BIOLOGY

Chair, *Associate Professor Lynn Hannum*
Associate Chair, *Associate Professor David Angelini*
Professors Catherine Bevier, Frank Fekete, Russell Johnson, and Judy Stone.; Associate Professors Syed Tariq Ahmad, David Angelini, Lynn Hannum, Ronald Peck, and Andrea Tilden; Assistant Professors Allison Barner, Christina Cota, Joshua Martin, Christopher Moore, and Suegene Noh; Visiting Assistant Professors Susan Childers, Thomas Klepach, and Johanna van Oers; Senior Laboratory Instructors Tina Beachy, Scott Guay and Sarah Staffiere; Laboratory Instructors I Lyndell Bade, April Chiriboga, and Serena Graham; Research Scientists Paul Berkner, Bets Brown, Susan Childers, Phillip de Maynadier, William Feero, Josh Kavaler, and Ross Zafonte; Research Associates Louis Bevier and Brenda Fekete

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, the Mount Desert Island Biological 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 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 **computational biology** 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 obtain employment or 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 Computational Biology)

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-one hours of course work in biology (excluding Advanced Placement credit), including Biology 163, 164, one course with laboratory in field biology (Biology 211, 237, 271, 277, 334, 358J), and one course with laboratory in cellular biology (Biology 225, 227, 248, 274, 279, 332, 367). Seniors must enroll in Biology 401 or 402. In addition, Chemistry 141, 142, or Chemistry 121, 122 or Chemistry 147; Mathematics 121 or 161 or equivalent; and one of the following courses: Computer Science 15X, Mathematics 122, 162, 253, Statistics 212.

Requirements for the Concentration in Ecology and Evolution

Thirty-one hours of coursework in biology (excluding Advanced Placement credit), including Biology 163, 164, 271, 320, and 328 or 382; one organismal or taxonomy-based biology course with lab (Biology 211, 237, 248, 276, 277, 334); and one course with laboratory in

cellular biology (Biology 225, 227, 248, 274, 279, 332, 367). Seniors must enroll in Biology 401 or 402. In addition, Chemistry 141, 142, or Chemistry 121,122 or Chemistry 147; Mathematics 121 or 161 or equivalent, and Statistics 212.

Requirements for the Concentration in Cell and Molecular Biology/Biochemistry

Thirty-one hours of course work in biology (excluding Advanced Placement credit), including Biology 163, 164, 279, 367 (with laboratory), 368 (with laboratory), 378; one course with laboratory in field biology (Biology 211, 237, 271, 277, 334, 358J); and one cell or molecular-level biology course (Biology 214, 225, 227, 246, 247, 248, 278, 329, 332, 351, 371). Seniors must enroll in Biology 401 or 402. In addition, Chemistry 141, 142 (or 121, 122 or 147), 241, 242; Physics 141 and 145; Mathematics 121 or 161 or equivalent; and one of the following courses: Computer Science 15X, Mathematics 122, 162, 253, or Statistics 212.

Requirements for the Concentration in Neuroscience

Thirty-one hours of course work in biology (excluding Advanced Placement credit), including Biology 163, 164, 274; one course with laboratory in field biology (Biology 211, 237, 271, 277, 334 358J); and at least two of the following courses: 225, 227, 275, 278, 279, 373, 374. Seniors must enroll in Biology 401 or 402. In addition, Chemistry 141, 142, or Chemistry 121,122 or Chemistry 147; Mathematics 121 or 161 or equivalent and one of the following courses: Computer Science 15X, Mathematics 122, 162, 253, or Statistics 212; Psychology 111; one course from the following: Psychology 232, 233, 242, 244, 272, 352, 374 (this list is frequently updated as new courses are introduced; please contact your advisor if you have questions about a specific course); and one elective course in psychology (200-level or above).

Requirements for the Major in Computational Biology

Students will design an integrative course of study in consultation with an academic advisor(s). Foundational courses (may be satisfied by AP or other placement exams): Biology 163 and 164; Computer Science 151, 152 or 153; and Mathematics 122. Required core courses: Biology 278 and 279; Computer Science 231 and 251 or 252; and Mathematics 253 or 262 and Statistics 212. Four elective courses at the 300-level or above should be chosen in consultation with an advisor two each from Biology and Computer Science. Recommended courses include Biology 320, 345, 371J, 382 and Computer Science 341+441 or 343+443 or 346+446.

