Biology (BIOL)

BIOL 1000. Biology at Northeastern. (1 Hour)
Introduces first-year students to the major and the field of biology and to the professional and academic resources available to students at Northeastern University; acquaints students with their faculty, advisors, and fellow students; provides an initial orientation to undergraduate research, cooperative education, and other experiential learning options; helps develop the academic skills necessary to succeed; provides grounding in the culture and values of the university community; and assists in interpersonal skill development—in short, familiarizes students with the resources and skills needed to become a successful university student.

BIOL 1107. Foundations of Biology. (4 Hours)
Introduces evolutionary principles, cellular structure and function, genetic transmission, energy pathways, and physiology. Covers current topics in biology and evaluates and discusses current scientific literature. Explores the interdisciplinary nature of biology. Offers students an opportunity to prepare for the topical inquiries in biology courses.

Corequisite(s): BIOL 1108

BIOL 1108. Lab for BIOL 1107. (1 Hour)
Accompanies BIOL1107. Includes various lab experiments that emphasize evolutionary principles, cellular structure and function, genetic transmission, energy pathways, and physiology.

Corequisite(s): BIOL 1107

BIOL 1111. General Biology 1. (4 Hours)
Explores basic principles of biology with a focus on those features shared by all living organisms and seen through the lens of evolutionary theory. Through lectures, readings and discussion, offers students an opportunity to understand how the scientific method has been and is used to address biological questions. Central topics include recent advances in cell anatomy and physiology, including the interplay between organelles, membrane transport, and cell-signaling; energy transfer through cells and through the biosphere; cellular reproduction and cancer; heredity and human genetic disorders; and protein synthesis and biotechnology. Explores the societal implications of such topics as biopharmaceuticals, ocean acidification, climate change, human diseases, epigenetics, cancer, and cloning.

Attribute(s): NUpath Natural/Designed World

BIOL 1112. Lab for BIOL 1111. (1 Hour)
Accompanies BIOL 1111. Offers students an opportunity to collect quantitative data through hands-on experimentation as well as simulations. Data is analyzed statistically and presented in written form.

Prerequisite(s): BIOL 1111 (may be taken concurrently) with a minimum grade of D-
Attribute(s): NUpath Analyzing/Using Data

BIOL 1113. General Biology 2. (4 Hours)
Continues BIOL 1111. Examines the evolution of structural and functional diversity of organisms; the integrative biology of multicellular organisms; and ecological relationships at the population, community, and ecosystem levels.

Prerequisite(s): BIOL 1101 with a minimum grade of D- or BIOL 1107 with a minimum grade of D- or BIOL 1111 with a minimum grade of D- or BIOL 1115 with a minimum grade of D-
Attribute(s): NUpath Natural/Designed World

BIOL 1114. Lab for BIOL 1113. (1 Hour)
Accompanies BIOL 1113. Covers topics from the course through various experiments.

Prerequisite(s): BIOL 1113 (may be taken concurrently) with a minimum grade of D-

BIOL 1141. Microbes and Society. (4 Hours)
Introduces the unseen world of microorganisms. Students analyze how the growth and behavior of this diverse group of organisms affect many aspects of human society including agriculture and food preparation; drug development and manufacture; liquid and solid waste management; genetic engineering; geochemical cycles; and health and disease.

Attribute(s): NUpath Natural/Designed World

BIOL 1143. Biology and Society. (4 Hours)
Offers an overview of how biology weaves its way across a broad spectrum of complex societal issues. Introduces students to the biological mechanisms and processes responsible for genetic inheritance, energy transfer, evolution, and population dynamics, providing a framework within which students may critically interpret and discuss important biological information provided in public forums. Seeks to empower students to make informed choices at the policy and personal levels. Offers students an opportunity to acquire an understanding of the basic principles of biology and apply the scientific process to the analysis of contemporary issues. Using a thematic approach, covers a wide range of issues including the reemergence of plagues, biological weapons and security, the environment, and human health and wellness.

Attribute(s): NUpath Natural/Designed World

BIOL 1147. The Human Organism. (4 Hours)
Introduces the structure and function of the human body. Emphasizes the principles of biological and physical science as they relate to life processes in health and disease.

Attribute(s): NUpath Natural/Designed World

BIOL 1149. Biology of Human Reproduction. (4 Hours)
Studies sexual and reproductive function in the human male and female, that is, sexual development, coitus, fertilization, pregnancy, birth, and lactation. Discusses the methods of controlling fertility and sexually transmitted diseases. Analyzes factors affecting reproduction and sexuality in human population.

