

# BIOLOGY (BIOL)

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## **BIOL 101 General Biology I (3 semester hours)**

Unifying principles of biology; introduction to cell structure and function, genetics, control systems, tissues, organs, and organ systems. Frank R. Seaver College of Science and Engineering majors only.

## **BIOL 102 General Biology II (3 semester hours)**

An introduction to the mechanism of evolution; major patterns of biotic evolution; and the principles of ecology. Prerequisites: BIOL 101 and BIOL 111. Frank R. Seaver College of Science and Engineering majors only.

## **BIOL 111 General Biology I Lab (2 semester hours)**

A survey of the three domains of life and exploration of the morphological, functional, and environmental factors that influence their biodiversity. Prerequisite: BIOL 101 or concurrent enrollment. Frank R. Seaver College of Science and Engineering majors only.

## **BIOL 112 General Biology II Lab (2 semester hours)**

An experimental approach to biology with emphasis on design, execution, and analysis to answer biological questions. Prerequisites: BIOL 101, BIOL 102 or concurrent enrollment, and BIOL 111. Frank R. Seaver College of Science and Engineering majors only.

## **BIOL 114 Biology for Engineers (3 semester hours)**

This course addresses fundamental concepts and language of biology. Topics include cell biology, genetics, organ systems, ecosystems, organisms, and engineering applications. Frank R. Seaver College of Science and Engineering majors only.

## **BIOL 190 First Year Biology Seminar (0 semester hours)**

This course provides perspectives and insight into being a successful Biology major at Loyola Marymount University, including available resources and activities such as course registration and meeting with academic advisors. Students will learn about how to identify and get involved in scientific research on campus and will hear professional seminars from campus and visiting biologists. Corequisite: BIOL 111. Biology majors only. Credit/No Credit only.

## **BIOL 194 Introduction to Research (1 semester hour)**

An introduction to scientific research methodology: information gathering, data analysis, laboratory research practice in a faculty laboratory.

## **BIOL 196 Independent Research With Faculty (1 semester hour)**

Independent undergraduate research in a faculty laboratory. Credit/No Credit only. May be repeated for credit. Permission of instructor required.

## **BIOL 198 Special Studies (0-4 semester hours)**

## **BIOL 199 Independent Studies (1-4 semester hours)**

## **BIOL 201 Cell Function (3 semester hours)**

Cellular and sub-cellular structures and functions including: DNA and RNA structure and function; protein synthesis and structure; enzyme function; metabolic pathways; membrane function. Prerequisites: BIOL 101, CHEM 112, or concurrent enrollment.

## **BIOL 202 Genetics (3 semester hours)**

A study of Mendelian and molecular genetics. Prerequisite: BIOL 201. University Core fulfilled: Explorations: Nature of Science, Technology, and Mathematics.

## **BIOL 214 Environmental Biology (3 semester hours)**

Provides a background in the fundamental concepts of biology, microbiology, and ecosystems and their importance and relationships to a variety of civil and environmental engineering applications. Frank R. Seaver College of Science and Engineering majors only.

## **BIOL 216 Medical Microbiology (3 semester hours)**

The major features and biology of microorganisms (viruses, bacteria, protozoans, fungi), including reproduction, virulence, and control both inside and outside the host. Emphasis will be placed on the interactions of microorganisms with humans, especially those microorganisms that cause disease and the host's immune response during infection. Prerequisites: BIOL 101, BIOL 111, CHEM 110, and CHEM 111. Health and Human Science majors only.

## **BIOL 217 Medical Microbiology Lab (1 semester hour)**

Basic techniques for the handling and culture of bacteria; sterile technique, sample collection, and isolation of bacteria; staining and microscopy, characterization and identification of unknown bacteria; evaluation of antimicrobial agents; diagnostic testing. Prerequisite: BIOL 216 or concurrent enrollment. Health and Human Science majors only.

## **BIOL 260 Human Biology (3 semester hours)**

The discussion of general biological principles with a human emphasis. Topics include: cells; heredity and reproduction; animal behavior; organ systems; drugs; disease; ecology; and evolution. Prerequisite: MATH 101 or higher, or placement into MATH 106 or higher.

## **BIOL 263 Natural History of Southern California (3 semester hours)**

Introduction to the geography, climate, plant communities, and common animals of Southern California; animals will be covered in regard to behavior, taxonomy, and ecology. Prerequisite: MATH 101 or higher, or placement into MATH 106 or higher.

## **BIOL 264 The Marine Environment (3 semester hours)**

An introduction to marine biology, including its history, different communities and the animals and plants that occur in marine ecosystems, and their economic importance. Prerequisite: MATH 101 or higher, or placement into MATH 106 or higher. University Core fulfilled: Explorations: Nature of Science, Technology, and Mathematics.

## **BIOL 266 Sacred and Medicinal Plant Use (3 semester hours)**

The sacred and medicinal use of plants and fungi by traditional and modern cultures, including the biological basis for their use. Prerequisite: MATH 101 or higher, or placement into MATH 106 or higher. University Core fulfilled: Explorations: Nature of Science, Technology, and Mathematics.

## **BIOL 271 Human Reproduction and Development (3 semester hours)**

The biological aspects of human reproduction, including the basic reproductive system, genetics, fetal development, nutrition, pregnancy, birth, and neonatal development. Prerequisite: MATH 101 or higher, or placement into MATH 106 or higher. University Core fulfilled: Explorations: Nature of Science, Technology, and Mathematics.

