in BIOL 2000 level.

Previous terms offered: Fall 2022, Fall 2021, Fall 2020, Fall 2019.

BIOL 2210 (a, INS, MCSR) Plant Ecophysiology
Barry Logan.
Every Spring. Spring 2024. Enrollment limit: 35.

Examines the functional attributes of plants and the manner in which they vary across the plant kingdom by the processes of evolution and acclimation. Topics of focus include photosynthesis and protection again high-light stress, the acquisition and distribution of water and mineral nutrients, and environmental and hormonal control of development. Special topics discussed may include plant parasitism, carnivory, the origins and present state of agriculture, plant responses to global climate change, plant life in extreme environments, and the impacts of local land-use history on plant communities. Contemporary research instrumentation is used in weekly laboratories, some conducted in the field, to enable first-hand exploration of phenomena discussed in lecture. (Same as: ENVS 2223)

Prerequisites: BIOL 1102 or BIOL 1109 or Placement in BIOL 2000 level.

Previous terms offered: Spring 2023, Fall 2020, Fall 2019.

BIOL 2214 (a, INS, MCSR) Comparative Animal and Human Physiology
Patsy Dickinson; Stephen Hauptman.
Every Spring. Spring 2024. Enrollment limit: 35.

An examination of animal function, from the cellular to the organismal level. The underlying concepts are emphasized, as are the experimental data that support current understanding of animal function. Topics include the nervous system, hormones, respiration, circulation, osmoregulation, digestion, and thermoregulation. Labs are short, student-designed projects involving a variety of instrumentation. Lectures and four hours of laboratory work per week.

Prerequisites: BIOL 1102 or BIOL 1109 or Placement in BIOL 2000 level.

Previous terms offered: Spring 2023, Spring 2022, Spring 2021, Spring 2020.

BIOL 2284 (a) Ecology of Rivers
Vladimir Douhovnikoff.
Every Other Fall. Fall 2023. Enrollment limit: 12.

Explories the ecology of river systems. Rivers are linear features through watersheds and across the landscape where ecosystem influences are reflected, focused, and transported from hilltops to coastal estuaries, and sometimes back again. Considers the role of rivers as corridors connecting a wide range of ecosystems, as indicators of broader landscape ecology, and as ecosystems in their own right with particular focus on the interaction of geomorphology, hydrology, and biology in the development and function of these dynamic and essential ecosystems. (Same as: ENVS 2284)

Prerequisites: BIOL 2315 (same as ENVS 2224) or BIOL 2316 or BIOL 2319 (same as ENVS 2229) or BIOL 2325 (same as ENVS 2225) or BIOL 2330 (same as ENVS 2233).

Previous terms offered: Fall 2021.

BIOL 2311 (a, INS, MCSR) Coral Reefs in the Anthropocene
Non-Standard Rotation. Enrollment limit: 35.

Coral reefs are the largest biogenic structures on earth that support exceptional levels of biodiversity in all the branches of the tree of life. They also face multiple threats due to human activities, including increased ocean acidity that is reducing reef construction, major coral bleaching events that are increasing in intensity and frequency, overfishing of increasingly limited wild fisheries stocks, and changes in land use in tropical nations and islands that can have strong local impacts on reef health. This course will explore the geological processes that build coral reefs, and the ecological and evolutionary processes that maintain exceptionally high levels of biodiversity. It will apply theory and data to the challenges now confronting coral reef ecosystems, and their future prospects. The class will include lectures, discussions, weekly lab meetings, and field trips.. (Same as: ENVS 2211)

Prerequisites: BIOL 1102 or BIOL 1109 or Placement in BIOL 2000 level or CHEM 1092 or CHEM 1102 or CHEM 1109 or Placement in CHEM 2000 level or Placement in CHEM 2000/1109 or ENVS 2201 (same as BIOL 1158 and CHEM 1105) or MATH 1001 - 2969 or Placement in MATH 1600 (M) or Placement in MATH 1700 (M) or Placement in MATH 1750 (M) or Placement in MATH 1800 (M) or Placement in MATH 1808 {2108} (M) or Placement in MATH 2020 or 2206 (M) or Placement in 2000, 2020, 2206 (M) or PHYS 1130 or PHYS 1140 or Placement in PHYS 1140.

Previous terms offered: Fall 2020.

BIOL 2316 (a, INS, MCSR) Evolution
Bethany Whalon; Michael Palopoli.
Every Spring. Spring 2024. Enrollment limit: 35.

