

# BIOLOGY (BIOL)

## **BIOL 100 Biological Sciences (4 credits)**

The study of life from molecule to organism with focus on structure and function of cells, mechanisms of heredity and change, survey of animals and plants and their interrelationships in the living world. Open to non-majors as well as majors. BIOL 100 is not included in the GPA as a biology major course. Meets Gen Ed - Natural Science Laboratory.

## **BIOL 107 Biology for Survival (3 credits)**

Basic concepts of biology that focus on social implications of pollution, population control, radiation, drugs, pesticides, the genetic revolution, etc. For non-science majors. Biology majors may only take this course as a free elective.

## **BIOL 110 The Biology of Human Life (4 credits)**

The course is intended to serve the non-biology major and present a basic introduction to human anatomy and physiology. It will provide students with a laboratory experience so that they may learn the scientific method and its application in the field of human biology. This course will provide these students with a body of knowledge specific to human anatomy and physiology so that they may be well informed when dealing with important personal, family and societal issues relative to health and life-style decisions. Meets Gen Ed - Natural Science Laboratory.

## **BIOL 111 Emerging Diseases (3 credits)**

This course employs topics in physiology and biology as foundation and forum to probe contemporary health and social issues for which an educated assessment and response requires an understanding of the science behind the issue. Specific topics will be discussed which demonstrate the importance of emerging diseases and how these diseases are affected by the environment, human development and international political events. These topics will include the emergence of new viral diseases, diseases related to diet and diseases related to aging.

## **BIOL 112 Principles of Biology: Introduction to the Cell (4 credits)**

This course involves the study of life from molecule to multicellular organism with focus on structure and function of cells, mechanisms of heredity and change, and the ways in which these processes shape higher levels of biological organization. This course is designed to fulfill the first core course requirement of the biology major. Special fee. Meets Gen Ed - Natural Science Laboratory.

## **BIOL 113 Principles of Biology: Organisms and Diversity (4 credits)**

This course will provide an introductory level study of biodiversity and the origins of life, phylogenetic relationships among organisms, genetics, developmental biology, reproduction, the biology of populations and communities, and ecosystem processes. Special fee.

## **BIOL 213 Introduction to Ecology (4 credits)**

Prerequisite(s): BIOL 113 with a grade of C- or higher. Restriction(s): Majors in Biology, Marine Biology and Coastal Science, Computer Science, Sustainability Science and Biology minors. Semester-long field oriented course designed as an introduction to the natural world. Emphasis will be placed on identifying and characterizing the variety of habitats in New Jersey through field observations, group and individual projects and specimen collection.

## **BIOL 230 Cell and Molecular Biology (4 credits)**

Prerequisite(s): CHEM 120 with a grade of C- or higher and BIOL 112 with a grade of C- or higher. Restriction(s): Majors in Molecular Biology, Biology, Biochemistry and Biology minors. An introduction to the chemistry, structure, and function of prokaryotic and eukaryotic cells. Topics covered include membrane structure and transport processes, bioenergetics and energy transformations in cells, DNA replication and expression, protein synthesis, and cell movement.

## **BIOL 240 Mammalian Anatomy and Physiology I (3 credits)**

Restriction(s): Not for Biology majors; Biology majors may only take this course as a free elective. Human anatomy and physiology for health education and physical education majors.

## **BIOL 243 Human Anatomy and Physiology (4 credits)**

Prerequisite(s): CHEM 130. A study of the dynamics of the human body in relation to its structure and function is based on its nutritional input. Each organ system is discussed in relation to its contribution to the whole functioning organism, as well as a basic survey of its pathologies. Primarily for ADA certification.

## **BIOL 244 Anatomy and Physiology I (4 credits)**

Restriction(s): Departmental approval; non-majors only. The structure and function of the cell, tissue and organ systems-integumentary, skeletal, muscular, circulatory and respiratory. Meets Gen Ed - Natural Science Laboratory.

## **BIOL 245 Anatomy and Physiology II (4 credits)**

Prerequisite(s): BIOL 244. Restriction(s): Not for Biology majors; departmental approval. The structure and function of the organ systems - nervous, excretory, endocrine, digestive and reproductive.

## **BIOL 254 Applied Microbiology (3 credits)**

Prerequisite(s): CHEM 130. Microbiological concepts and techniques applicable to food and dairy processing, health and disease, water, waste and other environmental problems.

## **BIOL 255 Survey of Microbiology (4 credits)**

Prerequisite(s): CHEM 113 for non-biology majors only; or CHEM 114 for Nursing majors only. Microbiological concepts and techniques applicable to medical, health and environmental problems.

## **BIOL 300 Environmental Biology and Related Controversial Issues (3 credits)**

Prerequisite(s): BIOL 213 with a grade of C- or higher. Analysis of ecological problems of today's population trends and control, food production, environmental deterioration, waste disposal etc.

## **BIOL 319 Genes, Brains, and Behavior (4 credits)**

Prerequisite(s): BIOL 112; and BIOL 230 or PSYC 203. Genetics, Neuroscience, and Behavior are three disciplines that overlap and feed off of each other. In this course, the three disciplines will be taught with lecture and hands on lab experience so that students will understand how the three interact with each other. Students will gain experience in molecular genetics, neuroimaging, psychological testing, and scientific investigative processes. Specifics include sequencing of genomes, transcranial magnetic stimulation, event-related potentials, personality measures and dissections. Case studies will be emphasized.

**BIOL 320 Social Neurobiology (3 credits)**

Prerequisite(s): BIOL 230 or PSYC 203. When the animals came to be in the Pre-Cambrian, two developments were about to become realized: Social Interactions and Nervous Systems. There were many reasons for this including the rise of predator/prey relations, the emergence of sexual reproduction, colony formation etc. In the Animal Kingdom, how organisms interact with others is critical to understanding behavior, anatomy, and physiology. We will, in lecture and reading, focus on the nervous system and how it relates to inter and intra species interactions in humans and non-humans. We will integrate neuroscience, social psychology, genetics and evolution so that one will understand the how and the why social interactions look like they do.

**BIOL 330 Introduction to Animal Behavior (3 credits)**

Prerequisite(s): BIOL 213 with a grade of C- or higher. Concepts and theories of the sensory world of animals and behavioral patterns resulting in environmental adaptations.