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

BI111j Emergency Medical Technician Training This course prepares students to provide prehospital assessment and care for patients of all ages with a variety of medical conditions and traumatic injuries. Includes online learning and simulated clinical experience using programmed patient scenarios. Sessions will be in-person on Mon/Thurs and online Tues/Weds/Fri. Provides eligibility to sit for the National Registry of EMT and State of Maine licensure examination. Students are responsible for $80 national registry fee. Meets requirements outlined in the National Highway Transportation Administration EMT Education Standards and Maine EMS EMT Curriculum. Course materials and textbook $1,156. Students are expected to have separate BLS CPR certification, which is offered through CER (kfburt22@colby.edu). Nongraded. Cannot be counted toward the biology majors. *Two credit hours.* INSTRUCTOR

BI118js 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

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. Cannot be counted toward the biology majors. Lecture and laboratory. *Four credit hours.* **N, Lb.** FEKETE

BI135s Biochemistry of Food Explores the biochemistry of food, including an introduction to the biomolecular families of food, the basic physiology of the gastrointestinal system, fundamental nutritional metabolism, biochemical transformations in raw, cooked, and otherwise

processed foods, an overview of modern biotechnology as it relates to food production, and a survey of the biochemical connections between human diet, health, and disease. Students will produce podcasts on a relevant topic of their choice. Lecture and laboratory. Significant civic engagement component built into lecture and lab activities. Cannot be counted towards the biology major. Lecture and laboratory. Previously offered as BI198 (Spring 2019). *Four credit hours.* **N, Lb.** KLEPACH

BI147f Anatomy and Physiology of Yoga and Mindful Practice A practical study of the anatomy and physiology underpinning mindful practices such as yoga and meditation, explores the mind-body connection fostered by mindful practice from a biological perspective. Topics include a survey of the musculoskeletal anatomy of yoga, and the physiological effects of mindful practice on the cardiovascular, respiratory, and nervous systems. With particular emphasis on helping students make their health and well-being a priority, we will explore the effects of stress on the body, strategies for mitigating this stress, and physiological aspects of nutrition, rest, and sleep. *Four credit hours.* **N.** KLEPACH

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. Lecture and laboratory. *Four credit hours.* **N, Lb.** COTA, HANNUM, MARTIN

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.** BEVIER, NOH

[BI176] Exercise Physiology Listed as Biochemistry 176. *Three credit hours.* **N, Lb.**

BI201f Biology Accelerator Workshop-style course developing skills in designing, analyzing and presenting results of biological studies, while reviewing fundamental concepts in biology. This course fills the gap between content knowledge mastered in AP or IB courses and the analytical and writing skills required for success at higher levels. Students may not receive credit for both this course and Biology 163 or 164. *Three credit hours.* STONE

[BI211] 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.*

[BI214] 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. Lecture and laboratory. *Prerequisite:* Biology 164. *Four credit hours.*

BI221f Infectious Diseases, Climate Change, and Health Explores health effects of climate change on Earths inhabitants. The biology of climate sensitive vector borne and zoonotic diseases and their transmission will be examined. Consequences of rising temperatures such as increases in waterborne pathogens and exposure to molds are discussed, as well as health challenges relative to food resources and antibiotic resistance stemming from changes in soil microbial communities. Broader climate change aspects, such as fossil fuel extraction, atmospheric emissions and soil and water pollution, are studied in context of human and animal health. Learning strategies will include lecture, discussion, and small group work. *Prerequisite:* Biology 164 (prerequisite), Chemistry 121 or 141 (may be taken concurrently). *Three credit hours.* CHILDERS