## **BIOL 272 Human Drug Use (3 semester hours)**

The physiological, psychological, and social effects of the use of alcohol, tobacco, and other therapeutic and recreational drugs. Prerequisite: MATH 101 or higher, or placement into MATH 106 or higher. University Core fulfilled: Explorations: Nature of Science, Technology, and Mathematics.

**BIOL 275 Human Genetics (3 semester hours)**

Basic Mendelian genetics and the application to individual risk assessments. Population genetics and the implications of artificial selection. Modern molecular genetics and medical applications. Prerequisite: MATH 101 or higher, or placement into MATH 106 or higher. University Core fulfilled: Explorations: Nature of Science, Technology, and Mathematics; Flag: Quantitative Literacy.

**BIOL 276 Epidemics and Infectious Diseases (3 semester hours)**

An introduction to microbiology with an emphasis on microorganisms (bacteria, viruses, parasites, and fungi) that cause disease in humans. Viral replication, pathogenic mechanisms of bacteria, transmission of parasites, the function of the immune system, and vaccination will be examined in context of diseases of historical, social, and public health importance. Prerequisite: MATH 101 or higher, or placement into MATH 106 or higher. University Core fulfilled: Explorations: Nature of Science, Technology, and Mathematics.

**BIOL 277 Plants and Society (3 semester hours)**

An introduction to the natural evolution of plant species and the associated cultural evolution of man's relationship to plants. A multidisciplinary approach to studying the relationship between plants and people. An exploration of plants as sources of food and medicine, commercial products, and the role of plants in preserving and restoring the environment. Prerequisite: MATH 101 or higher, or placement into MATH 106 or higher.

**BIOL 278 Tropical Marine Ecology (3 semester hours)**

Field studies of the tropical marine habitats in Isla Roatan, Honduras. This includes the examination of the ecology and biology of coral reefs, mangroves, seagrass beds, and intertidal communities. Prerequisite: MATH 101 or higher, or placement into MATH 106 or higher. Open water SCUBA certification highly recommended. University Core fulfilled: Explorations: Nature of Science, Technology, and Mathematics. Offered Summer semester - Study Abroad Program.

**BIOL 294 Independent Research (0-4 semester hours)****BIOL 295 Biology Internship (1-2 semester hours)**

Work experience involving research, industry-, or community-based projects. May be taken only once for credit. Credit/No Credit only.

**BIOL 296 Independent Research with Faculty (1 semester hour)**

Independent undergraduate research in a faculty laboratory. May be repeated for credit. Credit/No Credit only. Permission of instructor required.

**BIOL 298 Special Studies (1-4 semester hours)****BIOL 299 Independent Studies (0-4 semester hours)****BIOL 304 Biostatistical Analysis (3 semester hours)**

This course is designed to teach students how to analyze and interpret quantitative data using introductory and basic univariate and multivariate statistical methods. It demonstrates practical applications in addition to basic theory. We apply these methods to actual data from biological, ecological, and public health applications. Prerequisites: BIOL 101 and BIOL 102; MATH 122 or MATH 131; MATH 123 or MATH 132 or MATH 204. Permission of instructor required.

**BIOL 309 Applied Plant Ecology (3 semester hours)**

An integrative course focusing on the foundational role of plants in ecosystems and how ecological principles and theory can be applied to solving local and global conservation and resource management problems. Prerequisites: BIOL 101, BIOL 102, and BIOL 201. Permission of instructor required.

**BIOL 311 Plant Interactions (3 semester hours)**

Study of various ways in which plants interact with other organisms, such as herbivores, pathogens, symbiotic bacteria and fungi, and the outcomes of that interplay. Examination of the physiological, biochemical, and genetic bases of these interactions and how understanding the chemical and molecular communication that takes place has implications for improvement of agriculture and human health. Prerequisites: BIOL 101, BIOL 102, BIOL 112, BIOL 201, BIOL 202; CHEM 220. Permission of instructor required.

**BIOL 312 Field Botany (4 semester hours)**

The identification, distribution, evolution, and ecological relationships of the native plants of Southern California. Prerequisites: BIOL 101, BIOL 102, BIOL 111, BIOL 112; CHEM 110, CHEM 111; MATH 122 or MATH 131. University Core fulfilled: Flag: Engaged Learning. Permission of instructor required.

**BIOL 314 Tropical Ecology (4 semester hours)**

An introduction to Neotropical biodiversity, natural history and conservation, as well as an examination of the diversity of tropical species interactions in an international field setting. Prerequisites: BIOL 101, BIOL 102, BIOL 111, BIOL 112; CHEM 221; MATH 122 or MATH 131. Travel embedded course—lab travels to Costa Rica during Spring break. Permission of instructor required.

**BIOL 315 World Vegetation Ecology (3 semester hours)**

Characteristics and distribution of the major vegetation types of the world, emphasizing environmental conditions, plant adaptations and ecosystem processes. Prerequisites: BIOL 101, BIOL 102, BIOL 111; CHEM 110, CHEM 112. Permission of instructor required.

**BIOL 316 Island Biology (3 semester hours)**

Island biogeography and evolution, dispersal, adaptive radiation, gigantism/dwarfism, flightlessness, reproductive biology, endemism, and relictnalism. Prerequisites: BIOL 101 and BIOL 102. Permission of instructor required.

**BIOL 318 Principles of Ecology (4 semester hours)**

An exploration of the interactions between organisms and their biotic and abiotic environment across population, community, and ecosystem levels. Prerequisites: BIOL 101, BIOL 102, BIOL 111, BIOL 112, BIOL 201; MATH 122 or MATH 131. Permission of instructor required.

