BIOLGY

Chair, Professor Judy Stone
Associate Chair, Associate Professor Lynn Hannum
Professors Frank Fekete, Paul Greenwood, Russell Johnson, Judy Stone, and W. Herbert Wilson Jr.; Associate Professors Syed Tariq Ahmad, Catherine Bevier, Lynn Hannum, and Andrea Tilden; Assistant Professors David Angelini, Cat Collins, Joshua Martin, and Ronald Peck; Visiting Assistant Professors Susan Childers, Allison Galanis, and Sea McKeon; Senior Laboratory Instructors Tina Beachy and Scott Guay; Laboratory Instructor II Sarah Staffiere; Laboratory Instructors I Lyndell Bade and Phil Crystal; Research Scientists Paul Berkner, Bets Brown, Deboki Chakravarti, Susan Childers, Phillip deMaynadier, William Feero, Josh Kavaler, and Ross Zafonte; Research Associate Louis Bevier

The Biology Department ensures that students gain exposure to the breadth of biological science and become proficient in the methods of scientific inquiry. The curriculum emphasizes the study of plants, animals, and microorganisms from the molecular to the ecosystem level. Through laboratory and field experiences and the opportunity to carry out original research, students gain proficiency in gathering, interpreting, and communicating scientific knowledge. Department graduates continue their education in all fields of biology and in professional schools, and they pursue careers in scientific research, biotechnology, education, agriculture, medicine, and public health.

To promote interdisciplinary education, the Biology Department maintains close ties (often including cross-listed courses) with other departments and programs including Chemistry, Computer Science, Environmental Studies, Geology, and Psychology, and with external partners including the Jackson Laboratory and the Bigelow Laboratory for Ocean Sciences.

Three optional concentrations and an interdisciplinary option are offered in addition to the basic major.

The concentration in ecology and evolution is designed to provide students with a background to work in ecology, evolutionary biology, or related disciplines. Recent graduates in this area have enrolled in masters' and doctoral programs in ecology, evolution, marine biology, and natural resource management. Others are employed by federal and state agencies, private and public organizations, and consulting firms.

The concentration in cell and molecular biology/biochemistry focuses on the interdisciplinary field at the interface between biology and chemistry and also prepares students for graduate study or employment in the biomedical fields. Recent graduates have pursued interests in biomedical research, genomics, and molecular biology; others have attended medical school or graduate school in various of disciplines.

The concentration in neuroscience allows students to explore the interdisciplinary field at the interface between biology and psychology. This program prepares students for graduate study or employment in neuroscience or biomedical fields. Recent graduates have pursued research in neurodegenerative diseases, molecular neuroscience, and neuroimmunology.

The major in biology-interdisciplinary computation allows students to develop a coherent plan for the integration of computer science with biology, culminating in an integrative capstone experience. Students completing this major will be well prepared to pursue research in fields such as computational biology and bioinformatics.

Students interested in teaching are urged to read the “Education” section of the catalogue and to contact a member of the Education Program. Students majoring in biology and preparing for dental, medical, veterinary, or other health professions must carefully plan how to fit prerequisite courses in other disciplines into their course of study. Students interested in health professions should, in addition to working closely with their major advisor, consult regularly with the health professions advisor in the Career Center.

General Requirements for All Major Programs (Except Biology-Interdisciplinary Computation)

For all major programs offered by the department, the point scale for retention of the major applies to all courses required for the major and all elected biology courses. Courses required for the major may not be taken satisfactory/unsatisfactory. At least 32 credit hours must be taken for the major, including at least six courses with a laboratory component and at least two courses at the 300 level or above. A maximum of four credit hours of independent study and two credit hours of seminar may be counted toward the major. No more than eight credit hours in a semester or 12 credit hours in total from off-campus study programs may be counted toward the major requirements. The academic honor of “Distinction in the Major” will be awarded to students who have an average of at least 3.5 in the biology major.

Requirements for the Basic Major in Biology

Thirty-two hours of course work in biology (excluding Advanced Placement credit), including Biology 163, 164, one course with laboratory in field biology (Biology 211, 237, 259, 263, 334, Environmental Studies 271, 358), and one course with laboratory in cellular biology (Biology 225, 227, 248, 274, 279, 367). Seniors must enroll in Biology 401 or 402. In addition, Chemistry 141, 142; Mathematics 121 or 161 or equivalent; and one of the following courses: Computer Science 151, 152, Mathematics 122, 162, 253, Statistics 212.