[BI224] Biology of Vaccines Infectious disease has decimated populations throughout human history. The success of pathogen-specific vaccines evolved commensurate with our understanding of themammalian protective immune responses. This course focuses on the science of vaccinology and the development of safe and efficacious vaccines. Goals are to understand how vaccines work, to gain a practical understanding of the human immune response, and to learn the issues involved in developing new vaccines against known and emerging pathogens. *Prerequisite:* Biology 164. *Three credit hours.*

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.* HANNUM

BI227s Cell Biology A comprehensive overview of fundamentals of eukaryotic cell biology. Topics include cell structure and function, energy production and metabolism, cell division, protein transport and cell communication. Lecture and laboratory. *Prerequisite:* Biology 164. *Four credit hours.* COTA

[BI232] Developmental Biology A study of development, with emphasis on the experimental findings that have led to present ideas of the morphological and chemical processes underlying the development and growth of organisms. *Prerequisite:* Biology 164. *Three credit hours.*

BI237f 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. Lecture and laboratory. *Prerequisite:* Biology 164. *Four credit hours.* STONE

BI242j Comparative Biomechanics An exploration of the physical properties of the natural world to understand how they influence fundamental biological processes. Students will study the basics of animal movement through air and water, identify common biomaterials, describe their composition and how they constrain ecology and organismal growth, and dissect and reconstruct biological structures. The primary objective of this course is for students to understand each of these biomechanical principles in detail, understand when and how they vary across the tree of life, and understand how this variation influences ecology, physiology, behavior, and evolution. Previously offered as BI297E (Jan Plan 2019). *Prerequisite:* Biology 164. *Three credit hours.* O'BRIEN

BI244s Marine Communities Listed as Environmental Studies 244. *Four credit hours.* NEAL

[BI246] 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.*

BI247f Virology A study of viruses with a focus on the molecular aspects of how they reproduce and spread. General strategies of viruses to allow cell entry, information replication, and protein production, and cell exit will be examined. These strategies will then be examined in greater detail for specific viruses with a particular emphasis on those that cause human diseases. Current research in the field will be discussed, highlighting articles that address possible vaccines, therapies, and potential medical uses of viruses. *Prerequisite:* Biology 163. *Three credit hours.* **N.** 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, 145, or 147 (may be taken concurrently). *Four credit hours.* FEKETE

[BI265] Introduction to Human Anatomy and Physiology Designed 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. Significant civic engagement component built into lecture and lab activities. 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.**

BI271f Introduction to Ecology Ecology is the study of interactions among organisms and their environment. Studying these interactions provides us with the theoretical foundation for understanding many of the most pressing environmental problems. This course will examine ecological interactions at a wide range of scales from individuals, through populations and communities, to ecosystems. We will study how these interactions produce the patterns and processes we observe in biomes around the world. In the field-based laboratory, we will generate hypotheses, develop experimental designs, and apply statistical analyses to ecological data, while gaining first-hand familiarity with local ecological communities. Lecture and laboratory. Previously listed as Environmental Studies 271. *Prerequisite:* Biology 164. *Four credit hours.* **N, Lb.** BARNER, MCDONOUGH MACKENZIE

BI274fs Neurobiology Exploration 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.* MARTIN, TILDEN

BI275s Human Physiology A study of human homeostasis, organ system function, and mechanisms of disease. Topics include tissue types, endocrine function, central, peripheral and autonomic nervous systems, cardiovascular, respiratory and gastrointestinal systems, and renal physiology. Students cannot earn credit for this course if they have previously taken Biology 265 or Biochemistry 362. Lecture and laboratory. *Prerequisite:* Biology 164. *Four credit hours.* TILDEN

BI276f 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.* BEVIER

[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. In the primarily field-based laboratory, we will learn and use wildlife techniques to identify and study local vertebrates in their natural environments. Lecture and laboratory. *Prerequisite:* Biology 164. *Three or four credit hours.*

BI278f Genomics 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. Lecture and laboratory. *Prerequisite:* Biology 164. *Four credit hours.* NOH

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.* ANGELINI, VAN OERS

[BI282] 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.*

[BI286] Global Change Ecology Listed as Environmental Studies 276. *Four credit hours.*

BI306s Topics in Epidemiology Listed as Statistics 306. *Four credit hours.* SCOTT