Attribute(s): NUpath Natural/Designed World

BIOL 1153. Human Genome Editing: Science and Ethics. (4 Hours)
Designed to familiarize students with the basic process of human genome editing, including an overview of emerging technologies that enable this process. Explores both sides of the ongoing ethical debate, including the potential benefits and limitations of human genome editing, and ramifications for this clinical practice on society. Introduces the methodology for genetic editing, a historical overview of the science and clinical practice of gene editing, and a synopsis of the current regulatory status. Discusses the ethical implications of the utilization of genome editing in humans. Offers students an opportunity to evaluate the utilization of genetic editing to eradicate genetically inherited diseases, the potential to create designer babies, and the socioeconomic impacts of gene editing.

Attribute(s): NUpath Ethical Reasoning, NUpath Natural/Designed World

BIOL 1990. Elective. (1-4 Hours)
Offers elective credit for courses taken at other academic institutions. May be repeated without limit.

BIOL 2217. Integrated Anatomy and Physiology 1. (4 Hours)
Introduces students to integrated human anatomy and physiology. Focuses on structure and function of cells and tissues. Presents the anatomy and physiology of skin, bones, muscles, blood, and the nervous system.

Corequisite(s): BIOL 2218
Attribute(s): NUpath Natural/Designed World

BIOL 2218. Lab for BIOL 2217. (1 Hour)
Accompanies BIOL 2217. Covers topics from the course through various experiments.

Corequisite(s): BIOL 2217

BIOL 2219. Integrated Anatomy and Physiology 2. (4 Hours)
Continues BIOL 2217. Presents the structure and function of the human endocrine, reproductive, cardiovascular, respiratory, urinary, and digestive systems as well as the regulation of metabolism and body temperature.

Prerequisite(s): BIOL 1117 with a minimum grade of D- or BIOL 2217 with a minimum grade of D-
Corequisite(s): BIOL 2220
Attribute(s): NUpath Natural/Designed World

BIOL 2220. Lab for BIOL 2219. (1 Hour)
Accompanies BIOL 2219. Covers topics from the course through various experiments.

Corequisite(s): BIOL 2219
Attribute(s): NUpath Analyzing/Using Data

BIOL 2221. Foundations of Microbiology. (4 Hours)
Focuses on how to identify, control, and live with bacteria and viruses. Emphasizes the mechanisms of disease production, natural host defense systems, and medical interventions.

Corequisite(s): BIOL 2222

BIOL 2222. Lab for BIOL 2221. (1 Hour)
Accompanies BIOL 2221. Covers topics from the course through various experiments.

Corequisite(s): BIOL 2221

BIOL 2299. Inquiries in Biological Sciences. (4 Hours)
Focuses on the latest developments in the field. Offers students an opportunity to explore both scientific practice and progress through readings, discussion, and projects and to expand and deepen their understanding of fundamental biological principles.

Prerequisite(s): BIOL 1101 with a minimum grade of D- or BIOL 1107 with a minimum grade of D- or BIOL 1111 with a minimum grade of D-
Attribute(s): NUpath Natural/Designed World

BIOL 2301. Genetics and Molecular Biology. (4 Hours)
Focuses on mechanisms of inheritance, gene-genome structure and function, and developmental genetics and evolution. Examples are drawn from the broad spectrum of plants, animals, fungi, bacteria, and viruses. Topics and analytical approaches include transmission genetics, molecular biology and gene regulation, DNA molecular methods, quantitative and population genetics, bioinformatics, genomics, and proteomics.

Prerequisite(s): (BIOL 1103 with a minimum grade of D- or BIOL 1111 with a minimum grade of D- or BIOL 1115 with a minimum grade of D- or BIOL 2297 with a minimum grade of D- or BIOL 2299 with a minimum grade of D- or EEMB 1105 with a minimum grade of D- or EEMB 2290 with a minimum grade of D- or ENVR 2400 with a minimum grade of D- or EEMB 2400 with a minimum grade of D-); (CHEM 1211 with a minimum grade of D- or CHEM 1217 with a minimum grade of D- or CHEM 1151 with a minimum grade of D- or CHEM 1161 with a minimum grade of D-)
Attribute(s): NUpath Natural/Designed World

BIOL 2302. Lab for BIOL 2301. (1 Hour)
Accompanies BIOL 2301. Reinforces and extends concepts presented and practiced in the accompanying lecture course through the application of scientific investigation methods and data analysis.

Prerequisite(s): BIOL 2301 (may be taken concurrently) with a minimum grade of D-
Attribute(s): NUpath Analyzing/Using Data

BIOL 2307. Research Exploration in Biology. (4 Hours)
Introduces basic biological lab skills including lab safety, chemical handling, pipetting, and media preparation. Also introduces the fundamentals of experimental design, data analysis, and scientific communication. Provides an opportunity to explore authentic, current research questions in an immersive laboratory research experience. Coursework consists of team-based projects in which student groups design and execute biological experiments under the mentorship of Northeastern faculty and graduate students. Offers an opportunity to develop a research presentation and present experimental outcomes to fellow students, faculty, and staff.