Requirements for the Concentration in Ecology and Evolution

Thirty-two hours of course work in biology (excluding Advanced Placement credit), including Biology 163, 164, 263 or Environmental Studies 271, 320 (with or without the lab), and 382: one relevant summer research experience or research-based course (Biology 354, 373 with lab,
Agriculture is a fundamental way in which humans interact with their environment

**Requirements for the Concentration in Cell and Molecular Biology/Biochemistry**

Thirty-two hours of course work in biology (excluding Advanced Placement credit), including Biology 163, 164, 279, 367 (with laboratory), 368 (with laboratory), 378, and one course with laboratory in field biology (Biology 211, 237, 259, 263, 334, Environmental Studies 271, 358). Seniors must enroll in Biology 401 or 402. In addition, Chemistry 141, 142; Mathematics 121 or 161 or equivalent; and one of the following courses: Computer Science 151, 152, Mathematics 122, 162, 253, Statistics 212; and one course with laboratory chosen from Biology 225, 248, 274, Chemistry 331, or Physics 145.

**Requirements for the Concentration in Neuroscience**

Thirty-two hours of course work in biology (excluding Advanced Placement credit), including Biology 163, 164, 274, and one course with laboratory in field biology (Biology 211, 237, 259, 263, 334, Environmental Studies 271, 358). Seniors must enroll in Biology 401 or 402. In addition, Chemistry 141, 142; Mathematics 121 or 161 or equivalent and one of the following courses: Computer Science 151, 152, Mathematics 122, 162, 253, Statistics 212; Psychology 111; two courses from the following: Psychology 232, 233, 236, 275, 374, 375 (this list is frequently updated as new courses are introduced; please contact your advisor if you have questions about a specific course); one elective course in psychology (200-level or above) or physics (141 or above) or computer science (151 or above) or mathematics (in addition to the mathematics requirement).

**Requirements for the Major in Biology-Interdisciplinary Computation**

Students will design an integrative course of study in collaboration with academic advisors from the Biology and Computer Science departments. Students without Advanced Placement credit in biology must complete Biology 163, 164, 279, 320, and one additional 200- or 300-level biology elective course with an informatics component, such as Biology 306, 378, or 382. Students with Advanced Placement credit in biology must complete Biology 279, 320, two 200- or 300-level biology elective courses, and one 300-level course with an informatics component, such as Biology 306, 378, or 382. Typically, each major must complete Computer Science 151 or 152, 231, 251, 341, 441, and the capstone independent study 491 and 492.

**Honors Program in Biology**

Biology majors with a minimum cumulative grade point average of 3.5 at the end of the January term of the junior year or with permission of the department are eligible to apply for the Biology Honors Research Program during spring registration of the junior year. Honors research projects will earn a total of seven to nine credits and will be conducted during each semester of the senior year (and may include Jan Plan). Completion of the honors program will include a written thesis, an oral presentation at the Colby Liberal Arts Symposium, and successful completion of an oral examination given by the student's honors committee. Successful completion of the honors program will result in the degree being awarded with “Honors in Biology.”

**Course Offerings**

**B1101f  First-Year Seminar in Biology**  Students will meet with members of the faculty in the Department of Biology to discuss faculty research programs. Students will be expected to read papers from the primary literature to prepare for class. Introduces a wide range of subdisciplines within biology along with the associated research methods. Open to first-year students who also enroll in a biology class during their first year. Nongraded.  One credit hour.  STONE

**B1111j  Emergency Medical Technician Training**  Prepares students to administer out-of-hospital emergency medical care. Provides practice in patient assessment, airway management, CPR, automatic external defibrillation, oxygen delivery, dressings and hemorrhage control, splinting, spinal immobilization, childbirth, lifting and moving patients, and extrication. Also includes clinical experience in a hospital emergency department and/or ambulance service. Provides eligibility to sit the National Registry of EMT and State of Maine licensure examination. Meets the requirements outlined in the National Highway Transportation Administration EMT Education Standards and Maine EMS EMT Curriculum. Supplemental cost of $770 covers materials, uniform shirt, and a required CPR course, but not text and workbook. Students are required to wear the uniform shirt and dark blue chinos to class. In addition, there is a national registry fee of $80. Nongraded. Cannot be counted toward the biology majors.  Two credit hours.  BERKNER