**BIOL 350 Microbiology (4 credits)**

Prerequisite(s): BIOL 230 with a grade of C- or higher and CHEM 120 with a grade of C- or higher. Restriction(s): Majors in Molecular Biology, Biology, Biochemistry and Biology minors. A study of bacteria, yeast, molds and other microorganisms in relation to modern biological concepts and the welfare of man. Standard techniques employed in the laboratory.

**BIOL 351 Introduction to Aquatic Ecology (4 credits)**

Prerequisite(s): BIOL 213, CHEM 120 and CHEM 121. Introduction to Aquatic Ecology is a course that introduces students to the fundamental biological systems associated with marine and fresh water communities and serves as the foundation aquatic biological course for the BS/MS Marine and Coastal Sciences program. Equivalent course AQUA 351 effective through Summer 2023.

**BIOL 360 Introduction to Bio-Imaging (3 credits)**

Prerequisite(s): BIOL 230 with a grade of C- or higher or departmental approval. An introduction to biological applications of microscopy. Topics include history of microscopy, preparation of samples for light and electron microscopy, phase, polarization, interference, confocal, and cryogenic microscopy, as well as transmission and scanning electron microscopy. Special attention will be paid to microscopic localization and dynamics of biological molecules plus ions and intracellular messengers.

**BIOL 370 Principles of Ecology (3 credits)**

Prerequisite(s): BIOL 213 with a grade of C- or higher. To acquaint the biology majors with the general principles of ecology, population dynamics and adaptations of plants and animals to the various habitats.

**BIOL 380 Genetics (4 credits)**

Prerequisite(s): BIOL 230 with a grade of C- or higher and CHEM 120 with a grade of C- or higher. Restriction(s): Majors in Molecular Biology, Biology, Biochemistry and Biology minors. Lecture and lab. Heredity, gene and chromosomal structure and function, gene regulation, mutation and repair, genes in populations, genetic manipulation, and applied genetics are covered. Lab exercises demonstrate genetic concepts. A semester-long project with research paper is required. Required of all biology majors and minors. Meets the Graduation Writing Requirement for majors in Biology and Molecular Biology.

**BIOL 404 Plant and Animal Histological Techniques (3 credits)**

Prerequisite(s): BIOL 213 with a grade of C- or higher and BIOL 230 with a grade of C- or higher. Basic techniques and skills in preparation of permanent microscopic slides of plant and animal tissue.

**BIOL 405 Cell Culture (3 credits)**

Prerequisite(s): BIOL 350 with a grade of C- or higher and BIOL 380 with a grade of C- or higher. Theory of and practice in working with living cells: tissue culture techniques, cell communication, differentiation, regeneration and aging in several living cell systems.

**BIOL 406 Scanning Electron Microscopy (4 credits)**

Prerequisite(s): BIOL 380 with a grade of C- or higher. Introduction to theory and practice of scanning electron microscopy. Includes specimen preparation, scanning electron microscope operation, electron specimen interactions/imagery, and microanalysis.

**BIOL 409 Externship in Biological Research (Co-operative Education) (1-4 credits)**

Prerequisite(s): BIOL 380 with a grade of C- or higher and departmental approval. Full or part-time work in an established laboratory with a scientific investigator for the duration of the term. May be repeated for a maximum of 8 credits.

**BIOL 410 Toxicology (3 credits)**

Prerequisite(s): BIOL 380 with a grade of C- or higher and CHEM 230 with a grade of C- or higher. Examination of the major classes of toxic agents by identifying characteristics of their toxicity and factors which modify this outcome.

**BIOL 411 Introduction to Transmission Electron Microscopy (4 credits)**

Prerequisite(s): BIOL 380 with a grade of C- or higher. Basic theory and practice of electron microscopy. Specimen preparation, ultramicrotomy, microscopy, photographic preparation of final print, interpretation of results.

**BIOL 415 Population Genetics (3 credits)**

Prerequisite(s): BIOL 380 with a grade of C- or higher and departmental approval. Detailed survey of the theory and application of the genetics of populations. Topics to be covered include Hardy-Weinberg Equilibrium and Evolution, Natural and Artificial Selection, Migration, Mutation, Bottlenecks, Random Genetic Drift, and Genetic Variation. Students will learn population genetic principles and the mathematical theory behind those principles.

**BIOL 417 Evolutionary Biology (3 credits)**

Prerequisite(s): BIOL 213 with a grade of C- or higher; and BIOL 380 with a grade of C- or higher. Restriction(s): Majors in Biology, Molecular Biology and Biology minors. Mechanisms and processes underlying biological evolution, including natural selection, genetic drift, mutation, quantitative genetics and speciation. The central organizing principle of life science, evolutionary biology investigates the study of molecular biology, organisms, and ecology.

**BIOL 418 Biology Independent Research (1-4 credits)**

Prerequisite(s): Minimum GPA 3.0 and BIOL 213 with a grade of C- or higher or BIOL 230 with a grade of C- or higher and departmental approval. Under the guidance of a sponsor, students will investigate individual problems of appropriate scope. A written and/or oral report is required. May be repeated for a maximum of 8 credits. (Offered on demand.)

**BIOL 420 Economic Botany (3 credits)**

Prerequisite(s): BIOL 213 with a grade of C- or higher. Importance of plants to the world in general and to man in particular. (Not offered every year.)

**BIOL 422 Community Ecology (3 credits)**

Prerequisite(s): BIOL 213 with a grade of C- or higher. Community ecology bridges biodiversity science, biogeography, evolution and conservation. This course will provide students with a quantitative approach to understanding patterns and processes that define ecological communities, with an emphasis on theoretical, experimental, and quantitative approaches. The class format includes lectures, journal discussions, and hands-on processing and simulations of ecological data.

**BIOL 425 Elementary Plant Physiology (3 credits)**

Prerequisite(s): BIOL 213 with a grade of C- or higher and BIOL 230 with a grade of C- or higher and CHEM 230 with a grade of C- or higher. Major physiological processes of the flowering plant: growth, metabolism, photosynthesis, respiration, water relations and mineral nutrition. (Not offered every year.)

**BIOL 426 New Jersey Flora (4 credits)**

Prerequisite(s): BIOL 213 with a grade of C- or higher. Field identification of mosses, liverworts, ferns, and seed plants in a variety of habitats. (Not offered every year.)