**BIOL 319 Coastal Ecology (3 semester hours)**

This course provides students with a comprehensive overview of the ecology of coastal ecosystems, bridging the gap between terrestrial, freshwater, and marine systems. Students will utilize primary literature to study biodiversity, abiotic and biotic interactions, ecological drivers present, and adaptations of organisms to thrive in their unique environments. Students will develop a deep understanding of the ecology of different coastal habitats and current conservation efforts, practice skills in science communication, and engage in discussions on relevant literature and current topics of interest to the course. Prerequisites: BIOL 101, BIOL 102. Permission of instructor required.

**BIOL 320 Coastal Ecology Lab (1 semester hour)**

In this course, students will engage in both lab and field activities, studying a variety of coastal environments. Students will 1) learn field and laboratory techniques to observe and quantify diversity in a variety of coastal habitats, including the use and effectiveness of conservation efforts; 2) learn to identify Southern California coastal flora and fauna; 3) develop and carry out a research project relevant to the course material; 4) learn to think critically, analyze data, and communicate science effectively in multiple formats. Prerequisites: BIOL 101, BIOL 102, BIOL 111, BIOL 112. Permission of instructor required.

**BIOL 321 Urban Ecology (3 semester hours)**

An analysis of the dynamic and integrated nature of urbanized landscapes. Using active inquiry and the original literature, the course will engage the current theories and practice of the research being conducted on the patterns and process of urban ecosystems—ranging from biodiversity and trophic dynamics, to public health and environmental justice. Prerequisites: BIOL 101 and BIOL 102. Permission of instructor required.

**BIOL 322 Urban Ecology Lab (1 semester hour)**

An inquiry-based investigation into the biophysical and human social dimensions of a local urban ecosystem, with a focus on group project development. At least one Saturday trip. Prerequisites: BIOL 111, BIOL 112 and BIOL 321, or concurrent enrollment. Permission of instructor required.

**BIOL 325 Avian Biology Lab (1 semester hour)**

An inquiry-based investigation into the biophysical and human social dimensions of a local urban ecosystem, with a focus on group project development. At least one Saturday trip. Prerequisites: BIOL 111 and BIOL 112. Permission of instructor required.

**BIOL 327 Quantifying Biodiversity Field Laboratory (1 semester hour)**

Biodiversity is the variety of life on Planet Earth at all levels, from genes to ecosystems. In this course we will tackle the practical challenge of quantifying or counting biological diversity. Different methods are better suited for measuring different types of organisms; thus our focus will be on learning an assortment of field-based observational approaches to quantify biodiversity. We will aim to use traditional methods (quadrat sampling, transect sampling, visual searches) and emerging technology tools (remote sensing, environmental DNA, remote-controlled submersible). We will also explore the importance of practical considerations of survey spatial extent and duration, target organism's life history and population characteristics, terrain and vegetation challenges, and effort/cost trade-offs. Prerequisites: BIOL 102, BIOL 111, BIOL 112. Permission of instructor required.

**BIOL 328 Tropical Marine Ecology (3 semester hours)**

Field studies of the tropical marine habitats on Isla Roatan, Honduras. This includes the examination of physical, chemical, and ecological aspects as applied to coral reefs, mangroves, seagrass beds, and intertidal communities. Prerequisites: BIOL 101, BIOL 102, BIOL 111, BIOL 112; CHEM 110, CHEM 112. Open water SCUBA certification highly recommended. University Core fulfilled: Explorations: Nature of Science, Technology, and Mathematics; Flag: Engaged Learning. Permission of instructor required. Offered Summer semester - Study Abroad Program.

**BIOL 329 Marine Ecology of Baja, California (3 semester hours)**

Field studies of subtropical, intertidal and subtidal habitats along the coasts of Baja, California, peninsula. Emphasis on community structure. Prerequisites: BIOL 101, BIOL 102, BIOL 111, BIOL 112; CHEM 110, CHEM 112. Permission of instructor required. Offered Summer semester. Entire course held at the LMU Baja, California Biological Station.

**BIOL 330 Embryology and Development (4 semester hours)**

The development of chordates with emphasis on experimental embryology and underlying molecular mechanisms. Prerequisites: BIOL 101, BIOL 111, BIOL 112, BIOL 201, BIOL 202; CHEM 222, CHEM 223. Permission of instructor required.

**BIOL 333 Biology of Mammals (4 semester hours)**

Examination of physical, physiological, and ecological characteristics of mammals, including taxonomic relationships, feeding and reproductive strategies, and local and world distribution of mammalian orders and families. Prerequisites: BIOL 101, BIOL 102, BIOL 111, BIOL 112; CHEM 110, CHEM 112. For majors only. University Core fulfilled: Flags: Engaged Learning, Writing. Permission of instructor required.

**BIOL 334 Invertebrate Zoology (4 semester hours)**

A study of the anatomy, physiology, behavior, and ecology of invertebrates and the evolutionary relationships within and among the invertebrate phyla. Prerequisites: BIOL 101, BIOL 102, BIOL 111, BIOL 112; CHEM 110, CHEM 112. Permission of instructor required.

**BIOL 335 Comparative Anatomy (4 semester hours)**

A comparative study of the vertebrate structures and their significance in terms of their evolution and function. Prerequisites: BIOL 101, BIOL 102, BIOL 111, BIOL 112; CHEM 110, CHEM 112. Permission of instructor required.

**BIOL 338 Animal Behavior (4 semester hours)**

Study of the evolutionary aspects of behavioral ecology including foraging strategies, social competition, communication, sexual selection, mating systems, cooperation, and social organization. Prerequisites: BIOL 101, BIOL 102, BIOL 111, and BIOL 112. University Core fulfilled: Flag: Writing. Permission of instructor required.