**B1118j  Sustainable Agriculture and Food Systems**  Agriculture is a fundamental way in which humans interact with their environment and is at the nexus of ecological, social, and economic systems. An introduction to the ecological bases, practicalities, and philosophies of food and agricultural systems. Provides a foundation in such concepts as agroecology, sustainable soil management, pest and weed...
control, and organic farming. Also considers social, economic, and public-policy issues. Field trips to local farms and other agricultural institutions. Cannot be counted toward the biology major. Prerequisite: Senior standing. Three credit hours. N. MARSHALL

**[BI123]** The Science of Baseball This writing-intensive course will explore principles of statistics, evolution, animal behavior, physiology, and physics viewed through the lens of baseball. Several expository and analytical papers will be required, allowing students to develop and improve their critical analysis and scientific thinking skills. Four credit hours. N, W1.

**[BI131]** Biodiversity Examines the variety and variability of life on Earth, the causes of this variety, and the natural complex of relationships. Topics include habitat diversity, taxonomic diversity, interrelationships in ecosystems, conservation science, evolution, and speciation. Additionally, explores how humans influence and are influenced by biodiversity. Laboratory sessions focus on exploring biological diversity in different local ecosystems, using taxonomic keys, and applying the scientific method. Students with prior credit for Biology 164 may not receive credit for Biology 131. Four credit hours. N, Lb.

**[BI133s]** Microorganisms and Society An introduction to the importance of microorganisms to human health and the functioning of planet Earth. The diversity of the microbial world presented with relevant examples of how microorganisms affect our daily lives. Discussions and lectures based on the roles microorganisms and viruses play in disease, the food industry, ecological relationships, and biotechnology. Lecture and laboratory. Cannot be counted toward the biology majors. Four credit hours. N, Lb. F. FEKETE

**[BI152]** Human-Microbe Connection Presents an overview of the diversity of microorganisms and the impacts they have on our daily lives and activities. The role of microbes in medicine and human health, the food industry, and sustaining our environment will be discussed. Students will gain a basic understanding of what microorganisms are, their activities, and how they function in medical, practical, and environmental applications. They will learn fundamental concepts related to medical, food, and environmental microbiology that will help them make reasoned decisions throughout their lives. Cannot be counted toward the biology majors. Students with prior credit for Biology 133 or 248 may not receive credit for Biology 152. Three credit hours. N.

**[BI163f]** The Cellular Basis of Life An examination of cells as the fundamental unit of life. Aspects of evolutionary biology, cell biology, molecular biology, and genetics are discussed. A major objective is development of the intellectual tools to be able to ask and answer interesting biological questions. The objectives of the laboratory are to allow each student to design and conduct experiments, to analyze and present data, to write accurate scientific papers, and to critically evaluate the scientific literature. Four credit hours. N, Lb. JOHNSON, PECK, TILDEN

**[BI164s]** Evolution and Diversity An introduction to the theory of evolution and to the diversity of organisms. Topics will include the theory of natural selection, transmission genetics, speciation, and the adaptive radiation of all domains and kingdoms of organisms. Lecture and laboratory. Prerequisite: Biology 163. Four credit hours. N, Lb. STONE

**[BI176j]** Exercise Physiology Listed as Biochemistry 176. Three credit hours. N, Lb. MILLARD

**[BI197]** Genes, Chromosomes, and Genetic Disorders Introduce the exciting world of DNA and its effects on everyday life. Deoxyribonucleic acid is the molecule of life. Stable for years, it has proven its scientific value in many areas such as paleontology and forensics. On the other hand, DNA mutations introduce the variation that is the original source of all genetic diversity. Unfortunately, the ability to change is what makes DNA vulnerable as well, since genetic instability leads to a variety of genetic diseases including cancer. Cannot be counted toward the biology majors. Three credit hours. N. VAN OERS

**[BI197Jj]** Food and Drink: Everyday Biology and Chemistry Listed as Chemistry 197. Cannot be counted toward the biology majors. Three credit hours. N. HUDSON