**BIOL 429 Herpetology (4 credits)**

Prerequisite(s): BIOL 213 with a grade of C- or higher. Biology of the extant ectothermic tetrapods (amphibians and non-avian reptiles) including field identification, systematics, anatomy, physiology, behavior, reproduction and ecology. Laboratory includes field trips on a varying schedule.

**BIOL 430 Ornithology (4 credits)**

Prerequisite(s): BIOL 213 with a grade of C- or higher. The biology, identification, and natural history of birds in a variety of habitats. Laboratory includes trips on a varying schedule.

**BIOL 431 Entomology (3 credits)**

Prerequisite(s): BIOL 213 with a grade of C- or higher. Identification, physiology and ecology of common insect families. Offered periodically.

**BIOL 432 Medical Entomology (3 credits)**

Prerequisite(s): BIOL 213 with a grade of C- or higher. The study of arthropods that are vectors of diseases afflicting man and domestic animals. (Not offered every year.)

**BIOL 433 Developmental Biology (4 credits)**

Prerequisite(s): BIOL 230 with a grade of C- or higher and BIOL 380 with a grade of C- or higher and CHEM 230 with a grade of C- or higher. This course discusses the concepts and principles that are rapidly emerging from studies of developmental processes in animals. We shall consider egg organization, origins of cell differences, molecular mechanisms of cell differentiation, cell movements, inductive interactions in animals, long-range signaling mechanisms, and the cellular and molecular processes underlying pattern formation.

**BIOL 434 Molecular Biology (3 credits)**

Prerequisite(s): BIOL 350 with a grade of C- or higher and BIOL 380 with a grade of C- or higher and CHEM 370 with a grade of C- or higher. This course is designed to examine the molecular biology of plant and animal cells.

**BIOL 435 Experimental Molecular Biology (3 credits)**

Prerequisite(s): BIOL 434 with a grade of C- or higher. A laboratory course that will introduce biology and molecular biology majors to the basic techniques of modern molecular biology. Techniques to be covered include nucleic acid isolation, restriction enzyme mapping, plasmid manipulation and subcloning, genomic library construction, PCR amplification, and DNA sequence analysis.

**BIOL 436 Phylogenetic Zoology (4 credits)**

Prerequisite(s): BIOL 213 with a grade of C- or higher. Phylogenetic Zoology is a comprehensive survey of evolutionary zoology. The focus of the course is on the ecological and evolutionary processes that shape the natural histories of aquatic and terrestrial animals. Integrated lecture and laboratory investigations will explore the anatomy, physiology, diversity, ecology and evolutionary significance of animal clades. This course is designed to fulfill major elective requirements of the biology major.

**BIOL 439 Biology of Animal Parasites (3 credits)**

Prerequisite(s): BIOL 213 with a grade of C- or higher and BIOL 230 with a grade of C- or higher. The basic principles of parasitism. Ecological, morphological, and physiological adaptations for parasitism. Evolution of parasites and integration with the host.

**BIOL 440 Gross Mammalian Anatomy (4 credits)**

Prerequisite(s): BIOL 230 with a grade of C- or higher. Functional mammalian anatomy at the microscopic and gross level. Laboratory dissection of the cat and study of selected organs and anatomical models.

**BIOL 441 Comparative Anatomy of Vertebrates (4 credits)**

Prerequisite(s): BIOL 213 with a grade of C- or higher and BIOL 230 with a grade of C- or higher. A critical analysis of the ontogeny and morphology of the protochordates and chordates, and their phylogenetic relationships drawn from the fossil record, evolutionary trends, and comparisons of homologies and analogies. Materials include: extensive dissections, outside readings, and field trip to the American Museum of Natural History.

**BIOL 442 Human Physiology (4 credits)**

Prerequisite(s): BIOL 380 with a grade of C- or higher and CHEM 230 with a grade of C- or higher. Functions of animal organs and systems with emphasis on maintenance of homeostasis.

**BIOL 443 Vertebrate Embryology (4 credits)**

Prerequisite(s): BIOL 380 with a grade of C- or higher and CHEM 230 with a grade of C- or higher. Developmental anatomy of the vertebrates, especially amphibian, chick and human. General concepts of development and cell differentiation. (Not offered every year.)

**BIOL 444 Cell Physiology (3 credits)**

Prerequisite(s): BIOL 380 with a grade of C- or higher and CHEM 230 with a grade of C- or higher. Advanced course in cell function.

**BIOL 445 Immunology (3 credits)**

Prerequisite(s): BIOL 380 with a grade of C- or higher and CHEM 230 with a grade of C- or higher. Cellular and humoral immunological responses, immunoglobulins, antigen-antibody reactions, immunopathology, transplantation and blood transfusion. (Not offered every year.)

**BIOL 446 Endocrinology (3 credits)**

Prerequisite(s): BIOL 380 with a grade of C- or higher and CHEM 230 with a grade of C- or higher. Basic anatomy and physiology of the mammalian endocrine glands with special attention directed to the human endocrine glands. The interrelationships between the various endocrines including neural control and the role of these glands in maintaining the homeostasis of the body will be stressed.

**BIOL 447 Fundamentals of Pharmacology (3 credits)**

Prerequisite(s): BIOL 380 with a grade of C- or higher and CHEM 230 with a grade of C- or higher. Introduction to the study of chemicals that have biological effects, with special emphasis on those with medical importance. 3.

**BIOL 450 Medical Microbiology (3 credits)**

Prerequisite(s): BIOL 350 with a grade of C- or higher. The course is designed to acquaint the biology major with those microorganisms which cause disease, the prevention of disease, therapeutic agents to control microbial diseases and the body's natural defense mechanisms.

**BIOL 451 Comparative Animal Physiology (3 credits)**

Prerequisite(s): BIOL 213 with a grade of C- or higher and BIOL 230 with a grade of C- or higher. A comparison of physiological processes across vertebrate and invertebrate groups. Topics may include feeding and digestion, energy metabolism, ventilation, circulation, and osmoregulation.

**BIOL 457 Virology (3 credits)**

Prerequisite(s): BIOL 380 with a grade of C- or higher. This course will develop the fundamental principles of modern virology and examine the connection between viruses and disease. It will examine the molecular biology of virus replication, infection, gene expression, the structure of virus particles and genomes, pathogenesis, and classification of viruses.