Examines one of the most breathtaking ideas in the history of science – that all life on this planet descended from a common ancestor. An understanding of evolution illuminates every subject in biology, from molecular biology to ecology. Provides a broad overview of evolutionary ideas, including the modern theory of evolution by natural selection, evolution of sexual reproduction, patterns of speciation and macro-evolutionary change, evolution of sexual dimorphisms, selfish genetic elements, and kin selection. Laboratory sessions are devoted to semester-long, independent research projects.

Prerequisites: BIOL 1102 or BIOL 1109 or Placement in BIOL 2000 level.

Previous terms offered: Spring 2023, Spring 2022, Spring 2021, Spring 2020.

BIOL 2319 (a, INS, MCSR) Biology of Marine Organisms
Bethany Whalon; Amy Johnson.
Every Fall. Fall 2023. Enrollment limit: 35.

The study of the biology and ecology of marine mammals, seabirds, fish, intertidal and subtidal invertebrates, algae, and plankton. Also considers the biogeographic consequences of global and local ocean currents on the evolution and ecology of marine organisms. Laboratories, field trips, and research projects emphasize natural history, functional morphology, and ecology. Lectures and four hours of laboratory or field trip per week. One weekend field trip included. Students have the opportunity to take an optional field trip to the Bowdoin Scientific Station on Kent Island in the Bay of Fundy. (Same as: ENVS 2229)

Prerequisites: BIOL 1102 or BIOL 1109 or Placement in BIOL 2000 level.

Previous terms offered: Fall 2022, Fall 2021, Fall 2020.

BIOL 2327 (a, INS) Ecology
Patricia Jones; Shana Stewart Deeds.
Every Fall. Fall 2023. Enrollment limit: 35.

Ecology, the study of how organisms interact with each other and their environment, incorporates topics from how organisms cope with environmental stressors to global carbon cycling. Addresses current questions in ecology, from global change to food security to invasive species. Lectures, labs, primary and popular literature emphasize how scientists use the tenets of ecology to address current environmental issues. Labs, discussions and activities focus on practical applications of ecological theory, scientific writing and data analysis on topics such as plant-insect interactions, amphibian decline, river restoration and natural history. (Same as: ENVS 2227)

Prerequisites: BIOL 1102 or BIOL 1109 or ENVS 2201 (same as BIOL 1158 and CHEM 1105) or Placement in BIOL 2000 level.

Previous terms offered: Fall 2022, Fall 2021, Fall 2020, Fall 2019.

BIOL 2333 (a, INS, MCSR) Benthic Ecology
Katie DuBois; Jaret Reblin; Holly Parker.
Every Fall. Fall 2023. Enrollment limit: 15.

The principles of ecology, emphasizing the hard- and soft-bottom communities of Casco Bay and Harpswell Sound. Field trips and field exercises demonstrate the quantitative principles of marine ecological research, including good practices in sampling designs and field experiments. A class field project designs and implements a long-term study, based at the Bowdoin Marine Laboratory, to monitor and detect changes in community structure driven by climate change in the twenty-first century. Assumes a basic knowledge of biological statistics. Taught in residence at the Schiller Coastal Studies Center as part of the BCSS, Bowdoin Coastal Studies Semester program. (Same as: ENVS 2333)

Prerequisites: Two of: either BIOL 1102 or BIOL 1109 or Placement in BIOL 2000 level or either CHEM 1102 or CHEM 1109 or Placement in CHEM 2000 level or either EOS 1305 (same as ENVS 1104) or EOS 1505 (same as ENVS 1102) or EOS 2005 (same as ENVS 2221) or PHYS 1140 and MATH 1000 or higher.

Previous terms offered: Fall 2022, Fall 2019.

BIOL 2423 (a, INS) Biochemistry of Cellular Processes
Jake Muscato.
Non-Standard Rotation. Spring 2024. Enrollment limit: 35.

Explores the biochemical mechanisms that underlie the basis of life. Starts with the chemistry of proteins, DNA, lipids, and carbohydrates to build the main elements of a cell. Moves on to the process of gene organization and expression, emphasizing the biochemical mechanisms that regulate these events. Explores next the organization of the cell with emphasis on genetic and biochemical regulation. Concludes with specific examples of multicellular interactions, including development, cancer, and perception of the environment. This course does NOT satisfy a requirement for the biochemistry major and is not open to students who have credit for Biology 2124. Students who intend to enroll in Biology 2124 should not register for Biology 2423. (Same as: BIOC 2423)

Prerequisites: Two of: either BIOL 1102 or BIOL 1109 or BIOL 2100 or higher and CHEM 1092 or either CHEM 1102 or CHEM 1109 or CHEM 2250.