**[BI211f]** Taxonomy of Flowering Plants An overview of evolutionary relationships among flowering plants and their nearest living relatives, and the study of evolutionary processes leading to those relationships. Students will prepare a collection of plant specimens from the local flora, learn to recognize important plant families, use technical keys to identify plants, and become familiar with analytical methods for constructing and evaluating phylogenetic hypotheses. Lecture and laboratory. Prerequisite: Biology 164. Four credit hours. STONE

**[BI214f]** Plant Physiology The essential mechanisms of plant function. Emphasis will be placed on plant water relations and the regulation of plant growth and development by hormones and environmental signals. These physiological processes will be addressed in the context of both natural and agricultural ecosystems. The laboratory portion focuses on developing skills in experimental design, good laboratory technique, and proper interpretation of data, and it entails presentation of the results of experiments in the form of a scientific paper and an oral presentation. Prerequisite: Biology 164. Four credit hours. JOHNSON

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**[BI223]  Science and Baseball** Explores principles of statistics, probability, evolution, animal behavior, physiology, psychology, and physics using examples drawn from baseball. Statistics problem sets, discussions of assigned readings, and posting viewpoints on controversial topics on a class blog will allow students to improve their critical analysis and scientific thinking skills. Credit cannot be earned for both this course and Biology 123. Cannot be counted toward the biology majors. *Prerequisite:* Sophomore or higher standing.  
*Four credit hours.*  
HANNUM

**[BI225s]  Immunology** An introduction to the cellular and molecular components of immune recognition and effector responses against pathogens, with emphasis on the human immune system. Topics will include immune deficiency, allergy, and autoimmunity. *Prerequisite:* Biology 164.  
*Three credit hours.*  
MOLONEY

**[BI227s]  Cell Biology** All living organisms consist of at least one cell. A comprehensive overview of eukaryotic cell biology, covering topics such as metabolism, cellular structure, cell-to-cell communication, and gene regulation. Learning strategies will include lecture, discussion, and small group work. Laboratory exercises will be aimed at familiarizing students with techniques commonly encountered in cell biology research labs, including cell culture, microscopy, flow cytometry, and mathematical modeling. Lecture and laboratory. *Prerequisite:* Biology 164.  
*Four credit hours.*  
MOLONEY

**[BI237]  Woody Plants** Exploration of the processes that determine forest structure and species composition. Students will learn about the abiotic and biotic features of forest sites and the ways in which physiology and life history of individual tree species predict their responses to climate, soil, and land use history. In field-based laboratories, students will learn how to interpret forests and to describe how human actions interact with other factors to shape our forested environment. *Prerequisite:* Biology 164.  
*Four credit hours.*  
HANNUM

**[BI240]  Microbes in the Environment** An exploration of the function of microorganisms in natural and man-made ecosystems. Broad themes include plant and animal symbioses and diseases, element cycling, remediation of pollutants, and global climate change. Students gain an in-depth understanding of how to identify, collect, and quantify environmental microbes and microbial activities. They explore cutting-edge research, applying knowledge of microbes and microbial processes to advance global efforts focused on managing food production, reclaiming contaminated soils and water, and modeling climate change. Previously listed as BI298 (2015). *Prerequisite:* Biology 131 or 164.  
*Three credit hours.*  
N.

**[BI246f]  Parasitology** A study of parasitic organisms with a focus on eukaryotic parasites of animals. General principles including advantages and challenges of the parasitic life strategy will be introduced, then applied to parasites from a variety of phylogenetic backgrounds with a particular emphasis on medically relevant organisms. Current research in the field will be discussed, highlighting articles that address possible preventive and therapeutic approaches to parasites that cause human disease. *Prerequisite:* Biology 164.  
*Three credit hours.*  
PECK

**[BI248f]  Microbiology** Provides an understanding of the nature and diversity of microorganisms and viruses and the roles they play in the biosphere. Emphasis will be on the microbe itself—its functional, ecological, and evolutionary relationships—as well as the activities it carries out that are of interest to humans. The approach will be fundamental, stressing principles, but with considerable emphasis on how these principles are applied to practical problems in medicine, industry, and the environment. Lecture and laboratory. Credit cannot be earned for both this course and Biology 238. *Prerequisite:* Biology 164 (prerequisite), Chemistry 131, 141, 142, or 145 (may be taken concurrently).  
*Four credit hours.*  
F. FEKETE