**BIOL 458 Microbial Genetics (3 credits)**

Prerequisite(s): BIOL 350 with a grade of C- or higher and BIOL 380 with a grade of C- or higher. Microbial Genetics provides students with an understanding of the basis for genetic processes in microorganisms and the implication for higher organisms. The focus of the course will be on prokaryotes, particularly *E. coli*, and viruses, primarily bacteriophages. Current developments in microbial genetics, such as bioinformatics and genomics, will be presented.

**BIOL 460 Biological Oceanography (3 credits)**

Prerequisite(s): BIOL 213 with a grade of C- or higher. Biological processes within oceans and estuaries are considered in relation to the physical environment. Field and laboratory work. (Not offered every year.)

**BIOL 461 Aquatic Ecology (3 credits)**

Prerequisite(s): BIOL 112 with a grade of C- or higher and BIOL 213 with a grade of C- or higher. Biological and physical processes of rivers and lakes. Field work and laboratory. (Not offered every year.)

**BIOL 467 Biology of the Fishes (4 credits)**

Prerequisite(s): BIOL 213 with a grade of C- or higher. Systematics, adaptations, reproduction, evolution, ecology and zoo-geography of major groups of marine fishes. At New Jersey Marine Sciences Consortium. (Not offered every year.)

**BIOL 468 Neurobiology (3 credits)**

Prerequisite(s): BIOL 230 with a grade of C- or higher and BIOL 380 with a grade of C- or higher. Fundamental principles and current concepts of neuronal function, including evidence that lead to these concepts, organization of the peripheral nervous system and the brain, current scientific approaches and methods in neuroscience. Special attention will be given to molecular and cellular bases of brain function and their role in neurological diseases and their treatment.

**BIOL 475 Medical Genetics (3 credits)**

Prerequisite(s): BIOL 230 with a grade of C- or higher and BIOL 380 with a grade of C- or higher and CHEM 230 with a grade of C- or higher. A detailed study and analysis of human genetics, inborn genetic diseases, genomics, gene therapy, and the Human Genome Project.

**BIOL 476 Biology of Cancer (3 credits)**

Prerequisite(s): BIOL 230 with a grade of C- or higher and BIOL 380 with a grade of C- or higher and CHEM 230 with a grade of C- or higher. An in depth examination of the biology of cancer, including risk factors, genetics, causes of cancer, metastasis, therapies (conventional and recombinant DNA), and prevention will be presented. This course will also help students develop proficiency in critically evaluating primary scientific articles dealing with cancer.

**BIOL 480 Research Community I: Organism Biology (4 credits)**

Prerequisite(s): BIOL 213 with a grade of C- or higher and BIOL 230 with a grade of C- or higher. Survey of topics and techniques in contemporary organism biology research. Exploration and integration of molecular, cellular, physiological, population and ecological phenomena as they relate to biology at the organism level. Students will prepare and present a scientific research proposal for peer and faculty review.

**BIOL 481 Research Community II: Organism Biology (4 credits)**

Prerequisite(s): BIOL 480 with a grade of C- or higher. Team-based independent research on topics in contemporary organismal biology. Students will conduct experimental explorations designed in the prerequisite course, BIOL 480. Students will ultimately prepare and present a scientific research paper for peer and faculty review.

**BIOL 482 Research Community I: Molecular Biology (4 credits)**

Prerequisite(s): BIOL 380 with a grade of C- or higher. Survey of topics and techniques in contemporary molecular biology research. Exploration and integration of molecular, cellular, physiological, population and ecological phenomena as they relate to biology at the molecular level. Students will prepare and present a scientific research proposal for peer and faculty review.

**BIOL 483 Research Community II: Molecular Biology (4 credits)**

Prerequisite(s): BIOL 482 with a grade of C- or higher. Team-based independent research on topics in contemporary molecular biology. Students will conduct experimental explorations designed in the prerequisite course, BIOL 482. Students will ultimately prepare and present a scientific research paper for peer and faculty review.

**BIOL 484 Research Community I: Ecology (4 credits)**

Prerequisite(s): BIOL 112 with a grade of C- or higher and BIOL 213 with a grade of C- or higher. Survey of topics and techniques in contemporary ecology research. Exploration and integration of molecular, cellular, physiological, population and ecological phenomena as they relate to biology at the ecological level. Students will prepare and present a scientific research proposal for peer and faculty review.

**BIOL 485 Research Community II: Ecology (4 credits)**

Prerequisite(s): BIOL 484 with a grade of C- or higher. Team-based student independent research on topics in contemporary ecology. Students will conduct experimental explorations designed in the prerequisite course, BIOL 484. Students will ultimately prepare and present a scientific research paper for peer and faculty review.

**BIOL 486 Special Topics in Biology (3-4 credits)**

Prerequisite(s): BIOL 213 with a grade of C- or higher and BIOL 230 with a grade of C- or higher. This course will acquaint the student with recent developments and specialized content in the biological sciences. Examples of topic areas are: vision science, biological modeling, forensic entomology, disease ecology, pathophysiology, and mitochondrial genomics. This course is designed to fulfill elective requirements of the biology major. This course may be repeated once for a maximum of 8 credits.



**BIOL 487 Statistical Genomics (3 credits)**

Prerequisite(s): BIOL 380 and STAT 330; or equivalent with departmental approval. Analysis of discrete data, illustrated with genetic data on morphological characters, allozymes, restriction fragment length polymorphisms and DNA sequences. Maximum likelihood and Bayesian estimation, including iterative procedures. Numerical resampling and bootstrapping. Development of statistical techniques for characterizing genetic disequilibrium and diversity. Locating genes with markers. Mutually Exclusive with STAT 487.

**BIOL 488 Special Topics in Cell and Molecular Biology (3-4 credits)**

Prerequisite(s): BIOL 380 with a grade of C- or higher or departmental approval. This course will acquaint the student with recent developments and specialized content in cell and molecular biology. Examples of topic areas are: cellular metabolism, cell signaling, molecular analysis and molecular biology of disease. This course is designed to fulfill elective requirements of the biology and the molecular biology major. May be repeated once for a maximum of 8 credits.

**BIOL 489 Special Topics in Organismal Biology (3-4 credits)**

Prerequisite(s): BIOL 213 with a grade of C- or higher or BIOL 230 with a grade of C- or higher or departmental approval. This course will acquaint the student with recent developments and specialized content in organismal biology. Examples of topic areas are: physiology under extreme environments, comparative physiology, structural biology and infectious disease. This course is designed to fulfill elective requirements of the biology and the molecular biology major. Variable credit 3-4 semester hours. Course may be repeated for a maximum of 8 semester hours.