Prerequisite(s): BIOL 2299 with a minimum grade of C-

BIOL 2309. Biology Project Lab. (4 Hours)
Offers an inquiry-based, intensive laboratory experience in which students have an opportunity to design and conduct independent research projects, applying approaches and techniques used in cell and molecular biology. Offers students an opportunity to present their results in professional formats.

Prerequisite(s): BIOL 2301 with a minimum grade of D-
Attribute(s): NUpath Analyzing/Using Data, NUpath Creative Express/Innov, NUpath Writing Intensive

BIOL 2327. Human Parasitology. (4 Hours)
Examines the general biology, life cycles, modes of transmission, and pathogenesis of major parasites on global human health. Explores a number of important diseases, along with the diverse protozoans, worms, and arthropods responsible for them.

Prerequisite(s): BIOL 1101 with a minimum grade of D- or BIOL 1107 with a minimum grade of D- or BIOL 1111 with a minimum grade of D- or BIOL 1115 with a minimum grade of D-

BIOL 2329. Bioethics. (4 Hours)
Offers students an opportunity to explore ethical issues arising from biological research and emerging technologies, to learn to identify and critically analyze potential ethical implications of biological research, and to evaluate theory-based arguments while respectfully engaging with a diversity of perspectives. Using their knowledge of basic cellular and molecular science as a foundation, students have an opportunity to gain a deeper understanding of the biology of genome editing and other molecular and cellular biology-based technologies. Examines the history and ethical dialogue around genome editing as an in-depth example of an emerging technology with wide-ranging applications. Studies additional technologies with respect to research progress, international perspectives, and potential implications in the areas of security, environmental protection, and personal health.

Prerequisite(s): BIOL 1107 with a minimum grade of D- or BIOL 1111 with a minimum grade of D- or BIOL 2299 with a minimum grade of D-
Attribute(s): NUpath Ethical Reasoning

BIOL 2990. Elective. (1-4 Hours)
Offers elective credit for courses taken at other academic institutions. May be repeated without limit.

BIOL 2991. Research in Biology. (1-4 Hours)
Offers an opportunity to conduct introductory-level research or creative endeavors under faculty supervision. May be repeated seven times.

BIOL 3401. Comparative Vertebrate Anatomy. (4 Hours)
Examines the morphology and phylogeny of the vertebrates.

Prerequisite(s): BIOL 1103 with a minimum grade of D- or BIOL 1113 with a minimum grade of D- or BIOL 2297 with a minimum grade of D- or BIOL 2299 with a minimum grade of D- or ENVR 2290 with a minimum grade of D- or EEMB 2290 with a minimum grade of D-

BIOL 3405. Neurobiology. (4 Hours)
Introduces the cellular and molecular functioning of the nervous system, the organization of neurons into circuits, the processing of information, and the generation of motor output.

Prerequisite(s): BIOL 1103 with a minimum grade of D- or BIOL 1113 with a minimum grade of D- or BIOL 2297 with a minimum grade of D- or BIOL 2299 with a minimum grade of D- or ENVR 2290 with a minimum grade of D- or EEMB 2290 with a minimum grade of D- or PSYC 3458 with a minimum grade of D-

BIOL 3409. Current Topics in Biology. (4 Hours)
Examines selected topics in biology. Topics vary each semester. May be repeated without limit.

Prerequisite(s): BIOL 2301 with a minimum grade of D

BIOL 3411. Current Topics in Cell and Molecular Biology. (4 Hours)
Examines selected topics in cell and molecular biology. Topics vary each semester. May be repeated without limit.

Prerequisite(s): BIOL 2301 with a minimum grade of D-

BIOL 3413. Current Topics in Organismal and Population Biology. (4 Hours)
Examines selected topics in organismal and population biology. Topics vary each semester. May be repeated without limit.

Prerequisite(s): BIOL 1113 with a minimum grade of D- or BIOL 1115 with a minimum grade of D- or BIOL 2299 with a minimum grade of D- or EEMB 2400 with a minimum grade of D-

BIOL 3415. Current Topics in Behavioral Neuroscience. (4 Hours)
Examines selected topics in behavioral neuroscience. Topics vary each semester.

Prerequisite(s): BIOL 2301 with a minimum grade of D-

BIOL 3417. Bioethics of Human Genome Editing. (4 Hours)
Presents an overview of emerging gene-editing technologies, explores ongoing ethical debates, describes the potential benefits and limitations of these technologies, and reviews the ramifications for this clinical practice on society. Topics include a scientific review of gene-editing methodologies, historical timeline for their development, clinical applications, the ethical and socioeconomic impacts, and regulatory status of these technologies. Offers students an opportunity to engage in scientific and ethical discourse, evaluate media reports of genome-editing technologies, and deeply probe a student-selected topic related to human genome editing through a writing project.