**[BI254]  Marine Invertebrate Zoology** A survey of the major phyla of free-living marine invertebrates and the study of the evolutionary relationships of those groups. Students will learn to classify marine invertebrates and to understand their role in marine communities. They will work collaboratively to produce Wiki accounts on topics of current interest in marine invertebrates. Each student will give a talk on a topic of her/his choice based on a critical survey of the primary literature. A comprehensive lab practical will test the students' mastery of marine invertebrate morphology. *Prerequisite:* Biology 164.  
*Four credit hours.*  
F. FEKETE

**[BI259]  Plants of the Tropics** An intensive study of tropical plant biology taught in Costa Rica during the January term. Emphasis is on the physiology, ecology, and conservation of plants in both wild and agricultural settings, and the importance of plants for human cultures in tropical Latin America. We visit two distinct environments in Costa Rica: a lowland tropical rain forest (La Selva Biological Reserve), and a tropical dry forest (Santa Rosa National Park). Students complete a field research project during the final week. Students must cover expenses of approximately $2,300. Limited scholarship funds may be available. *Prerequisite:* Biology 164 and permission of the instructor.  
*Three credit hours.*

**[BI263f]  Principles of Ecology** An examination of ecological concepts applied to individuals, populations, and communities of plants and animals in terrestrial environments. Students will acquire a conceptual and theoretical understanding of population dynamics, species interactions, the structure and diversity of ecological communities, and biogeography. Students will explore primary literature in ecology, learn techniques for designing and conducting ecological studies in the field, and identify connections between ecology and other
subdisciplines such as physiology, genetics, and evolution. Students will be expected to attend one weekend field trip. Lecture and laboratory. Prerequisite: Biology 164. Four credit hours. MCKEON

BI265 Introduction to Human Anatomy and Physiology Designed especially for students interested in health professions (e.g., physician, nurse, dentist, allied health) and for anyone who wishes to learn more about how the human body works. Students will understand how physiological functions are performed by specific anatomical structures and that these functions follow physical and chemical principles. They will also learn anatomical terms used to describe body sections, regions, and relative positions and about the organ systems in the human body and how these systems work together. Lecture and laboratory. Students cannot earn credit for this course if they have previously taken Biology 275. Prerequisite: Biology 131 or 163 or equivalent. Three credit hours. N. KLEPACH

BI271f Introduction to Ecology Listed as Environmental Studies 271. Prerequisite: Biology 131 or 164. Four credit hours. N, Lb. MCDOWELL

BI274fs Neurobiology Discussion of the molecular and cellular fundamentals of neurophysiology and neuroanatomy. Topics include structure and function of neurons, molecular basis of signaling and communication within and between neurons, sensory and motor systems, and mechanisms of learning and memory. The lab portion involves acquiring skills in electrophysiology (including electrode construction and testing on animal models), effects of modulators and anesthetics on electrophysiology of cardiac activity, and an independent research project. Lecture and laboratory. Prerequisite: Biology 164. Four credit hours. AHMAD, MARTIN

BI275s Human Physiology A study of human homeostasis and mechanisms of disease. Topics include endocrinology, autonomic nervous system, osmoregulation, cardiovascular system, respiratory system, renal physiology, and reproduction. Lecture and laboratory. Students cannot earn credit for BI275 if they have previously taken Biochemistry 265 or 362. Prerequisite: Biology 164. Four credit hours. KLEPACH

[BI276] Comparative Vertebrate Anatomy Comparative studies of basic vertebrate anatomical systems and their structural, functional, and evolutionary relationships among the major vertebrate groups. Laboratories emphasize comparisons of anatomical structure across different vertebrate species through dissection. Lecture and laboratory. Prerequisite: Biology 164. Four credit hours.

[BI277] Vertebrate Natural History A study of the vertebrates with emphasis on natural history, evolutionary relationships, adaptations, functional anatomy, and conservation. Features species found in New England, and addresses specific questions about the distribution and abundance of vertebrates across a range of habitat types. Previously listed as Biology 297 (Fall 2014). Prerequisite: Biology 131 or 164. Three credit hours.