**BIOL 490 Senior Seminar in Biology (3 credits)**

Restriction(s): Senior status in Department of Biology. Course which will allow the advanced undergraduate student to study controversial biological, bioethical, and ecological issues in a seminar format. Students will be required to produce written and verbal presentations utilizing peer-reviewed scientific papers. Presentations will be in both individual and group formats.

**BIOL 491 Research in Biology Literature (1 credit)**

Prerequisite(s): BIOL 230 with a grade of C- or higher. Each student will survey current biological literature pertinent to a specific problem. A comprehensive report is required. May be repeated for a maximum of 3 credits.

**BIOL 492 Senior Colloquium (1 credit)**

Prerequisite(s): BIOL 380 with a grade of C- or higher or departmental approval. Students in this course will read primary resources material and interpret the data. This course will also teach students how to read, critique and present scientific data to a peer group. Students will analyze, discuss and present primary research articles with respect to scientific content, accuracy of the data and significance of the experiments.

**BIOL 493 Molecular Ecology (3 credits)**

Prerequisite(s): BIOL 213 with a grade of C- or higher and BIOL 230 with a grade of C- or higher and BIOL 380 with a grade of C- or higher. Detailed survey of the application of molecular methods to address ecological, behavioral, and conservation questions. Topics to be covered include the principles of most common molecular techniques used in molecular ecology, and application of those molecular techniques to phylogeography, behavioral ecology, population genetics, conservation genetics, and adaptive variation.

**BIOL 495 Special Topics in Ecology (3 credits)**

Prerequisite(s): BIOL 213 with a grade of C- or higher and BIOL 380 with a grade of C- or higher. This course will acquaint the student with recent developments and specialized content in ecology. Examples of topic areas are: behavioral ecology, ecological physiology, evolutionary ecology, population ecology, community dynamics and ecosystem energetics. This course is designed to fulfill elective requirements of the biology major.

**BIOL 497 Genomics (3 credits)**

Prerequisite(s): BIOL 230 with a grade of C- or higher and BIOL 380 with a grade of C- or higher. The course will examine the associations among nucleic acid sequence (RNA and DNA), structure, and function in complex biological systems, while treating these systems as biological databases. Both computer program-based and laboratory methods will be discussed to better understand the relationship between nucleic acid sequence and function. Future opportunities and current limitations of genome analyses will be critically addressed.

**BIOL 500 Introductory Molecular Cell Biology (1.5 credit)**

Prerequisite(s): Permission of graduate advisor. This course will focus on an introduction to the science and methods of cell and molecular biology.

**BIOL 501 Biology for Middle Grade Teaching (4 credits)**

Restriction(s): Majors in Elementary School with Subject Matter Specialization: Science 5-8 or program coordinator approval. This course will provide concepts and learning activities for middle school teacher and will emphasize the study of life from molecule to organism, with a focus on the structure and function of cells, mechanisms of heredity and change, biodiversity, phylogenetic relationships among organisms, biology of populations, and communities, and ecosystems. Equivalent course SCIM 501 effective through Summer 2019.

**BIOL 505 Experimental Cell Culture (3 credits)**

Prerequisite(s): BIOL 380, or similar Genetics course with passing grade and a previous Microbiology course or experience. This graduate course will provide theoretical and practical experience working on living cells. Provides understanding, observation, and hands-on experiences in tissue and organ culture techniques, primary cell culturing, cell differentiation, and techniques in toxicity and mutagenicity assays, plant callus and protoplast experimentation.

**BIOL 510 Biology Pedagogy for Secondary Teachers (3 credits)**

Prerequisite(s): 24 semester hours in biology. Seminar and research course designed for study of methods and practices being used in teaching of secondary school biology.

**BIOL 512 Special Topics in Modern Genetics (3 credits)**

Prerequisite(s): Undergraduate course in genetics. Seminar course. Selected topics from current development in genetic research, including chromosome and gene fine structure, extra chromosomal genetic elements, genetic engineering, and aspects of biomedical genetic research. May be repeated once for a maximum of 6 credits as long as the topic is different.

**BIOL 514 Graduate Seminar in Biology (2 credits)**

Restriction(s): Graduate biology majors only. Through a series of seminars delivered by faculty and guests, students will survey a broad range of topics in modern biology, and be introduced to the variety of specializations represented within the department. Emphasis shall be placed on recent advances in diverse areas of biology.

**BIOL 515 Population Genetics (3 credits)**

Prerequisite(s): BIOL 547 or permission of instructor. Detailed survey of the theory and application of the genetics of populations. Topics to be covered include Hardy-Weinberg Equilibrium and Evolution, Natural and Artificial Selection, Migration, Mutation, Bottlenecks, Random Genetic Drift, and Genetic Variation. Students will learn population genetic principles and the mathematical theory behind those principles. Students will be required to write a literature paper on a topic of their choice related to Population Genetics.

**BIOL 518 Strategies for Teaching College Biology (1 credit)**

Restriction(s): BS in Biology and departmental approval. Biology Teaching Assistants and upper-level undergraduates with interests in teaching will interact with experienced teachers, but more importantly will gain access to a forum for discussing their experiences and concerns with other prospective biology teachers. Students will discuss contemporary articles on science teaching at the college level.

**BIOL 520 Plant Physiology (3 credits)**

Prerequisite(s): Permission of instructor. Investigation of physiology of plants. Plant growth, development and reproduction as well as the new advances in plant physiology. Water relations of plants, mineral nutrition, physiological significance of soil and soil moisture, photosynthesis, respiration, plant biosynthesis and dynamics of growth.

**BIOL 521 Field Studies of Flowering Plants (4 credits)**

Prerequisite(s): Botany and field course in biology. The taxonomy, evolutionary trends and ecological adaptations of the gymnosperms and angiosperms. A variety of habitats will be visited and analyzed.

**BIOL 524 Advanced Systemic Physiology I (3 credits)**

Restriction(s): Graduate Standing or departmental approval. This course is a comprehensive survey course centered on the biology of the major human physiological systems with a focus on their role and interactions in order to maintain homeostasis for the human body. This course will focus primarily on the following subjects and systems: homeostasis, cell physiology, signal transduction, neurophysiology and the brain, nervous systems, and immune function. Integrated lectures, discussions, and projects will investigate these systems at a molecular, cellular and systemic level to understand how the human body regulates itself in an ever changing world.