**BIOL 340 Embryology (3 semester hours)**

This class delves into the tissue and cell movements (morphogenesis), into the cellular differentiation pathways, and the genetic and epigenetic mechanisms that produce form and function in chordate embryos. Prerequisites: BIOL 101, BIOL 111, BIOL 112, BIOL 201, BIOL 202; CHEM 220. Permission of instructor required.

**BIOL 341 Embryology Lab (1 semester hour)**

The study of embryology through development histologically, through dissection and experimental embryology. Observational skills will be improved through hand-drawn reproductions, learning to recognize embryonic features and stages and become familiar with histology and anatomical terminology in sections. Students will design, conduct, make observations and document, analyze, and write up an approved, novel experimental embryology project of their own choosing. Prerequisites: BIOL 101, BIOL 111, BIOL 112, BIOL 201, BIOL 222, BIOL 340 or concurrent enrollment; CHEM 222, CHEM 223. Permission of instructor required.

**BIOL 343 Developmental Biology (3 semester hours)**

Introduction to the molecular and cellular mechanisms governing the development of multicellular animals, with attention to genetic control. The biology of model systems is emphasized. Prerequisites: BIOL 101, BIOL 111, BIOL 112, BIOL 201, and BIOL 202. Permission of instructor required.

**BIOL 344 Developmental Biology Lab (1 semester hour)**

A survey course highlighting developmental principles through observation and experimentation with a variety of animal systems. Topics include fertilization, gastrulation, patterning, organogenesis, and regeneration. Prerequisites: BIOL 101, BIOL 111, BIOL 112, BIOL 201, BIOL 202, and BIOL 343 or concurrent enrollment. Permission of instructor required.

**BIOL 351 General Physiology (3 semester hours)**

Introduction to physiological principles and concepts with emphasis on organ systems. Prerequisites: BIOL 101, BIOL 102, BIOL 201; CHEM 110, CHEM 112. Permission of instructor required.

**BIOL 352 General Physiology Lab (1 semester hour)**

Laboratory experiments in general physiology. Prerequisites: BIOL 111, BIOL 112, and BIOL 351 or BIOL 357, or concurrent enrollment. Cannot be taken if already completed BIOL 360. University Core fulfilled: Flags: Quantitative Reasoning, Writing. Permission of instructor required.

**BIOL 353 Plant Physiology (3 semester hours)**

Introduction to plant function, including photosynthesis, mineral nutrition, water relations, metabolism, and growth processes. Prerequisites: BIOL 101, BIOL 201; CHEM 220, MATH 122 or MATH 131. Permission of instructor required.

**BIOL 354 Plant Physiology Laboratory (1 semester hour)**

Laboratory experiments in plant physiology. Prerequisites: BIOL 111, BIOL 112, and BIOL 353 or concurrent enrollment. University Core fulfilled: Flag: Writing. Permission of instructor required.

**BIOL 355 Plants, Pharmacy, and Medicine (3 semester hours)**

The historical, ethnobotanical, and chemical basis of medicinal plant use, plant-based pharmaceuticals, and their physiological efficacy. Prerequisites: BIOL 101, BIOL 102, BIOL 201; CHEM 220; MATH 122 or MATH 131. University Core fulfilled: Flag: Oral Skills. Permission of instructor required.

**BIOL 356 Cell Biology (3 semester hours)**

A detailed study of subcellular organelles, including their origin, function, and regulation within the cell. Prerequisites: BIOL 101, BIOL 201, BIOL 202; CHEM 222, CHEM 223. Permission of instructor required.

**BIOL 357 Comparative Animal Physiology (3 semester hours)**

Environmental and evolutionary influences on functioning of animals, focusing on mechanisms and strategies utilized by animals to cope with challenges imposed by their biotic and abiotic surroundings. Prerequisites: BIOL 101, BIOL 102, BIOL 201; CHEM 110, CHEM 112. Permission of instructor required.

**BIOL 358 Hormones and Behavior (4 semester hours)**

Study of the interaction of hormones and behavior in vertebrates. Topics include organizational and activational effects of hormones, sex differences in behavior, reproductive behavior, parental behavior, social behavior, and stress. Prerequisites: BIOL 101, BIOL 111, BIOL 112, BIOL 201; CHEM 220, CHEM 221. University Core fulfilled: Flag: Engaged Learning. Permission of instructor required.

**BIOL 359 Cell Biology Laboratory (1 semester hour)**

Laboratory experiments in cell biology. Prerequisites: BIOL 111, BIOL 112, BIOL 201; CHEM 220. Permission of instructor required.

**BIOL 360 Comparative Animal Physiology Laboratory (1 semester hour)**

Laboratory experiments in Comparative Physiology. Prerequisites: BIOL 111, BIOL 112, and BIOL 351 or BIOL 357 or concurrent enrollment. Cannot be taken if already completed BIOL 352. Permission of instructor required.

**BIOL 361 General Microbiology (3 semester hours)**

Properties and ecology of viruses, bacteria and protists, including the genetics, physiology, and metabolism of bacteria; pathogenesis, reproduction, and control of bacteria and viruses; host-microbe interactions and immune responses; and microbes as tools for molecular biology. Prerequisites: BIOL 101, BIOL 201, BIOL 202, and CHEM 220. Permission of instructor required.

**BIOL 362 General Microbiology Laboratory (1 semester hour)**

Laboratory experiments in general microbiology. Prerequisites: BIOL 111, BIOL 112, and BIOL 361 or BIOL 460 or concurrent enrollment. Permission of instructor required.