BI278s Biomedical Genomics and Bioinformatics The genomics era is producing vast quantities of data that are revolutionizing our understanding of evolution, disease, and variation. Publicly accessible and rapidly expanding databases now hold entire genomes and transcriptomes for numerous species. We will take a computational bioinformatics approach to exploring this data, from single genes and proteins to entire genomes. We will explore the technologies used to produce the data, as well as other current, emerging, and controversial genomic technologies. While the laboratory is computer based, no prior computational experience is necessary. Prerequisite: Biology 164. Four credit hours. TILDEN

BI279fs Genetics The mechanisms of inheritance, with emphasis on experimental findings. The physical and chemical bases for the behavior of genes, and applications of genetic principles to society. Lecture and laboratory. Prerequisite: Biology 164. Four credit hours. AHMAD, ANGELINI

[BI287] Impact of Climate Change on Ocean Life Listed as Environmental Studies 287. Three credit hours. N.

[BI297A] Biological Oceanography: Microbial Denizens of the Living Ocean The ocean engine comprises many connected biological cogwheels. Chemical and physical processes fuel this engine and interactions between biotic and abiotic components ensure its smooth functioning. We will explore the diversity and biological activities of oceanic life, with emphasis on microbial aspects, across contrasting ecosystems (open/coastal oceans, polar seas, deep sea, and coral reefs). We will address current topics that drive biological oceanography research, including the role of diversity and organismal interactions in sustaining healthy ecosystems, climate change, and human impacts. Students will gain a working knowledge of the role biological processes play in global ocean cycles and the factors that affect them. Prerequisite: Biology 131 or 163. Three credit hours. N.

[BI297B] Extreme Climate Change in the Gulf of Maine The Gulf of Maine has undergone extreme climate-related changes, resulting in changes to marine population structure and instances of harmful, toxic, or otherwise undesirable species. We will explore the causes of, impacts of, and potential adaptations to climate change in the Gulf of Maine. Includes a weeklong experiment at Bigelow Laboratory for Ocean Sciences using indoor seawater mesocosms to simulate rapid ecosystem change and to investigate the biological response of
marine microbes. Students will be introduced to traditional and modern oceanographic data collection techniques for estimating the impacts of climate change. Prerequisite: Biology 164. Three credit hours.

**BI297C** Disease Ecology Listed as Environmental Studies 297C. Three credit hours. N. MCDOWELL

**BI297D** Global Change Impacts on Marginal Marine Ecosystems Listed as Environmental Studies 297D. Three credit hours. N, Lb. PRICE

**BI298s** Principles of Evolution Explores the principles of evolution—the conceptual core of biology—through a discussion/lecture format. Topics include the theory of evolution, origin of new species, genetics of populations, adaptation and co-evolution, relative roles of selection, drift, mutation, and migration in the evolutionary process, evolutionary ecology, and how scientists approach the study of evolution. Prerequisite: Biology 164. Three credit hours. MCKEON

**BI306f** Topics in Epidemiology Listed as Statistics 306. Four credit hours. SCOTT

**BI319f** Conservation Biology Listed as Environmental Studies 319. Four credit hours. NYHUS

**[BI320]** Evolutionary Analysis Focuses on the mechanisms that drive evolutionary change and on the long-term consequences of these mechanisms. We develop analytical techniques to infer the causes and consequences of genetic variation within species. These techniques can be applied to any species, including those of particular relevance to humans such as agricultural species, introduced invasive species, species of conservation concern, and parasites. Students will develop a grant proposal in the form of a National Science Foundation Graduate Research Fellowship. Prerequisite: Biology 164 and junior or higher standing. Three credit hours.

**BI325f** Advanced Immunology In-depth exploration of topics in immunology through reading and discussion of primary literature. Focuses on several main topics per semester, with an emphasis on the human immune system and human health. Students will learn to communicate their understanding of basic and clinical immunology research to others through class discussions and a formal presentation. The optional laboratory, when offered, earns a fourth credit and focuses on enhancing students' laboratory skills through a semester-long research project. Prerequisite: Biology 225. Three credit hours. HANNUM

**[BI327]** The Biology of Cancer Cancer is the leading cause of death in Americans under the age of 85. Annually, the disease costs the United States more than $200 billion. Students will examine the public health impacts of cancer, the biological basis of the disease, and current advances in diagnostics and therapeutics. Class sessions will include lecture, discussion, and presentation, with focus on the analysis and critique of scientific research. During an optional discussion section (for a fourth credit), students will survey different types of science writing dealing with cancer, from popular press to specialized, professional literature. Previously offered as Biology 398 (Spring 2014). Prerequisite: One 200-level biology lab course (Biology 225, 227, 274, 275, or 279). Three or four credit hours.