Previous terms offered: Spring 2023, Spring 2022, Spring 2021, Spring 2020.

BIOL 2503 (a, INS, MCSR) Methods in Ocean Change Ecology
Every Fall. Enrollment limit: 12.

Explores how marine organisms, populations, communities, and ecosystems will respond to global ocean change. Concepts in ecology, behavior, physiology, and evolution will be highlighted to demonstrate how marine systems are affected by ocean change factors like warming, ocean acidification, hypoxia, habitat loss, and invasive species. Emphasizes in-depth discussion of key literature to exemplify the theory, study design, and analysis tools marine scientists employ to research current and projected ocean change. Also integrates laboratory, fieldwork, and computer activities to illustrate approaches to monitoring and predicting shifts in biological communities. Taught in residence at the Schiller Coastal Studies Center. Biology 2503/Environmental Studies 2235 is a course-module in the Bowdoin Marine Science Semester. Biology 2232 (same as Environmental Studies 2232), Biology 3117 (same as Environmental Studies 2217), and History 2129 (same as Environmental Studies 2449) are co-requisites of this course. (Same as: ENVS 2235)

Prerequisites: Two of: either BIOL 1102 or BIOL 1109 and MATH 1000 or higher.

Previous terms offered: Fall 2022, Fall 2021, Fall 2019.

BIOL 2510 (a, INS) Neuropharmacology
Manuel Diaz-Rios; Tina Rioux.
Every Spring. Spring 2024. Enrollment limit: 24.

This course will discuss drug-induced changes in the functioning of the nervous system. The specific focus will be to provide a description of the cellular and molecular actions of drugs (natural or artificial) on the communication between neurons (known as synaptic transmission) and on the production of behaviors such as walking, breathing, heart function, and learning/memory, among others. This course will also refer to specific diseases of the nervous system and their treatment, in addition to giving an overview of the techniques used for the study of neuropharmacology. The lab portion of this course would involve the dissection and handling of mouse tissue. If you are not comfortable with the idea of dissecting mice you should not take this course. (Same as: NEUR 2510)

Prerequisites: Two of: either BIOL 1102 or BIOL 1109 and either BIOL 2135 (same as NEUR 2135) or BIOL 2214 (same as NEUR 2214) or PSYC 2050 (same as NEUR 2050).

Previous terms offered: Spring 2023, Spring 2022, Spring 2021, Spring 2020.

BIOL 2553 (a, INS) Neurophysiology
Tina Rioux; Daniel Powell.
Every Fall. Fall 2023. Enrollment limit: 20.

A comparative study of the function of the nervous system in invertebrate and vertebrate animals. Topics include the mechanism that underlie both action potentials and patterns of spontaneous activity in individual nerve cells, interactions between neurons, and the organization of neurons into larger functional units. Lectures and four hours of laboratory work per week. (Same as: NEUR 2553)

Prerequisites: Two of: either BIOL 1102 or BIOL 1109 and either BIOL 2135 or BIOL 2214 or PSYC 2050.

Previous terms offered: Fall 2022, Fall 2021, Fall 2020, Fall 2019.

BIOL 2557 (a, INS) Immunology
Non-Standard Rotation. Enrollment limit: 35.

Covers the development of the immune response, the cell biology of the immune system, the nature of antigens, antibodies, B and T cells, and the complement system. The nature of natural immunity, transplantation immunology, and tumor immunology also considered.

Prerequisites: BIOL 2112 or BIOL 2118 or BIOL 2124 (same as BIOC 2124) or BIOL 2175.

Previous terms offered: Fall 2021.

BIOL 2566 (a, INS) Molecular Neurobiology
Anja Forche; Michael Fine.
Every Spring. Spring 2024. Enrollment limit: 24.

Examination of the molecular control of neuronal structure and function. After understanding classic cloning techniques and experiments, students will learn more modern variations of techniques related to nucleic acid sequencing, protein visualization, and genetic manipulation. Additional topics such as intracellular signaling, neurotrophins and cell death, growth cone guidance, and the molecular basis of learning and memory are covered. The final portion of the course revolves around pathological disorders, such as Alzheimer's disease and spinal cord injuries, culminating in an independent investigation of the molecular basis of a neurological disorder of each student's choosing. Students will gain experience reading and interpreting primary research articles, working collaboratively in small groups, and communicating scientifically. Weekly laboratory sessions are devoted to exploring the molecular basis of compensatory plasticity in the cricket auditory system. (Same as: NEUR 2566)

Prerequisites: Two of: either BIOL 1102 or BIOL 1109 or Placement in BIOL 2000 level and either BIOL 2112 or BIOL 2124 (same as BIOC 2124) or BIOL 2135 (same as NEUR 2135) or BIOL 2553 (same as NEUR 2553) or PSYC 2050 (same as NEUR 2050).