Prerequisite(s): BIOL 2301 with a minimum grade of D-

BIOL 3419. Engaging with Genomics: Ethics Law and Policy. (4 Hours)
Focuses on the recent developments in human genetics and how they shape, and are shaped by, society. Topics include several of the most important social and legal aspects of genomic research, including the impact of new technologies on reproduction and kinship, gene editing and enhancement, genetic privacy, race and genomics, and the effects of gene patenting on research and pharmaceutical development. Explores questions related to the responsible conduct of genetic testing and research in human populations, practices of eugenics, rights of stakeholders during genetic testing, the patenting of human genes, and how concepts of race are being used in genetic research and in direct-to-consumer genomics.

Prerequisite(s): BIOL 2301 with a minimum grade of D-

BIOL 3421. Microbiology. (4 Hours)
Introduces morphological, ecological, and biochemical consideration of representative groups of bacteria. Introduces virology and microbial genetics; host-parasite relationships, prokaryotes of medical significance; and physical and chemical controls of microbial growth.

Prerequisite(s): BIOL 2301 with a minimum grade of D-
Corequisite(s): BIOL 3422
Attribute(s): NUpath Writing Intensive

BIOL 3422. Lab for BIOL 3421. (1 Hour)
Accompanies BIOL 3421. Covers topics from the course through various experiments.

Corequisite(s): BIOL 3421

BIOL 3423. Animal Models in Biomedical Research. (4 Hours)
Seeks to familiarize students with the use of animal models in research. Emphasizes specific animal models for physiology through a detailed survey of popular and alternative animal model systems. Covers legislation; ethics; the 3Rs (replacement, reduction, and refinement of animals used in research); and the current principles that guide animal research; as well as study design and statistical analysis and animal model selection. Includes reading assignments from media reports and primary scientific literature. Requires a final report in the form of a formal protocol detailing the use of animal models, including animal model selection, description of methodology, and application of statistics to animal modeling.

Prerequisite(s): BIOL 2301 with a minimum grade of D-

BIOL 3601. Neural Systems and Behavior. (4 Hours)
Reviews major experimental approaches and key concepts used in behavioral neurobiology. Begins with a look at its history. Topics covered include spatial orientation and sensory guidance, neuronal control of motor output, neuronal processing of sensory information, sensorimotor integration, neuromodulation, circadian rhythms and biological clocks, behavioral physiology of large-scale navigation, neurobiology of communication, and cellular mechanisms of learning and memory.

Prerequisite(s): BIOL 3405 with a minimum grade of D- or PSYC 3458 with a minimum grade of D-

BIOL 3603. Mammalian Systems Physiology. (4 Hours)
Designed to familiarize students with fundamental principles in mammalian physiology. Emphasizes major organ systems integration. Where applicable, explores and uses human physiology to reinforce principles in physiology and build upon these principles by analyzing how major organ systems effectively network for proper organismal function. Initially covers the physiological principles of energy and metabolism in mammals, including human adaptation for basic energy requirements, and then delves into basics of membrane transport. Evaluates roles for organ systems integration in the respiratory, cardiovascular, gastrointestinal, hemopoietic, renal, and reproductive systems.

Prerequisite(s): BIOL 2301 (may be taken concurrently) with a minimum grade of D-

BIOL 3605. Developmental Neurobiology. (4 Hours)
Covers the cellular, molecular, and genetic processes that guide neural development. Focuses on how nerve cells are generated, patterned, and connected with one another to regulate animal behavior. Topics include cell differentiation, tissue patterning, neural plasticity, and cognitive development.

Prerequisite(s): BIOL 2301 (may be taken concurrently) with a minimum grade of D-

BIOL 3607. Current Trends in Reproductive Sciences. (4 Hours)
Introduces current trends in the field of reproductive sciences, spanning basic human reproduction, infertility, and potential horizons in medicine. Surveys topics in basic research that have the most promise to make an impact in the field of women's health. Emphasizes human health but includes animal models in the analysis.

Prerequisite(s): BIOL 2301 (may be taken concurrently) with a minimum grade of D-

BIOL 3611. Biochemistry. (4 Hours)
Covers structure and function of biomolecules, central concepts of bioenergetics and thermodynamics, enzyme kinetics and regulation, and metabolic pathways.

Prerequisite(s): BIOL 2301 with a minimum grade of D- ; (CHEM 2313 with a minimum grade of D- or CHEM 2317 with a minimum grade of D-)
Corequisite(s): BIOL 3612

BIOL 3612. Lab for BIOL 3611. (1 Hour)
Accompanies BIOL 3611. Covers topics from the course through various experiments.

Corequisite(s): BIOL 3611

BIOL 3990. Elective. (1-4 Hours)
Offers elective credit for courses taken at other academic institutions. May be repeated without limit.

BIOL 4701. Biology Capstone. (4 Hours)
Integrates and assesses the concepts and skills obtained from the entire biology curriculum, including experiential and classroom-based components. Requires reflection by students on their various educational experiences, extensive research of scientific questions related to these experiences, and development of an original research proposal. Offers students an opportunity to hone communication skills through formal and informal presentations, class discussion, and critique.