**BIOL 525 Advanced Systemic Physiology II (3 credits)**

Restriction(s): Graduate standing or permission of the instructor. A comprehensive survey course centered on the biology of the major human physiological systems with a focus on their role and interactions in order to maintain homeostasis for the human body. This course will focus primarily on the following systems: Cardiovascular, Musculoskeletal, Liver, Kidney and Reproductive systems. Integrated lectures, discussions, and projects will investigate these systems at a molecular, cellular and systemic level to understand how the human body regulates itself in an ever changing world.

**BIOL 529 Advanced Herpetology (4 credits)**

Prerequisite(s): BIOL 113. Biology of the extant ectothermic tetrapods (amphibians and non-avian reptiles), including field identification, systematics, anatomy, physiology, behavior, reproduction, and ecology.

**BIOL 532 Advanced Entomology (3 credits)**

Restriction(s): Matriculation in MS Biology program or permission of instructor. Examination of insects as model systems for biological inquiry. Topics include an integrative treatment of insect molecular biology, genetics, physiology, behavior, evolution and ecology.

**BIOL 533 Advanced Cell Biology (3 credits)**

Restriction(s): Matriculation in the biology master's program or permission of professor. Detailed analysis of cellular structure and function. Topics to be covered include the role of subcellular organelles in maintaining cell viability, analysis of cytoskeletal components, structure and function of the plasma membrane and cellular defects that lead to cancer and other disease states.

**BIOL 535 Advanced Community Ecology (3 credits)**

The field of Community ecology bridges biodiversity science, biogeography, evolution and conservation. This course will provide graduate students with a quantitative approach to understanding patterns and processes that define ecological communities, with an emphasis on theoretical, experimental, and quantitative approaches. The class format includes lectures, journal discussions, and hands-on processing and simulations of ecological data. Students in this course will be expected to read, comprehend, and evaluate literature that defines theories and models that define community ecology, including classic literature. Additionally, students will learn basic syntax allowing them to use R, a programming language. Graduate students will be expected to use those basic syntax skills to utilize provided code to model ecological populations and communities, and evaluate those results.

**BIOL 540 Mammalian Physiology (3 credits)**

Restriction(s): Graduate standing, but not open to students who have completed undergraduate upper division Mammalian/Human Physiology classes. A broad survey of the physiology of mammalian systems aimed at graduate students who lack an upper-level background in physiology at the undergraduate level. The principles of homeostatic mechanisms as they apply to various organ systems will be stressed.

**BIOL 542 Advanced Endocrinology (3 credits)**

Prerequisite(s): BIOL 444 and BIOL 446. A study of the physiology of the mammalian endocrine system with emphasis on hormonal control of homeostasis.

**BIOL 543 Advances in Immunology (3 credits)**

Prerequisite(s): Immunology. To study in detail selected topics in immunology.

**BIOL 544 Advanced Comparative Animal Physiology (3 credits)**

Restriction(s): Undergraduate degree in Biology or permission of instructor. Students who have previously completed BIOL 451 may not enroll. The physiological mechanisms involved in the varied responses of both vertebrates and invertebrates to critical fluctuations of their physico-chemical environment.

**BIOL 545 Experimental Endocrinology (4 credits)**

Prerequisite(s): Endocrinology. A seminar and laboratory course in endocrinology in which the various endocrine glands will be surgically removed or chemically destroyed and the morphologic and physiologic effects measured and observed.

**BIOL 546 Special Topics in Physiology (3 credits)**

Prerequisite(s): An undergraduate or graduate course in Physiology and departmental approval. To give the student an in-depth understanding of a specific area of physiology in which there is a rapidly expanding body of knowledge. May be repeated once for a maximum of 6 credits as long as the topic is different.

**BIOL 547 Molecular Biology I (3 credits)**

Prerequisite(s): Cell biology, and one year organic chemistry. Central concepts at the cellular level will be emphasized. Contemporary viewpoints in the areas of biomolecules, energy yielding and energy requiring processes and transfer of genetic information.

**BIOL 548 Molecular Biology II (4 credits)**

Prerequisite(s): BIOL 547. Central concepts at the cellular level will be emphasized. Contemporary viewpoints in the areas of biomolecules, energy yielding and energy requiring processes and transfer of genetic information. The laboratory will deal with up-to-date investigative procedures via selected experiments.

**BIOL 549 Special Topics in Developmental Biology (3 credits)**

Prerequisite(s): Genetics and developmental embryology. Seminar in the regulation of developmental events, including both classical morphogenesis and recent advances using techniques of cell and molecular biology. May be repeated once for a maximum of 6 credits as long as the topic is different.

**BIOL 550 Special Topics in Microbiology (3 credits)**

Prerequisite(s): Microbiology. Coverage of selected topics such as the microbial genetics, antibiotic action, bacteriophage, virus, cancer and microbial metabolism. Emphasis will be placed on practical applications of modern research in specific areas. May be repeated once for a maximum of 6 credits as long as the topic is different.

**BIOL 552 Biology of Lipids (3 credits)**

Prerequisite(s): Cell biology and organic chemistry. Biological cycles, unity and diversity in metabolic paths, metabolic evolution, metabolic control mechanisms and other special topics. Primary emphasis is placed on the metabolism of lipids.

**BIOL 553 Advanced Pathophysiology (3 credits)**

Prerequisite(s): BIOL 524, BIOL 525, BIOL 540 or permission from instructor. This course is a comprehensive survey course investigating the adaptations that human physiological systems undergo when an outside challenge pushes the body away from homeostasis. Integrated lectures, discussions, and projects will investigate changes at both a molecular and systemic level to understand how the human body responds in an effort to return to baseline. Topics will include the physiological response to exercise, aging, injury/disease, as well as various environmental extremes.

**BIOL 554 Microbial Physiology (3 credits)**

Prerequisite(s): Microbiology. A study of microorganisms in terms of their morphology and metabolism. The significance of metabolic diversity and secondary metabolic products of various microorganisms will be explored through lecture topics. The economic significance of microbial metabolism in relation to industry and pathogenic diseases will be emphasized.

**BIOL 555 Medical Genetics (3 credits)**

Prerequisite(s): A genetics course or permission of instructor. A detailed study and analysis of human genetics, inborn genetic diseases, genomics, gene therapy, and the Human Genome Project.