Previous terms offered: Spring 2023, Spring 2022, Spring 2021, Spring 2020.

BIOL 3117 (a, INS, MCSR) Current Topics and Research in Marine Science
Olaf Ellers; Jaret Reblin; Holly Parker.
Every Fall. Fall 2023. Enrollment limit: 12.

Current Topics and Research in Marine Science is an experiential research course in which students design and carry out an individual semester long research project. In an advanced seminar setting, students choose topics and learn to (1) search for information in the scientific literature; (2) evaluate the utility of papers to their research topic; (3) identify gaps in existing understanding; (4) formulate hypothesis-driven research questions; and (5) utilize the R programming environment for analysis and presentation of scientific data. Ultimately, students design and carry out a research project that includes integration of their understanding of the scientific literature. Students present their results in a final oral presentation and written paper. Taught in residence at the Schiller Coastal Studies Center as part of the BCSS, Bowdoin Coastal Studies Semester program. (Same as: ENVS 2217)

Prerequisites: Two of: either BIOL 1102 or BIOL 1109 or Placement in BIOL 2000 level or either CHEM 1102 or CHEM 1109 or Placement in CHEM 2000 level or either EOS 1305 (same as ENVS 1104) or EOS 1505 (same as ENVS 1102) or EOS 2005 (same as ENVS 2221) or PHYS 1140 and MATH 1000 or higher.

Previous terms offered: Fall 2022, Fall 2021, Fall 2019.

BIOL 3280 (a, INS) Plant Responses to the Environment
Barry Logan.
Non-Standard Rotation. Fall 2023. Enrollment limit: 16.

Plants can be found growing under remarkably stressful conditions. Even your own backyard poses challenges to plant growth and reproduction. Survival is possible only because of a diverse suite of elegant physiological and morphological adaptations. The physiological ecology of plants from extreme habitats (e.g., tundra, desert, hypersaline) is discussed, along with the responses of plants to environmental factors such as light and temperature. Readings from the primary literature facilitate class discussion. Excursions into the field and laboratory exercises complement class material. (Same as: ENVS 3280)

Prerequisites: BIOL 2210 (same as ENVS 2223) or BIOL 2325 (same as ENVS 2225).

Previous terms offered: Spring 2020.

BIOL 3304 (a, INS) The RNA World
Every Fall. Enrollment limit: 15.

Seminar exploring the numerous roles of ribonucleic acid, from the discovery of RNA as a cellular messenger to the development of RNAs to treat disease. Topics also include RNA enzymes, interactions of RNA viruses with host cells, RNA tools in biotechnology, and RNA as a potential origin of life. Focuses on discussions of papers from the primary literature.

Prerequisites: BIOL 2112 or BIOL 2118 or BIOL 2124 (same as BIOC 2124) or BIOL 2423 (same as BIOC 2423) or CHEM 2320 (same as BIOC 2320).

Previous terms offered: Fall 2022, Fall 2021, Fall 2020, Fall 2019.

BIOL 3307 (a, INS) Evolutionary Developmental Biology
William Jackman.
Every Spring. Spring 2024. Enrollment limit: 15.

Advanced seminar investigating the synergistic but complex interface between the fields of developmental and evolutionary biology. Topics include the evolution of novel structures, developmental constraints to evolution, evolution of developmental gene regulation, and the generation of variation. Readings and discussions from the primary scientific literature.

Prerequisites: BIOL 2175 or BIOL 2316.

Previous terms offered: Spring 2022, Spring 2021, Spring 2020.

BIOL 3308 (a, INS) Research in Ecology, Evolution, and Marine Biology
David Carlon.
Every Spring. Spring 2024. Enrollment limit: 16.