Prerequisite(s): ENGW 3307 with a minimum grade of C or ENGW 3315 with a minimum grade of C or ENGW 3302 with a minimum grade of C
Attribute(s): NUpath Capstone Experience, NUpath Writing Intensive

BIOL 4705. Neurobiology of Cognitive Decline. (4 Hours)
Introduces the neuroanatomical and cognitive sequelae of brain aging and neurodegenerative disease. Covers molecular and cellular processes that damage neurons, animal models, and brain imaging. Explores higher-level manifestations of damage to, for example, memory, language, and reward systems.

Prerequisite(s): BIOL 3405 with a minimum grade of D- or PSYC 3458 with a minimum grade of D-

BIOL 4707. Cell and Molecular Biology. (4 Hours)
Integrates molecular biology and biochemistry in the cellular context. Focuses on the organization and function of eukaryotic cells, including the regulation of nuclear structure and gene expression, signal transduction, protein synthesis and growth, cellular energetics, the cytoskeleton and cell motility, cell division, and cell death. Emphasizes the scientific methodologies and approaches that underlie discovery in cell biology.

Prerequisite(s): BIOL 2323 with a minimum grade of D- or BIOL 3611 with a minimum grade of D-

BIOL 4709. Neurobiology of Learning and Memory. (4 Hours)
Explores the neurobiology of learning and memory from the level of the synapse up to the neural systems underlying emergent mnemonic function. Topics include the synaptic mechanisms underlying neural plasticity; the molecular basis of mnemonic processes; and the neural circuits serving distinct memory systems. In addition to lecture-based material, students utilize primary research and review articles from the current scientific literature to evaluate data and develop hypotheses via oral presentations and active discussions in the classroom. The overarching goal of the course is to provide a neurobiological perspective on how information is encoded, consolidated, and later retrieved and the significance of dysfunction in these processes associated with neurologic deficits and disease.

Prerequisite(s): PSYC 3458 with a minimum grade of D- or BIOL 3405 with a minimum grade of D-

BIOL 4900. Biology Research Capstone. (1 Hour)
Offers a capstone experience for biology majors who are concurrently registered for BIOL 4991 or BIOL 4994, in which they are conducting original research under the guidance of an approved mentor. Students conduct a literature search, write a research proposal, conduct the proposed research (in the context of the concurrent 4-SH research course), orally present the research, and produce a final research report. Requires students to reflect on and integrate their prior learning, participate in peer feedback, and revise their work in response to peer and instructor feedback.

Prerequisite(s): (ENGW 3307 with a minimum grade of D- or ENGW 3315 with a minimum grade of D-); (BIOL 4991 (may be taken concurrently) with a minimum grade of D- or BIOL 4994 (may be taken concurrently) with a minimum grade of D-)
Attribute(s): NUpath Capstone Experience, NUpath Writing Intensive

BIOL 4970. Junior/Senior Honors Project 1. (4 Hours)
Focuses on in-depth project in which a student conducts research or produces a product related to the student's major field. Combined with Junior/Senior Project 2 or college-defined equivalent for 8 credit honors project. May be repeated without limit.

BIOL 4971. Junior/Senior Honors Project 2. (4 Hours)
Focuses on second semester of in-depth project in which a student conducts research or produces a product related to the student's major field.

Prerequisite(s): ENGW 3307 with a minimum grade of D- ; (BIOL 4970 with a minimum grade of D- or BIOL 4991 with a minimum grade of D- or BIOL 4992 with a minimum grade of D-)
Attribute(s): NUpath Capstone Experience, NUpath Integration Experience, NUpath Writing Intensive

BIOL 4990. Elective. (1-4 Hours)
Offers elective credit for courses taken at other academic institutions. May be repeated without limit.

BIOL 4991. Research. (4 Hours)
Offers independent laboratory research work on a chosen topic under the direction of members of the department. Course content depends on instructor. May be repeated without limit.

Attribute(s): NUpath Integration Experience

BIOL 4994. Internship. (4 Hours)
Offers students an opportunity for internship work.

Attribute(s): NUpath Integration Experience

BIOL 5100. Biology Colloquium. (1 Hour)
Offers a series of colloquia in biological research by invited experts on current topics. May be repeated without limit.

BIOL 5301. Clinical Embryology. (4 Hours)
Designed to familiarize students with core biological processes associated with fertilization and early embryogenesis in humans, with an emphasis on clinical relevance. Covers fundamental aspects of female fertility and embryo development, including hormonal control of ovarian follicle growth and ovulation, fertilization, preimplantation embryonic development, implantation, and postimplantation embryonic development through gastrulation. Examines current parameters for determining egg and embryo quality. Additionally, discusses evolving stem-cell-based strategies for the treatment of female reproductive failure.