**BIOL 363 Microbial Genomics Laboratory (1 semester hour)**

Application of genomics tools, including laboratory methods and computer analyses, in a semester-long research project to understand microbial processes. Prerequisites: BIOL 111, BIOL 112, and BIOL 202. Permission of instructor required.

**BIOL 364 Cell Culture Laboratory (1 semester hour)**

Hands-on experience in maintenance and propagation of mammalian cell cultures, including use of current molecular biology tools in qualitative and quantitative analyses of cells, manipulating cells under various experimental conditions (exposure to cellular stresses), in multiple enquiry-based research projects. Prerequisites: BIOL 111, BIOL 112, and BIOL 201. Permission of instructor required.

**BIOL 367 Biological Databases (3 semester hours)**

Interdisciplinary course at the interface between biology and computer science focusing on how biological information is encoded in the genome of a cell and represented as data in a database. Biological concepts include DNA structure and function, the central dogma of molecular biology, and regulation of gene expression. Computer science concepts and skills include command line interaction, the structure and functions of a database, and the management of data ranging from individual files to a full relational database management system. Emphasis on science and engineering best practices, such as maintaining journals and notebooks, managing files and code, and critically evaluating scientific and technical information. Course culminates with team projects to create new gene databases. Prerequisites: BIOL 201 and MATH 123 or MATH 132 or MATH 204. University Core fulfilled: Integrations: Interdisciplinary Connections; Flags: Information Literacy, Oral Skills. Permission of instructor required.

**BIOL 368 Bioinformatics Laboratory (1 semester hour)**

Current bioinformatics techniques will be used to address systems-level biological questions. Techniques may include: querying biological databases, sequence alignment, construction of phylogenetic trees, comparative genomics, genome annotation, protein structure analysis and prediction, modeling pathways and networks, use of biological ontologies, or the analysis of high-throughput genomic and proteomic data. Prerequisites: BIOL 111, BIOL 112, BIOL 202; CHEM 220. University Core fulfilled: Flags: Information Literacy, Oral Skills. Permission of instructor required.

**BIOL 370 Plant Biotechnology (3 semester hours)**

Biotechnology is a broad discipline in which biological processes, organisms, cells or cellular components are exploited to develop new technologies. Plant biotechnology employs a wide range of tools, including traditional breeding techniques and genetic engineering, to create plants with improved traits—more productive crops, more nutritious foods, and the production of biomaterials, medicines, and bioenergy. Principles of genetics, molecular biology, genomics, biochemistry, plant cell and tissue culture, and agronomy are employed to develop these novel technologies. We will discuss methodologies used to produce these plants, the genes that have been introduced to crop plants, and commercial product development. The course will also address concerns associated with plant biotechnology, including food safety, ecological risks, and resistance. Prerequisites: BIOL 101, BIOL 201, and CHEM 220. Permission of instructor required.

**BIOL 371 Protein Biotechnology Lab (1 semester hour)**

Experimental methodology to study proteomics and protein structure and function, integrating methods of biochemistry, molecular biology, microscopy, structural biology and bioinformatics. Prerequisites: BIOL 111, BIOL 112, BIOL 201, CHEM 220. Permission of instructor required.



**BIOL 375 Advanced Genetics (3 semester hours)**

Topics in genetics including both meiotic and mitotic recombination, quantitative genetics, gene structure, genetic control, and gene therapy. Prerequisites: BIOL 101, BIOL 201, BIOL 202; CHEM 112. Permission of instructor required.

**BIOL 376 Genetics Laboratory (1 semester hour)**

Laboratory experiments in genetics. Prerequisites: BIOL 101, BIOL 111, BIOL 112, BIOL 201, BIOL 202; CHEM 110, CHEM 112. Permission of instructor required.

**BIOL 380 Tropical Marine Ecology Laboratory (1 semester hour)**

Permission of instructor required.

**BIOL 381 Baja Marine Ecology Laboratory (1 semester hour)**

Permission of instructor required.

**BIOL 388 Biomathematical Modeling (3 semester hours)**

Introduction to mathematical and statistical concepts closely related to research problems in biology. Biological topics include the structure, function, and regulation of the three major types of cellular pathways: metabolic, signaling, and gene regulatory pathways. Mathematical topics include statistical analysis of biological measurements, dynamic modeling of biological systems, and fitting models to observed data. Students will critically evaluate the primary literature and carry out three major modeling projects throughout the semester. Prerequisites: BIOL 201; and MATH 123 or MATH 132 or MATH 204 or MATH 205 with a grade of C (2.0) or higher. Permission of instructor required.

**BIOL 394 Independent Research (0-4 semester hours)**

Independent research in a faculty laboratory. Permission of instructor required.

**BIOL 395 Biology Internship (1-2 semester hours)**

Work experience involving research, industry-, or community-based projects. Credit/No Credit only. May be taken only once for credit. Permission of instructor required.

**BIOL 396 Independent Research with Faculty (1 semester hour)**

Independent undergraduate research in a faculty laboratory. Credit/No Credit only. Permission of instructor required.

**BIOL 398 Special Studies (1-4 semester hours)**

Permission of instructor required.

**BIOL 399 Independent Studies (0-4 semester hours)**

Permission of instructor required.