**BI332f** Developmental Biology The study of the formation and growth of individual organisms focusing on experimental evidence from several model species. Examines developmental processes as they relate to animal structure, physiology, biochemistry and cell processes, classical and molecular genetics, and evolution. Students learn the history and methods of developmental biology, from descriptive embryology to current molecular genetic tools, and gain experience using primary literature sources for writing in scientific format. The optional lab section requires students to make careful observation, develop a hypothesis, and design experiments to address a novel question regarding development. Optional fourth credit for laboratory. Prerequisite: Biology 227, 279, or 327, or Biochemistry 362 or 367. Three or four credit hours. ANGELINI

**BI334f** Ornithology A broad survey of the biology of birds including their evolutionary history, morphology, physiology, flight adaptations, behavior, vocalizations, nesting, life history, conservation, and phylogeny. Students will prepare three critiques of the primary literature on particular controversial topics in ornithology. A lab practical will test each student's knowledge of skeletal, feather, and internal anatomy. The final exam will be a test of visual and aural identification of all the species found during the field trips. Prerequisite: Biology 164, and junior standing. Four credit hours. WILSON

**[BI343]** Environmental Change Listed as Environmental Studies 343. Four credit hours.

**BI348s** Pathogenic Bacteriology Objectives are to provide an understanding of 1) the nature and diversity of pathogenic bacteria, 2) the roles they play as infectious agents of disease, and 3) the mechanisms of the mammalian defense against infectious disease. The approach will be fundamental, stressing principles, but with considerable emphasis on how these principles are applied to practical problems in medicine and public health. Credit cannot be earned for both this course and Biology 238. Prerequisite: Biology 248, and Chemistry 131, 145, 147, or 141 and 142 (may be taken concurrently). Three credit hours. F. FEKETE
[BI352s] Advanced and Applied Ecology  Listed as Environmental Studies 352.  Four credit hours.  MCDOWELL

[BI354] Marine Ecology  A study of the interactions that determine the distribution and abundance of marine organisms. Emphasis will be on North Atlantic communities. One weekend field trip to the coast for all students. Optional fourth credit for laboratory. Prerequisite: Junior standing, a W1 course, Biology 164, and either Biology 263 or Environmental Studies 271.  Three or four credit hours.  W3.

[BI356s] Aquatic Ecology  Listed as Environmental Studies 356.  Four credit hours.  BRUESEWITZ

[BI358] Ecological Field Study in Moorea  Listed as Environmental Studies 358.  Three credit hours.

[BI362f] Medical Biochemistry  Listed as Biochemistry 362.  Four credit hours.  MILLARD

[BI366s] The Environment and Human Health  Listed as Environmental Studies 366.  Four credit hours.  N.  CARLSON

[BI367f] Biochemistry of the Cell I  Listed as Biochemistry 367.  Four or five credit hours.  RICE

[BI368s] Biochemistry of the Cell II  Listed as Biochemistry 368.  Prerequisite: Biochemistry 367. Biochemistry 367 laboratory is prerequisite to Biology 368 laboratory.  Four or five credit hours.  MILLARD

[BI371j] Applied Biomedical Genomics  A laboratory-intensive course designed to familiarize students with modern molecular, genomic, and bioinformatic approaches to biomedical research. Students will use next-generation sequencing platforms to investigate mammalian or cancer genomes, and will be exposed to clinically relevant research including patient-derived xenograft (PDX) mouse models. One to two weeks spent at an off-campus facility (the Jackson Laboratory), with the rest of the time spent on campus. Nongraded. Previously offered as BI397 (Jan Plan 2015). No extra student cost. Prerequisite: A 200-level biology course and permission of instructor.  Three credit hours.  TILDEN

[BI373s] Animal Behavior  An examination of animal behavior from a biological perspective. Topics include the control, development, function, and evolution of behavior. Optional fourth credit for laboratory. Prerequisite: Biology 164 and junior standing.  Three or four credit hours.  MCKEON