Prerequisite(s): BIOL 2301 with a minimum grade of D- or graduate program admission

BIOL 5306. Biological Clocks. (4 Hours)
Examines the expression of endogenously generated twenty-four-hour (circadian) rhythms in eukaryotic life, emphasizing theoretical foundations as well as current research strategies for understanding how biological clocks work. Presents analytic principles essential for understanding biological rhythmicity in any organism at any level of organization. Emphasizes strategies used to understand the concrete mechanisms underlying biological rhythmicity.

Prerequisite(s): BIOL 2301 with a minimum grade of D- or graduate program admission

BIOL 5535. Expanding Frontiers: Vector-Borne Diseases. (4 Hours)
Explores the biology of vectors and vector-borne infectious diseases. The World Health Organization estimates that about one-fifth of all infectious diseases are caused by vector-borne diseases. Vectors discussed include mosquitoes; ticks; Plasmodium; trypanosomes; Lyme disease-causing bacteria; and arboviruses such as dengue, yellow fever, West Nile, and Zika. Examines the development, metabolism, behavior, and symbiotic relationships—including the vector-host-pathogen relationships—through a student-generated literature review and a research proposal. Thoroughly reviews treatments and prevention strategies ranging from vaccination, pre- and postexposure prophylaxis, antimicrobial intervention, management of sequelae, and vector-control strategies. Discusses each topic from the perspective of historical and modern research.

Prerequisite(s): BIOL 2301 with a minimum grade of D- or graduate program admission

BIOL 5539. Advances in Genome Editing. (4 Hours)
Analyzes the scientific literature to investigate the rapidly changing field of genome editing and identify the implications for biological sciences. Explores developments in genome editing along with the clinical and experimental applications of these tools. Life sciences have been revolutionized by the emergence of technologies that enable precise alterations in DNA sequences, cells, model organisms, and even humans.

Prerequisite(s): BIOL 2301 with a minimum grade of D- or graduate program admission

BIOL 5541. Endocrinology. (4 Hours)
Explores the endocrine regulation of physiological systems, emphasizing current research. Lectures provide background, followed by analysis of primary literature and case studies. Topics include growth, reproduction, nutrient utilization, stress, and environmental endocrine disruption. Emphasizes humans but includes material on other animals, including invertebrates.

Prerequisite(s): BIOL 2319 with a minimum grade of D- or BIOL 2323 with a minimum grade of D- or BIOL 3405 with a minimum grade of D- or BIOL 3611 with a minimum grade of D- or BIOL 4707 with a minimum grade of D- or graduate program admission

BIOL 5543. Stem Cells and Regeneration. (4 Hours)
Explores the biological basis of embryonic, adult, and induced pluripotent stem cells toward an understanding of their roles in development, homeostasis, and regeneration, as well as their therapeutic potential. The study of stem cells is a rapidly advancing area in biology and biomedicine. Although the biological basis of stem cells is a major focus, the course aims to put this knowledge into a biomedical context.

Prerequisite(s): BIOL 2301 with a minimum grade of D- or graduate program admission

BIOL 5549. Inventions in Microbial Biotechnology. (4 Hours)
Offers readings and seminar-style discussion from the current literature on important inventions and practical applications in biotechnology, with a focus on microbiome and antibiotic discovery, emphasizing new concepts.

BIOL 5573. Medical Microbiology. (4 Hours)
Emphasizes host-parasite interactions: virulence, toxins, natural flora, and immunological responses; characteristics of the common bacterial, rickettsial, and protozoal infections in humans; and epidemiology, pathology, vaccines, and chemotherapy.

Prerequisite(s): BIOL 2301 with a minimum grade of D- or graduate program admission

BIOL 5581. Biological Imaging. (4 Hours)
Illustrates imaging principles and techniques and their application to biological problems. Topics vary and may include microscopic and macroscopic approaches in areas such as cellular and neurobiology, ecology, and biochemistry.

Prerequisite(s): BIOL 2301 with a minimum grade of D- or graduate program admission

BIOL 5583. Immunology. (4 Hours)
Provides an overview of the structure and function of genes, proteins, and cells involved in the generation of the immune response. Emphasis is on molecular immunology and immunogenetics.

Prerequisite(s): BIOL 2323 with a minimum grade of D- or BIOL 3611 with a minimum grade of D- or graduate program admission

BIOL 5585. Evolution. (4 Hours)
Discusses history of evolutionary theory and lines of evidence. Emphasis is on mechanisms of speciation. Introduces and discusses current evolutionary topics.

Prerequisite(s): BIOL 2301 with a minimum grade of D- or graduate program admission

BIOL 5587. Comparative Neurobiology. (4 Hours)
Presents a cellular approach to structure and function of the nervous system. Topics include neuronal anatomy, phylogeny of nervous systems, electrophysiology of membrane conductances, synaptic transmission, integration in nerve cells, neuronal networks, sensory systems, motor systems, sensory-motor integration, development and regeneration of neuronal connectivity, and fundamentals of neurotechnology for biomedics. Focuses on the development of these concepts from the primary research literature. A term project involves the design of a simple nervous system for a hypothetical animal.