Focuses on research methods in field biology, reading the primary literature, and training in scientific writing and presentation, careers in ecology, and next steps to pursuing those careers. Prepares students for productive future research experiences in areas of ecology, marine biology, animal behavior, and evolution. Students will focus on a research topic of their interest, for which they will read the primary literature, design experiments, produce a draft of a scientific paper, deepen their understanding of statistics and present their proposed research. Includes field excursions to marine and terrestrial environments. (Same as: ENVS 3308)

Prerequisites: Two of: either BIOL 1102 or BIOL 1109 and either BIOL 2315 (same as ENVS 2224) or BIOL 2316 or BIOL 2319 (same as ENVS 2229) or BIOL 2325 (same as ENVS 2225) or BIOL 2330 (same as ENVS 2233) or BIOL 2210 (same as ENVS 2223) or BIOL 2327 (same as ENVS 2227).

Previous terms offered: Spring 2023, Spring 2022, Spring 2021, Spring 2020.

BIOL 3309 (a, INS) Ecotoxicology: Pollution Impacts on Ecosystems and Human Health
Mary Rogalski.
Every Other Spring. Spring 2024. Enrollment limit: 15.

Chemical exposure can strongly impact both ecological communities and human health, often in complex and unexpected ways, yet limited data and scientific uncertainty make pollution regulation challenging. Examines pollution impacts on biological systems, from the organism to the ecosystem scale, with a focus on emerging research areas, including evolutionary ecotoxicology and the potential synergy of multiple environmental stressors. Investigates how society might use available toxicological data to protect ecological integrity and human health. Guest visitors explore political, historical, and social justice aspects, providing an interdisciplinary lens. Reading–, writing–, and discussion-focused seminar (Same as: ENVS 3930)

Prerequisites: BIOL 2000 - 2969 or CHEM 2000 - 2969 or EOS 2000 - 2969 or ENVS 2201 (same as BIOL 1158 and CHEM 1105).

Previous terms offered: Spring 2022, Spring 2021, Spring 2020.

BIOL 3310 (a, INS, MCSR) Advanced Evolution
David Carlon.
Every Spring. Spring 2024. Enrollment limit: 15.

A seminar that focuses on current research in evolutionary biology. Topics include macroevolution, microevolution, and applications of evolutionary theory to problems in medicine, agriculture, fishery science, and environmental change. Students read and discuss papers from the primary literature.

BIOL 3311 (a) Motor Systems Neurobiology
Manuel Diaz-Rios.
Non-Standard Rotation. Fall 2023. Enrollment limit: 16.

In this course you will learn about the main animal models used in the study of how the nervous system controls motor behavior as animals, including humans, interact with the environment. The course will cover the principal motor systems (including those for walking, flying, swimming, breathing, and others), focusing in particular on bridging the gap between molecular/cellular neuroscience and higher-level perception and behavior. Topics to be covered include neuroanatomy, neurophysiology and functions of the most studied animal behaviors, and the groups of interconnected neurons (termed neural circuits) that control them. Students will read, interpret, analyze, and discuss seminal (classical) and recent scientific papers from influential motor systems neurobiology laboratories. The course will also discuss the relevance of these neuronal motor systems to human diseases. (Same as: NEUR 3311)

Prerequisites: BIOL 2112 or BIOL 2124 (same as BIOC 2124) or BIOL 2135 (same as NEUR 2135) or BIOL 2175 or BIOL 2553 (same as NEUR 2553) or BIOL 2566 (same as NEUR 2566) or PSYC 2750 (same as NEUR 2750) or PSYC 2751.

Previous terms offered: Fall 2022, Fall 2021, Fall 2020, Fall 2019.

BIOL 3314 (a, INS) Advanced Genetics and Epigenetics
Jack Bateman.
Every Fall. Fall 2023. Enrollment limit: 15.

A seminar exploring the complex relationship between genotype and phenotype, with an emphasis on emerging studies of lesser-known mechanisms of inheritance and gene regulation. Topics include dosage compensation, parental imprinting, paramutation, random monoallelic expression, gene regulation by small RNAs, DNA elimination, copy number polymorphism, and prions. Reading and discussion of articles from the primary literature.

Prerequisites: BIOL 2112.

Previous terms offered: Fall 2022, Fall 2020, Fall 2019.

BIOL 3317 (a, INS) Molecular Evolution
Michael Palopoli.
Every Fall. Fall 2023. Enrollment limit: 15.

Examines the dynamics of evolutionary change at the molecular level. Topics include neutral theory of molecular evolution, rates and patterns of change in nucleotide sequences and proteins, molecular phylogenetics, and genome evolution. Students read and discuss papers from the scientific literature.

Prerequisites: BIOL 2112 or BIOL 2118 or BIOL 2124 or BIOL 2175 or BIOL 2316.

Previous terms offered: Fall 2022, Fall 2021, Fall 2020.