BI319s Conservation Biology Listed as Environmental Studies 319. *Four credit hours.* SULLIVAN

BI320s 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.* STONE

BI325s 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

BI328s Community Ecology Explores the interactions between organisms that drive the diversity and dynamics of the natural world. We'll use published case studies of terrestrial, marine, aquatic, and microbial ecosystems to learn the fundamental principles of community ecology. Students will learn to evaluate and critique the scientific literature by working through multiple historical and contemporary debates that are central to the field. Further, we?ll use openly-accessible ecological data to develop quantitative analysis skills and derive new insights to these debated theories. *Prerequisite:* Biology 271 or Environmental Studies 271. *Four credit hours.* BARNER

BI329f Synthetic Biology Synthetic biology has moved from being a scientific dream to impacting the lives of the public. Driven by advances in genome sequencing and gene editing tools, we can now interrogate the biology of organisms and develop applications that benefit society. This course will introduce students to advances in synthetic biology, genome editing, and genetic engineering. The basics of biotechnology will be explained through diverse examples in biology, ecology, and medicine. We will also discuss the role that genetic engineering is playing and ought to play to benefit society. *Prerequisite:* Biology 279. *Three credit hours.* FERNANDEZ-ROBLEDO

[BI332] 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. Lecture and laboratory. *Prerequisite:* Biology 227, 279, or 327, or Biochemistry 362 or 367. *Four credit hours.*

BI334s 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.* BEVIER

BI338s Forest Ecosystems Listed as Environmental Science 338. *Four credit hours.* **N.** MCDONOUGH MACKENZIE

[BI345] Advanced Genomics Designed to enable students to become familiar with the various types of genomic data used to examine biological phenomena. Students will become proficient at critically examining the application and interpretation of genomic data, including closely and distantly related genomes, populations of genomes, and metagenomes from environmental samples. *Prerequisite:* Biology 278. *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 122, 147, or 141 and 142 (may be taken concurrently). *Three credit hours.* FEKETE

BI351f 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. Lecture and laboratory. *Prerequisite:* Biology 246, 248, or 279. *Four credit hours.* PECK

[BI354] Marine Ecology A study of the biological, physical, and chemical interactions that determine the structure and function of marine ecosystems, with an emphasis on North Atlantic communities. The laboratory will consist of a field component, with the goal of developing field and independent research skills. One day trip on a weekend to the coast for all students. Lecture and laboratory. *Prerequisite:* Biology 164, and either Biology 263 or 271 or Environmental Studies 271. *Four credit hours.*

BI356s Aquatic Ecology Listed as Environmental Studies 356. *Four credit hours.* BRUESEWITZ, PEARSON

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

BI362fs Medical Biochemistry Listed as Biochemistry 362. *Four credit hours.* MILLARD, PECK

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 computation-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 biomedical questions in collaboration with MDI Biological Lab and Jackson Lab (no travel away from campus this year). No prior computation experience necessary. *Prerequisite:* A 200-level biology course. *Three credit hours.* TILDEN

[BI372] Current Topics in Environmental Science: Corals Listed as Environmental Studies 371. *Four credit hours.*

[BI373] Animal Behavior An examination of animal behavior from a biological perspective. Topics include the control, development, function, and evolution of behavior. *Prerequisite:* Biology 164 and junior or higher standing. *Three credit hours.*

BI374s 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.* 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.*

BI376f 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. Lecture and laboratory. *Prerequisite:* Biology 279. *Four credit hours.* ANGELINI

BI378s Molecular Biology Listed as Biochemistry 378. *Four credit hours.* VAN OERS

[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.*

[BI392] Cell Biology of Cancer Explores the cellular and molecular mechanisms that underly the development of cancer. In addition, the complexities associated with diagnosing and treating cancer will be considered. *Prerequisite:* Biology 164 and 227. *Three credit hours.*

BI401f, 402s 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

BI483f, 484s 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

[BI483J] Honors Research in Biology *Noncredit.*

BI491f, 492s 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

BI494f Problems in Environmental Science Listed as Environmental Studies 494. *Five credit hours.* BRUESEWITZ, NEAL