Attribute(s): NUpath Creative Express/Innov

BIOL 5591. Advanced Genomics. (4 Hours)
Intended for those familiar with the basics of genetics, molecular and cellular biology, and biochemistry, all of which are required to appreciate the beauty, power, and importance of modern genomic approaches. Introduces the latest sequencing methods, array technology, genomic databases, whole genome analysis, functional genomics, and more.

Prerequisite(s): BIOL 2301 with a minimum grade of D- or graduate program admission

BIOL 5593. Cell and Molecular Biology of Aging. (4 Hours)
Covers the recent scientific discoveries that have transformed our understanding of the process of aging. Examines in-depth the current understanding of the molecular mechanisms that control life span in model organisms, including yeast, worms, flies, and mice. Discusses dietary interventions and pharmacological approaches that extend the life span and delay the onset of age-related diseases. Covers potential applications of the new science of aging to improve human health. Requires students to read, discuss, present, and report on primary research papers from the literature.

Prerequisite(s): BIOL 2301 with a minimum grade of D- or graduate program admission
Attribute(s): NUpath Writing Intensive

BIOL 5595. Cell and Molecular Neuroscience. (4 Hours)
Combines molecular biology, cell biology, pharmacology, and genetics to address the fundamental molecular properties of neurons and neuronal networks. At its core, the principles that govern the communication between cells of the nervous system are determined by their molecular components. The molecular landscape defines the individual properties of a neuron and the function of neuronal networks as a whole. Focuses on neuronal signaling through the function of ion channels and receptors, supramolecular mechanisms like synaptic transmission and axonal transport, and the molecular mechanisms that underlie biological networks and neural coding of information. Uses the fundamental understanding of molecular networks as a framework to explore the mechanisms that underlie neurological diseases and disorders. Discusses current treatments and therapies that rely on modulating neuronal signaling through molecular interactions.

Prerequisite(s): (BIOL 2301 with a minimum grade of D- ; (PSYC 3458 with a minimum grade of D- or BIOL 3405 with a minimum grade of D-)) or graduate program admission

BIOL 5597. Immunotherapies of Cancer and Infectious Disease. (4 Hours)
Describes the basic principles and the current promises and disappointments with immunotherapies of cancer. Provides a historical overview of the main barriers between tumors and antitumor killer cells. The unifying focus of the lectures is the role of immunological and physiological negative regulators, i.e., “brakes” of anti-tumor immune response. A significant part of the course is dedicated to the retrospective evaluation of the last three decades of the immunological and biochemical studies that culminated in identification of the “chief of tumor defense operations,” i.e., a hypoxia-adenosinergic pathway in the tumor microenvironment.

Prerequisite(s): BIOL 2301 with a minimum grade of D- or graduate program admission

BIOL 5601. Multidisciplinary Approaches in Motor Control. (4 Hours)
Studies the field of human motor control, or motor neuroscience. Offers students an opportunity to obtain a fundamental understanding of the processes underlying the acquisition and control of sensorimotor behavior. The systems approach connects a variety of disciplines ranging from neurophysiology, to engineering, to neurorehabilitation. Reviews a selection of approaches with emphasis on motor learning. Focuses on early behavioral approaches, more recent neurophysiological and imaging approaches, and rehabilitation. Discusses selected representative papers, including seminal historical papers and more recent studies reflecting the current discussion in the field.

Prerequisite(s): (BIOL 2301 with a minimum grade of D- ; (PSYC 3458 with a minimum grade of D- or BIOL 3405 with a minimum grade of D-)) or graduate program admission

BIOL 5821. Cell and Gene Therapies. (4 Hours)
Presents a comprehensive overview of the most recent clinical approaches in treating previously known incurable diseases. Focuses on an introduction to cell and gene therapy, how gene therapies are developed to treat some rare and genetic diseases, different modalities of in vivo and ex vivo gene therapy (cell therapy), the delivery of genetic materials to the cells, limitations, and more. Offers students an opportunity to learn about CAR T-cell therapy, different types of viruses (AAVs and retroviruses), nanoparticles, CRISPR-Cas9, RNA interference(RNAi), and many more tools in this fast-paced field.

BIOL 6216. Applied Bioinformatics. (4 Hours)
Introduces a foundational understanding of bioinformatics. Emphasizes computational techniques and programming skills essential for analyzing biological data. Covers key bioinformatics concepts such as data types, databases, and algorithms for genomic data analysis, including sequencing. Offers students an opportunity to gain experience with tools used in the analysis of genetic data by engaging with real-world applications in genetic modification and therapeutic genome editing.