**BIOL 556 Molecular Biology of Proteins (3 credits)**

Restriction(s): Admission into the graduate biology program or permission of department. Study of the molecular biology of biomolecules, including proteins. The course will examine how changes in the three dimensional structure of biomolecules affect their biological function. Protein engineering, enzyme catalysis, and site-directed mutagenesis will be discussed.

**BIOL 557 Virology (3 credits)**

Prerequisite(s): Satisfactory completion of a Cell & Molecular Biology course or permission of instructor. This course will develop the fundamental principles of modern virology and examine the connection between viruses and disease. It will examine the molecular biology of virus replication, infection, gene expression, the structure of virus particles and genomes, pathogenesis, classification of viruses, and contemporary viral research.

**BIOL 558 Microbial Genetics (3 credits)**

Prerequisite(s): BIOL 350. Microbial Genetics provides students with an understanding of the basis for genetic processes in microorganisms and the implication for higher organisms. The focus of the course will be on prokaryotes, particularly E.coli, and viruses, primarily bacteriophages. Current developments in microbial genetics, such as bioinformatics and genomics, will be presented.

**BIOL 560 Molecular Genetics (3 credits)**

Prerequisite(s): BIOL 547 with a grade of B or higher. A course that will focus on biological research problems that are being addressed in eucaryotic systems from a molecular genetics viewpoint.

**BIOL 561 Genomics (3 credits)**

Prerequisite(s): BIOL 380 or permission of instructor. Describes the entire DNA sequence of organisms. Facilitates the understanding of the function of the genomes. Specific topics include comparative genomics, functional genomics and bioinformatics.

**BIOL 562 Special Topics in Molecular Biology (1 credit)**

Prerequisite(s): BIOL 547. Focus on specific topics in molecular biology including the development induced pluripotent cells, advances in RNA interference and recent innovations in understanding transcriptional regulation. Emphasis will be placed on providing the most up to date information on these topics. May be taken for up to 6 credits as long as the topics are different.

**BIOL 563 Statistical Genomics (3 credits)**

Prerequisite(s): BIOL 547 and STAT 401 or equivalent Statistics course as determined by department. Introduction to the statistical problems arising recently in gene mapping, high throughputomic data analysis, phylogenetics and sequence analysis by integrating of both statistics and genomics. To learn the statistical methods and concepts that are of particular use in analyzing genetics and genomic data.

**BIOL 564 Proteomics (3 credits)**

Prerequisite(s): BIOL 547. Proteomics is the study of the entire complement of proteins expressed by a genome. This course will describe the structure of the proteins in the proteome and the functional interaction between the proteins and cover the development of large-scale technologies for protein separation, isolation, detection and quantitation.

**BIOL 566 Bioinformatics (4 credits)**

Prerequisite(s): BIOL 547. Describes the computational analysis of gene sequences, protein structures, and expression datasets on a large scale. Provides a way in which to manage and store huge amounts of data, and to create statistical tools for analyzing it. Specific topics include biological database search tools, DNA sequence alignment and comparison, analysis of protein structure, and phylogenetics analysis, as well as topics of current interest.

**BIOL 568 Advanced Neuroscience (3 credits)**

Prerequisite(s): BIOL 547 or departmental approval. The students will achieve an understanding of current concepts of nervous system function at the cellular level and at the level of higher systems and brain. The students will learn about the state of the art methods in modern neuroscience research and their applications. They will summarize and critique primary research papers and develop research proposals based on the acquired knowledge and their vision of future progress in neuroscience. A particular attention will be given to the molecular and cellular mechanisms of neurological diseases, and to current scientific approaches to treatment.

**BIOL 570 Ecology (3 credits)**

Prerequisite(s): Botany and zoology. Basic ecological principles and concepts. Habitat approach to field exercises in fresh water and terrestrial ecology. Intra and interspecific relationships with all living members of the ecosystem, problems in plant and animal biology.

**BIOL 571 Physiological Plant Ecology (4 credits)**

Prerequisite(s): Botany and one course in field biology. The effects of soil, light, and water on plant growth, as well as, toxic effects of metals and salinity are measured using growth chamber and greenhouse facilities.

**BIOL 572 Wetland Ecology (4 credits)**

Prerequisite(s): Botany, and zoology, and field biology. Important biotic, chemical and physical parameters of New Jersey's estuaries. Evolution and successional trends of estuarine communities. Ecology of individual communities studied by field trips to Delaware Bay shore and to some Atlantic coast bays, marshes and offshore barrier islands. Also offered at the New Jersey Marine Sciences Consortium.

**BIOL 573 Shoreline Ecology (4 credits)**

Prerequisite(s): Botany, and zoology, and field biology. Community structure, trophic dynamics, species diversity and distribution of bottom dwelling organisms in relationship to their environment; lectures, laboratory work and field investigations of the marine benthos. Also offered at NJ Marine Sciences Consortium.

**BIOL 574 Behavioral Ecology (3 credits)**

Prerequisite(s): Field biology and zoology. This seminar course explains the ecological consequences of animal behavior, viewed within the context of how behavior evolves and how populations adapt to their environments.

**BIOL 575 Avian Biology (4 credits)**

Prerequisite(s): BIOL 570 or permission of instructor. An in-depth examination of the biology and life histories of birds, including their anatomy, physiology, behavior, ecology and systematics. Laboratory includes field trips on a varying schedule.

**BIOL 576 Biology of Extreme Habitats (3 credits)**

The course will describe the adaptations that allow the survival of plants and animals, as well as microorganisms, in a variety of extreme habitats. Some of these habitats include: deserts, arctic, grassland, estuaries.

**BIOL 578 Urban Ecology (3 credits)**

Prerequisite(s): BIOL 570 or department approval. Majority of human populations are living in cities; the proportion of people living in cities is increasing worldwide. Additionally, the projected growth of human population is predicted to occur largely in urban areas. Urban Ecology is a subdiscipline of Ecology focusing on the consequences of urbanization on ecological systems, functions and processes. In this course, we will examine how both nature and humans have responded ecologically to urbanization. We will discuss factors, such as hydrology, temperature, nutrient cycling, pollution, invasive species and biodiversity, in urban systems. The class will also investigate ways to improve urban ecology through remediation, green engineering and sustainable living.