[BI374fs] Advanced Neurobiology  An in-depth discussion of the principles and current research in various fields of neurobiology at the molecular and cellular level through extensive review of primary literature. Topics include neurodevelopment (axon guidance), regeneration (stem cells), disorders (neurodegenerative and neuropsychiatric), and behavior. Students will discuss and present a topic of their choice and interest. Prerequisite: Biology 274.  Three or four credit hours.  AHMAD, MARTIN

[BI375] Animal Physiology: Environment and Adaptation  A study of the diversity of animal function, from organisms to molecules, with an emphasis on adaptations to the environment. Physical and chemical principles and their application to physiological processes will be emphasized. The optional laboratory, when offered, earns a fourth credit and is an in silico exploration of quantitative concepts, genomics, proteomics, and bioinformatics. Prerequisite: A 200-level biology course.  Three credit hours.  ANGELINI

[BI376s] Development, Genes, and Evolution  Evolutionary developmental biology investigates the intersections of development, genetics, and evolution. We will present an overview of these subjects, followed by ideas and methodologies that emerge from their synthesis. Topics include plasticity, polyphenism, gene networks, constraint, parallel evolution, evolvability, among others. Students will (1) become familiar with the history and evidence of these concepts, (2) understand the arguments for and criticisms of their roles in evolution, (3) practice discussion, peer review, and presentation of these and related topics. Prerequisite: Biology 279.  Three credit hours.  ANGELINI

[BI378s] Molecular Biology  Listed as Biochemistry 378.  Four credit hours.  JOHNSON

[BI382] Ecological Modeling  Examines the development and application of models that form the basis for theoretical ecology. Students will use model-building approaches to inform their understanding of fundamental ecological principles, exploring topics such as spatial and temporal dynamics of populations, competition and predation, and community composition and diversity. They will also learn statistical approaches for modeling data using large-scale, long-term datasets. Includes a lab in which students combine modeling with empirical approaches to generate and test predictions in population and community ecology. Prerequisite: Biology 263 or 271 or Environmental Studies 271, and Mathematics 212 or Statistics 212.  Four credit hours.
**The Cell Cycle and Cancer** A detailed investigation of the cellular mechanisms that control the cell cycle and how defects in these systems lead to cancer. In addition, complexities of diagnosing, treating, and living with cancer are considered. A broad combination of detailed content provided by primary and secondary literature, student-led discussions, creative essays, and a detailed oral presentation. **Prerequisite:** Biology 164, Chemistry 142, and junior standing. Three credit hours.

**Synthetic Biology** Introduces students to the latest advances in synthetic biology, genome editing, and genetic engineering. We will explore these technical advances, study practical examples, and use a marine protozoan parasite as a model system. We will also discuss and debate the role that genetic engineering is playing and ought to be playing to benefit society. **Prerequisite:** Biology 279. Three credit hours. FERNANDEZ-ROBLEDO

**Biology Seminar** Participation in selected department seminars during the fall or spring semester. Seminars will focus on student-led discussions of readings from the primary literature and will also include playing host to several outside speakers. Required of all senior biology majors. **Prerequisite:** Senior standing. One credit hour. FACULTY

**Applied and Environmental Microbiology** Students will develop and conduct an independent research project to explore microbes and how they affect, and are affected by, their environments. A particular focus will be learning about and employing modern biochemical and genetic techniques to analyze microbes in extreme environments. Students will analyze scientific literature, conduct experiments, and interpret data. Results and data analysis will be disseminated in the form of oral and written reports. **Prerequisite:** Biology 248 or 279. Four credit hours. PECK

**Neuroscience Research** A laboratory-intensive course designed to familiarize students with modern cellular and molecular approaches to neuroscience research. Two weeks spent at an off-campus facility, with the rest of the time spent on campus. **Prerequisite:** Biology 274 and permission of the instructor. Three credit hours.

**Honors Research in Biology** Research conducted under the guidance of a faculty member and focused on an approved topic leading to the writing of an honors thesis and an oral presentation of the research results. **Prerequisite:** Senior standing as a biology major and permission of the department chair. One to four credit hours. FACULTY

**Independent Study** Individual projects in areas where the student has demonstrated the interest and competence necessary for independent work. **Prerequisite:** Permission of a faculty sponsor. One to four credit hours. FACULTY

**Problems in Environmental Science** Listed as Environmental Studies 494. Five credit hours. BRUESEWITZ, MCCLENACHAN