BIOL 3318 (a, INS) Advanced Molecular Microbiology
Jake Muscato.
Non-Standard Rotation. Fall 2023. Enrollment limit: 16.

Advanced seminar-style course exploring the molecular basis for the many interactions between humans and microorganisms. Includes topics such as pathogenicity and infection, antimicrobial development and resistance, microbial evolution, microbiomes in health and disease, and biotechnology and industrial microbiology. Focuses on reading, interpretation, analysis, and discussion of articles from the primary scientific literature.

Prerequisites: BIOL 2112 or BIOL 2118 or BIOL 2124 (same as BIOC 2124) or BIOL 2423 (same as BIOC 2423) or CHEM 2320 (same as BIOC 2320).

Previous terms offered: Spring 2023.

BIOL 3325 (a, INS) Topics in Neuroscience
Michael Fine.
Non-Standard Rotation. Fall 2023; Spring 2024. Enrollment limit: 15.

An advanced seminar focusing on one or more aspects of neuroscience, such as neuronal regeneration and development, modulation of neuronal activity, or the neural basis of behavior. Students read and discuss original papers from the literature. (Same as: NEUR 3325)

Prerequisites: BIOL 2135 (same as NEUR 2135) or BIOL 2553 (same as NEUR 2553) or BIOL 2566 (same as NEUR 2566) or BIOL 2588 (same as NEUR 2588) or PSYC 2750 (same as NEUR 2750)- 2751 or PSYC 2775 (same as NEUR 2775).

Previous terms offered: Spring 2023, Spring 2022, Spring 2021, Spring 2020.

BIOL 3329 (a, INS) Neuronal Regeneration
Every Fall. Enrollment limit: 15.

The consequences of neuronal damage in humans, especially in the brain and spinal cord, are frequently devastating and permanent. Invertebrates, on the other hand, are often capable of complete functional regeneration. Examines the varied responses to neuronal injury in a range of species. Topics include neuronal regeneration in planaria, insects, amphibians, and mammals. Students read and discuss original papers from the literature in an attempt to understand the basis of the radically different regenerative responses mounted by a variety of neuronal systems. (Same as: NEUR 3329)

Prerequisites: BIOL 2112 or BIOL 2124 or BIOL 2135 or BIOL 2175 or BIOL 2553 or BIOL 2566 or PSYC 2750 or PSYC 2751.

Previous terms offered: Fall 2021.

BIOL 3333 (a, INS) Advanced Cell and Molecular Biology
Bruce Kohorn.
Every Spring. Spring 2024. Enrollment limit: 15.

An exploration of the multiple ways cells have evolved to transmit signals from their external environment to cause alterations in cell architecture, physiology, and gene expression. Examples are drawn from both single-cell and multi-cellular organisms, including bacteria, fungi, algae, land plants, insects, worms, and mammals. Emphasis is on the primary literature, with directed discussion and some background introductory remarks for each class.

Prerequisites: BIOL 2124 or CHEM 2310 or BIOL 2423.

Previous terms offered: Spring 2023, Spring 2022, Spring 2021, Spring 2020.

BIOL 3353 (a) Animal Behavior
Patricia Jones.
Every Other Spring. Spring 2024. Enrollment limit: 16.

This seminar will investigate the genetics, physiology, ecology and evolution of animal behavior using readings from the primary literature. It will explore the historical underpinnings of the field of animal behavior and current research topics including sexual selection and mating displays, the cognitive ecology of foraging, learning and decision-making, and the role of animal behavior in agriculture and conservation biology.

BIOL 3554 (a, INS, MCSR) Biomechanics
Amy Johnson.
Non-Standard Rotation. Spring 2024. Enrollment limit: 15.

Examines the quantitative and qualitative characterization of organismal morphology and explores the relationship of morphology to measurable components of an organism's mechanical, hydrodynamic and ecological environment. Students read, interpret, analyze, and discuss scientific papers. Discussions, lectures, problem sets, and a final literature-based paper emphasize (1) the analysis of morphology, including analyses of the shape of individual organisms, different modes of locomotion, and the mechanical and molecular organization of the tissues; (2) characterization of water flow associated with organisms; and (3) analyses of the ecological and mechanical consequences to organisms of their interaction with their environment.

Prerequisites: BIOL 1102 or BIOL 1109 or BIOL 2100 or higher or CHEM 1100 or higher or EOS 1100 or higher or MATH 1100 or higher or PHYS 1100 or higher.

Previous terms offered: Spring 2023, Spring 2022, Spring 2020.