**BIOL 579 Physiological Ecology of Animals (3 credits)**

Restriction(s): Graduate standing in Biology or permission of instructor. A variety of different animals, ranging from protists to mammals, will be examined and compared to demonstrate the physiological adaptations they have evolved to successfully survive and reproduce.

**BIOL 580 Evolutionary Mechanisms (3 credits)**

Restriction(s): Matriculation in the biology master's program or permission of the instructor. This course will provide students the opportunity to read primary resource material and interpret the findings of the data. This course will also teach students how to read, critique and present scientific data to a peer group. Students will analyze, discuss and present primary research articles with respect to scientific content, accuracy of the data and significance of the experiments.

**BIOL 586 Special Topics in Advanced Biology (3-4 credits)**

Prerequisite(s): BIOL 520 or BIOL 540 or BIOL 547 or BIOL 570. This course is designed to provide advanced biology graduate students with a literature intensive exploration of current developments and specialized content in the biological sciences. Topics will cover specific research areas in ecology, physiology, molecular biology, embryology and bioinformatics. This course is designed to fulfill elective requirements of the biology masters degree. This course may be repeated once for a maximum of 8 credits. Special fee.

**BIOL 587 Special Topics in Advanced Molecular Biology (3-4 credits)**

Prerequisite(s): BIOL 547. This course is designed to provide advanced biology and molecular biology graduate students with a literature intensive exploration of current developments and specialized content in the biological sciences. Topics will cover specific research areas in molecular biology. This course is designed to fulfill elective requirements of the biology masters degree and the molecular biology masters degree.

**BIOL 588 Special Topics in Advanced Physiology (3-4 credits)**

Prerequisite(s): BIOL 520 or BIOL 540. This course is designed to provide advanced biology and molecular biology graduate students with a literature intensive exploration of current developments and specialized content in the biological sciences. Topics will cover specific research areas in physiology. This course is designed to fulfill elective requirements of the biology masters degree and the molecular biology masters degree.

**BIOL 589 Special Topics in Advanced Ecology (3-4 credits)**

Prerequisite(s): BIOL 570. This course is designed to provide advanced biology and molecular biology graduate students with a literature intensive exploration of current developments and specialized content in the biological sciences. Topics will cover specific research areas in ecology. This course is designed to fulfill elective requirements of the biology masters degree and the molecular biology masters degree.



**BIOL 592 Graduate Colloquium (1 credit)**

Restriction(s): Matriculation in the biology master's program or permission of the professor. Students in this course will read primary resource material and interpret the data. This course will also teach students how to read, critique and present scientific data to a peer group. Students will analyze, discuss and present primary research articles with respect to scientific content, accuracy of the data and significance of the experiments.

**BIOL 593 Molecular Ecology (3 credits)**

Prerequisite(s): BIOL 547 or instructor's permission. Detailed survey of the application of molecular methods to address ecological, behavioral, and conservation questions. Topics to be covered include the principles of most common molecular techniques used in molecular ecology, and application of those molecular techniques to phylogeography, behavioral ecology, population genetics, conservation genetics, and adaptive variation. Students will develop and present independent research proposal.

**BIOL 594 Signal Transduction (3 credits)**

Prerequisite(s): BIOL 547 or permission of instructor. This course will cover various aspects of cellular signaling from the plasma membrane to the nucleus. Topics will include specific signal transduction systems, methods for studying these systems and the results of these signaling events on cell division, cell differentiation and cell function.

**BIOL 595 Conservation Biology: The Preservation of Biological Diversity (3 credits)**

Prerequisite(s): Botany, and zoology, and field biology. This course addresses concerns about the loss of biological diversity and genetic resources through species extinctions. Students will learn about the importance of maintaining biological diversity, the problems involved in monitoring and protecting sensitive and crucial habitat, the impact of human societies on biodiversity, the alternatives to the destruction of habitat/species, the prospects of restoration, and the policies needed to prevent the loss of biological diversity. Students will also learn about population processes that are directly related to species survival.

**BIOL 596 Selected Techniques in Biology Science Education (1.5 credit)**

Restriction(s): Biology teaching certification or approval of instructor. A laboratory course that trains teachers in manipulatives suitable for secondary biology education. Students will be introduced to a variety of physiological, ecological, molecular biological techniques applicable for implementation in secondary school classrooms. May be repeated three more times for a total of six semester hours.

**BIOL 597 Research in Biological Literature (1 credit)**

Prerequisite(s): Departmental approval. To allow the student to investigate and evaluate a specific topic in biology under the supervision of a faculty member and to develop the student's skills in presenting current research in both the written and oral modes.

**BIOL 598 Selected Techniques in Molecular Biology (1.5 credit)**

Prerequisite(s): Undergraduate or graduate molecular biology courses or equivalent and permission of instructor. A laboratory course that trains students in advanced techniques in molecular biology. Students will learn how to perform a specific technique as well as learning the theory behind the technique. May be repeated for a maximum of 6 credits.

**BIOL 599 Introduction to Biological Research (4 credits)**

Prerequisite(s): Departmental approval. A research experience in which students will be exposed to current biologic techniques by working with scientific investigators in industry, or within the department. Students will work on projects involving research techniques, data collection and the analysis and interpretation of the data.

**BIOL 601 Advanced Biological Science Education Pedagogy (3 credits)**

This course aims for the development of an understanding of the pedagogy of inquiry-based learning and of the processes of scientific investigation and reasoning, as well as other factors influencing effective teaching (e.g. equity issues, assessment methods, and communication skills). Modeling of the inquiry-based approach will be applied to a range of scientific concepts, focusing on biological concepts such as natural selection, meiosis and Mendelian genetics, and photosynthesis. As these concepts are explored, relevant science education literature will be examined in order to understand the nature of student conceptions as well as broader issues of constructivist and situated learning and implications of philosophy and sociology of science for science education.

**BIOL 698 Master's Thesis (4-6 credits)**

Prerequisite(s): Departmental approval. Independent research project done under faculty advisement. Students must follow the MSU Thesis Guidelines, which may be obtained from the Graduate School. Students should take BIOL 699 if they don't complete BIOL 698 within the semester.

**BIOL 699 Master's Thesis Extension (1 credit)**

Prerequisite(s): BIOL 698. Continuation of Master's Thesis Project. Thesis Extension will be graded as IP (in Progress) until thesis is completed, at which time a grade of Pass or Fail will be given.