**BIOL 422 Marine Biology (4 semester hours)**

Marine biology will provide students with an introduction to the physical and biological world: the oceans. This course is integrative, focusing on function, biodiversity, and ecology of marine organisms. In addition, students will learn how abiotic processes shape marine environments and the ecology and evolution of marine organisms. Prerequisites: BIOL 101, BIOL 102, BIOL 111, BIOL 112, BIOL 201; CHEM 110, CHEM 112. University Core fulfilled: Flags: Engaged Learning, Information Literacy. Permission of instructor required.

**BIOL 423 Marine Conservation Biology (3 semester hours)**

Marine Conservation Biology focuses on conservation issues faced and potential solutions in marine environments. Examples include climate change and climate change mitigation, unsustainable overfishing and fisheries management, marine habitat loss and marine protected area planning, and other issues and their potential solutions. After taking the course students will be able to: 1) identify human-caused environmental changes effecting marine environments, 2) understand the science behind these changes, 3) consider and discuss potential solutions to the issues, and 4) explain the public policy context behind a diversity of marine conservation issues and management solutions.

**BIOL 424 Marine Physiology Laboratory (1 semester hour)**

An inquiry-based investigation into the relationship between abiotic factors and marine invertebrate physiology. Prerequisites: BIOL 101, BIOL 102, BIOL 111, BIOL 112, and BIOL 201. Permission of instructor required.

**BIOL 433 Histology (3 semester hours)**

The structure and function of human tissue types including basic histological techniques. Prerequisites: BIOL 101, BIOL 102, BIOL 111, BIOL 112; CHEM 110, CHEM 112. Permission of instructor required.

**BIOL 437 Plant Development (3 semester hours)**

Biochemical, molecular, and genetic approaches to the study of pattern and tissue formation, embryogenesis, germination, flowering, photosynthesis, and plant-microbe interaction. Prerequisites: BIOL 101, BIOL 201, BIOL 202; CHEM 222, CHEM 223 or concurrent enrollment. Permission of instructor required.

**BIOL 438 Plant Development Laboratory (1 semester hour)**

Laboratory experiments in plant developmental biology. Prerequisites: BIOL 111, BIOL 112, and BIOL 437 or 370, or concurrent enrollment. Permission of instructor required.

**BIOL 439 Molecular Biology Applications (4 semester hours)**

The application of the techniques employed in molecular biology to the study of inherited diseases, genetic engineering, infectious diseases, cancer, and gene therapy. Prerequisites: BIOL 111, BIOL 112, BIOL 202; CHEM 220. Permission of instructor required.

**BIOL 440 Molecular Neurobiology (3 semester hours)**

A comprehensive study of the physiological and molecular properties of individual nerve cells and the synaptic connections between them. Basic mechanisms of mammalian nervous system function through the study of human neurological diseases, and how cellular and molecular basis of these diseases is driving therapeutic development will be discussed. Topics range from neuronal structure and function, communication at the synapse, biophysics of single channel gating, and transmission across chemical and electrical synapses. Additionally, actions of drugs on brain at clinical, cellular, and molecular levels will be explored. Prerequisites: BIOL 101, BIOL 201, and CHEM 112. Permission of instructor required.

**BIOL 443 Molecular Biology (3 semester hours)**

Study of properties, synthesis, and interactions of macromolecules; genetic engineering. Prerequisites: BIOL 202; CHEM 220, CHEM 222. Permission of instructor required.

**BIOL 445 Endocrinology (3 semester hours)**

The study of the production, functions, and interactions of hormones and other chemical messengers involved in the integration of the living organism. Prerequisites: BIOL 101, BIOL 201, BIOL 202, and CHEM 220. Permission of instructor required.

**BIOL 446 Behavioral Endocrinology (3 semester hours)**

This course discusses foundational literature and recent advances in the study of the interaction between hormones and behavior. The role of hormones in regulating various animal behaviors, including reproductive, parental, and social behaviors will be major themes of this course. We will also focus on experiments and techniques for studying how hormones facilitate behavioral and physical responses in vertebrates. Pre-requisites: BIOL 101, BIOL 102, BIOL 111, BIOL 112, BIOL 201, BIOL 202. Permission of instructor required.

**BIOL 449 Immunology (3 semester hours)**

The study of the human immune system, including innate and adaptive immune responses; the interaction of cells, receptors, and soluble factors during an immune response; the development of B and T cells; and the role of the immune systems in health and disease. Prerequisites: BIOL 101, BIOL 201, BIOL 202, and CHEM 220. Permission of instructor required.

**BIOL 450 Physiology of Disease (3 semester hours)**

Examination of normal function and selected disease-associated dysfunctions of the body's organ systems. Prerequisites: BIOL 102, BIOL 201, BIOL 202; CHEM 220. Permission of instructor required.

**BIOL 456 Molecular Cell Biology and Lab (4 semester hours)**

Advanced study of topics in cell biology: subcellular organelles and structures; molecular and biochemical analysis of genome organization, RNA and protein trafficking, regulation of the cell cycle; virus-host cell interactions; cell movement and communication. Laboratory experiments that examine cellular structure and function. Prerequisites: BIOL 101, BIOL 111, BIOL 112, BIOL 201, BIOL 202; CHEM 222, CHEM 223. Permission of instructor required.

**BIOL 459 Stem Cell Biology (3 semester hours)**

This course provides an introduction to progenitor and stem cell biology, and the role of these cell types in development, homeostasis, and potential therapeutics. These topics are explored in several model systems and in humans, with an emphasis on scientific research. Prerequisites: BIOL 201, BIOL 202. Permission of instructor required.