BIOL 6299. Molecular Cell Biology for Biotechnology. (3 Hours)
Integrates biochemistry and molecular biology in the cellular context. Includes the organization and replication of genomes, principles and methods for genetic manipulation, the regulation of gene expression, and the structure and function of organelles. Emphasizes protein synthesis, including translation, post-translational modifications, and translocations of proteins within the cells and secretion.

BIOL 6300. Biochemistry. (4 Hours)
Studies the structure and function of biomolecules, with an emphasis on proteins; enzyme catalysis; and cellular metabolism, with an emphasis on bioenergetics and carbohydrate/lipid.

BIOL 6301. Molecular Cell Biology. (4 Hours)
Integrates biochemistry and molecular biology in the cellular context. Emphasizes the organization and replication of genomes, the regulation of gene expression, the structure and function of organelles, and the mechanisms of signal transduction.

Prerequisite(s): BIOL 6300 with a minimum grade of C-

BIOL 6303. Neurobiology and Behavior. (4 Hours)
Provides a comprehensive overview of behavioral neurobiology, emphasizing a neuroethological approach. Fosters a contemporary understanding of the historical development of the behavioral sciences, the major ethological and neurobiological concepts, and the principal mechanisms that govern behavior in animals and humans.

BIOL 6381. Ethics in Biological Research. (2 Hours)
Discusses ethical issues relevant to research in the biological sciences. Requires student presentations.

BIOL 6405. Prokaryotic Cell and Molecular Biology. (4 Hours)
Provides in-depth discussion about fundamentally important cellular processes in prokaryotic systems—such as replication, transcription, and translation—and the corresponding regulatory mechanisms. Also discusses molecular mechanisms of gene regulation and bacterial pathogenesis, using selected examples and mechanisms of prokaryotic cell signaling, and advanced and high-throughput techniques used in prokaryotic molecular and cell biology.

BIOL 6407. Biochemistry for Molecular Biologists. (4 Hours)
Focuses on the interface between molecular biology, molecular genetics, and biochemistry. Concentrates on biochemical problems that molecular biologists are likely to find in their research. Includes examples of prokaryotic and eukaryotic (whenever available) systems. Experimental approaches are discussed for all topics. Seeks to enable students to develop a deep understanding of concepts in biological systems through reading and discussion of the primary literature.

BIOL 6962. Elective. (1-4 Hours)
Offers elective credit for courses taken at other academic institutions. May be repeated without limit.

BIOL 7399. Research Problem Solving, Ethics, and Communication Skills. (4 Hours)
Focuses on research problem-solving skills, including formulation of hypotheses; experimental design, execution, and analysis; and research ethics. Offers instruction in scientific writing, including daily record keeping, grants and papers, and oral communication skills. Discusses the use and misuse of statistics and discusses responsibility to the public. Requires permission of instructor for those students not enrolled in biology.

BIOL 7962. Elective. (1-4 Hours)
Offers elective credit for courses taken at other academic institutions. May be repeated without limit.

BIOL 7986. Research. (0 Hours)
Offers students an opportunity to conduct full-time research under faculty supervision.

BIOL 7990. Thesis. (1-4 Hours)
Offers thesis supervision by members of the department. May be repeated without limit.

BIOL 7996. Thesis Continuation - Half-Time. (0 Hours)
Offers continuing thesis supervision by members of the department.

BIOL 8420. Biological Lab Rotation 1. (4 Hours)
Offers experience in biology research in a faculty research laboratory. Intended only for students who have not yet chosen a lab in which to carry out dissertation/thesis work.

BIOL 8960. Exam Preparation—Doctoral. (0 Hours)
Offers the student the opportunity to prepare for the PhD qualifying exam under faculty supervision.

BIOL 8982. Readings. (1-4 Hours)
Offers readings from current literature on an area of interest to students and faculty. May be repeated without limit.

BIOL 8984. Research. (1-4 Hours)
Focuses on research methods and their application to a specific problem under the direction of a graduate faculty member. May be repeated without limit.

BIOL 8986. Research. (0 Hours)
Offers the student the opportunity to conduct full-time research. May be repeated without limit.

BIOL 9000. PhD Candidacy Achieved. (0 Hours)
Indicates successful completion of the doctoral comprehensive exam.

BIOL 9984. Research. (1-4 Hours)
Focuses on research methods and their application to a specific problem under the direction of a graduate faculty member. May be repeated without limit.

BIOL 9990. Dissertation Term 1. (0 Hours)
Offers theoretical and experimental research for the PhD degree.

Prerequisite(s): BIOL 9000 with a minimum grade of S

BIOL 9991. Dissertation Term 2. (0 Hours)
Offers dissertation supervision by members of the department.

Prerequisite(s): BIOL 9990 with a minimum grade of S

BIOL 9996. Dissertation Continuation. (0 Hours)
Offers dissertation supervision by members of the department.

Prerequisite(s): BIOL 9991 with a minimum grade of S or Dissertation Check with a score of REQ