**BIOL 460 Environmental Microbiology (3 semester hours)**

Introduction to the diversity of microorganisms and their role in ecological and environmental processes in soil, water, and air; environmental services provided by microorganisms; and how microbial functions are utilized in managed and artificial systems. Prerequisites: BIOL 101, BIOL 201, and either CHEM 220 or ENVS 358. Consent of instructor required.

**BIOL 461 Microbial Genetics (3 semester hours)**

Mechanisms of inheritance and the regulation of gene expression in bacteria and viruses. Viral interactions with higher eukaryotes. Prerequisites: BIOL 202; CHEM 222, CHEM 223 or concurrent enrollment. Permission of instructor required.

**BIOL 472 Epidemiology (3 semester hours)**

Introduction to the principles of epidemiology, including factors governing health and disease in populations. Prerequisites: BIOL 101 and BIOL 102. Permission of instructor required.

**BIOL 474 Principles of Evolution (3 semester hours)**

Study of the pattern and process of evolution. Topics include the development of theories of evolutionary change; the mechanisms of evolutionary change at the population (micro) level; and evolution at the macro level, focusing on speciation, phylogenetic analysis, historical biogeography, and extinctions. Prerequisites: BIOL 101, BIOL 102, BIOL 111, BIOL 201, BIOL 202. Permission of instructor required.

**BIOL 475 Evolution (4 semester hours)**

Study of the pattern and process of evolution. Topics include the development of theories of evolutionary change; the mechanisms of evolutionary change at the population (micro) level; and evolution at the macro level, focusing on speciation, phylogenetic analysis, historical biogeography, and extinctions. Prerequisites: BIOL 101, BIOL 102, BIOL 111, BIOL 112, BIOL 201, BIOL 202. Permission of instructor required.

**BIOL 477 Conservation Genetics (4 semester hours)**

Survey of the major topics in conservation genetics. Basic models of population genetics and topics relevant to conservation genetics, such as population structure, inbreeding, genetic load, genetic variation, reserve design, and the ethical, moral, and political aspects of species conservation. Prerequisites: BIOL 101, BIOL 102, BIOL 111, BIOL 112, BIOL 202. Permission of instructor required.

**BIOL 478 Molecular Biology of the Genome (4 semester hours)**

Advances in understanding cellular processes, gene expression, and the structure and function of macromolecules due to The Human Genome Project and associated new high-throughput techniques. Use of systems biology perspectives and bioinformatics tools to answer biological questions. May include: functional genomics, and biological pathways and networks. Prerequisites: BIOL 111, BIOL 112, BIOL 202; CHEM 220. University Core fulfilled: Flag: Information Literacy. Permission of instructor required.

**BIOL 479 Molecular Mechanisms of Disease (3 semester hours)**

Analysis of the molecular mechanisms which underlie the pathology of genetic and infectious diseases. Particular attention paid to molecular mechanisms of disease treatment and experimental analysis in the field of human molecular genetics. Prerequisites: BIOL 202; CHEM 220, CHEM 222. Permission of instructor required.

**BIOL 490 Biological Teaching (1 semester hour)**

Guided teaching of undergraduate laboratories. May be repeated for credit. Credit/No Credit only. Permission of instructor required.

**BIOL 491 First Year Biological Teaching (1-2 semester hours)**

Guided teaching of first year undergraduate laboratories. May be repeated for credit for up to 4 semester hours. Permission of instructor required.

**BIOL 494 Independent Research (0-4 semester hours)**

Independent research in a faculty laboratory. Permission of instructor required.

**BIOL 496 Independent Research with Faculty (1 semester hour)**

Independent undergraduate research in a faculty laboratory. Credit/No Credit only. Permission of instructor required.

**BIOL 498 Special Studies (1-4 semester hours)**

Permission of instructor required.

**BIOL 499 Independent Studies (0-4 semester hours)**

Permission of instructor required.

**BIOL 515 Ecology of Mutualisms (2 semester hours)**

Characterization of conditional interspecific interactions and investigations into the variability of outcomes as mediated by seasonality, chemistry, novel habitats, and morphology. Prerequisites: BIOL 102, BIOL 111, BIOL 112; CHEM 113; MATH 122 or MATH 131. Permission of instructor required.

**BIOL 518 Applied Ecology Research (2 semester hours)**

Participation in original laboratory and/or field research in applied ecology, to address questions in conservation, resource management, and ecological sustainability. Permission of instructor required.

**BIOL 520 Urban Ecology Research (2 semester hours)**

Research on the dynamic and integrated nature of urbanized landscapes. Projects may include the study of the patterns and process of urban ecosystem ranging from biodiversity and trophic dynamics to public health and environmental justice. Permission of instructor required.

**BIOL 521 Urban Ecology (3 semester hours)**

An analysis of the dynamic and integrated nature of urbanized landscapes. Using active inquiry and the original literature, the course will engage the current theories and practice of the research being conducted on the patterns and process of urban ecosystem - ranging from biodiversity and trophic dynamics, to public health and environmental justice. Enrollment in Urban Ecology Track or permission of program director required. Permission of instructor required.

**BIOL 522 Marine Biology Research (2 semester hours)**

Participation in marine biology, ecology, and conservation research. Research may include relevant field or laboratory work and current marine science methodologies. Permission of instructor required.

**BIOL 523 Marine Conservation Research (2 semester hours)**

Participation in marine conservation research. Research may include relevant field or laboratory work and current marine science methodologies. Permission of instructor required.

**BIOL 524 Marine Ecophysiology Research (2 semester hours)**

Directed senior level research in the physiology and ecology of marine organisms. Permission of instructor required.

**BIOL 525 Marine Physiology Research (2 semester hours)**

Participation in original laboratory and/or field research related to marine environmental physiology. Permission of instructor required.

**BIOL 528 Invertebrate Conservation Research (2 semester hours)**

Participation in research on topics in invertebrate conservation biology. Research may include ecological and/or genetic approaches and methodologies. Permission of instructor required.

**BIOL 531 Developmental Genetics Research (2 semester hours)**

Investigation through original literature and laboratory experience of the ways in which genes direct development. Prerequisite: BIOL 394, BIOL 494, or BIOL 594. Permission of instructor required.

**BIOL 532 Drosophila Genetics Research (2 semester hours)**

An introduction to the use of drosophila as a research tool in classical and molecular genetics. Permission of instructor required.

**BIOL 534 Cardiac Neural Crest Research (2 semester hours)**

Participation in original research on the development of the cardiac neural crest, primarily using the chicken embryo as a model organism. Permission of instructor required.

**BIOL 536 Functional Morphology Research (2 semester hours)**

Participation in original research investigating the functional aspect of morphology and development in carnivorous mammals. Permission of instructor required.

**BIOL 537 Vertebrate Paleontology Research (2 semester hours)**

Participation in original research investigating functional, evolutionary and ecological aspects of vertebrate paleontology in mammals and birds. Permission of instructor required.

**BIOL 551 Behavior and Physiology Research (2 semester hours)**

Participation in original laboratory and/or field research on social birds or mammals, addressing questions at the interfaces of behavior, physiology and ecology. Permission of instructor required.

**BIOL 552 Avian Biology Research (2 semester hours)**

Participation in laboratory and/or field research on birds, addressing questions at the interfaces of behavior, physiology, and ecology. Permission of instructor required.

**BIOL 561 Bioinformatics and Genomics Research (2 semester hours)**

Investigation of the systems-level properties of biological pathways and networks. Research may include bioinformatics and/or functional genomics techniques. Permission of instructor required.

**BIOL 562 Microbiology Research (2 semester hours)**

Participation in research investigating the role of microbes in the environment using culture based and molecular techniques. Permission of instructor required.

**BIOL 563 Molecular Genetics Research (2 semester hours)**

Laboratory work in gene mapping and gene isolation. Permission of instructor required.

**BIOL 565 Plant Developmental Biology Research (2 semester hours)**

Laboratory work in molecular and genetic analysis of plant development. Permission of instructor required.

**BIOL 566 Plant Research (2 semester hours)**

Participation in laboratory and/or field research on the ecophysiological response of plants to environmental extremes. Permission of instructor required.

**BIOL 567 Plant-Microbe Interactions Research (2 semester hours)**

Participation in research investigating the association between microbes and plants. Permission of instructor required.

**BIOL 569 Ethnobotany Seminar (2 semester hours)**

An introduction to the mutual relationships between plants and traditional peoples with an emphasis on phyto medicines and sustainability. Permission of instructor required.

**BIOL 571 Conservation Biology Seminar (2 semester hours)**

A survey of topics relating to the conservation of animals and plants, including extinction, genetic aspects, demography, insularization, threats to biodiversity, economics and politics, religious and ethical perspectives, and practical applications. Permission of instructor required.

**BIOL 574 Evolutionary Ecology Research (2 semester hours)**

Participation in original field, laboratory, and/or computational research that addresses questions at the interface between evolutionary biology and ecology. Permission of instructor required.

**BIOL 575 Mitochondrial Biology Research (2 semester hours)**

Independent laboratory research examining questions pertaining to import of proteins into mitochondria utilizing current molecular and cell biology, biochemistry, and genetic techniques in yeast and mammalian systems. Permission of instructor required.

**BIOL 584 Advanced Topics in Gene Expression (2 semester hours)**

An in-depth exposure to topics in gene expression through analysis of data from primary research literature. Prerequisites: BIOL 201 and BIOL 202. Permission of instructor required.

**BIOL 585 Issues in Biotechnology Seminar (2 semester hours)**

An interdisciplinary seminar series bringing together faculty from different disciplines to present and discuss topics in biotechnology. Examples include sustainable agriculture, advances in medicine and biotechnology, legal and ethical considerations and biotechnology, the environment and biotechnology, the manipulation of biological machinery (proteins), the fusion of engineering and biotechnology (nanotechnology), the business of biotechnology. University Core fulfilled: Flags: Oral Skills, Writing. Permission of instructor required.

**BIOL 586 Molecular Cell Biology Research (2 semester hours)**

Independent laboratory research examining questions pertaining to gene expression, including ribosome biogenesis and mRNA transport/localization, utilizing techniques of molecular and cell biology, biochemistry, and genetics. Permission of instructor required.

**BIOL 587 Molecular Mechanisms in Development Seminar (2 semester hours)**

An exploration of current research utilizing molecular/genetic techniques to study developmental biology. Permission of instructor required.

**BIOL 588 Advanced Systems Biology Research (2 semester hours)**

Investigation of the systems-level properties of biological pathways and networks. Research may include bioinformatics, biomathematics, and/or functional genomics techniques. Permission of instructor required.

**BIOL 594 Independent Research (1-4 semester hours)**

Independent research in a faculty laboratory. Results must be presented formally. Permission of instructor required.

**BIOL 597 Biology Honors Thesis (2 semester hours)**

Senior-level capstone research in biology and the preparation and publication of the Honors Thesis. Restricted to members of the University Honors Program. Permission of instructor required.

**BIOL 598 Special Studies (1-4 semester hours)**

Permission of instructor required.

**BIOL 599 Independent Studies (0-4 semester hours)**

Permission of instructor required.