

## Lower-Division Courses

**BIOL 002 Cellular Basis of Life (4)** Lecture, 3 hours; laboratory, 3 hours. Prerequisite(s): none. An introduction to the fundamentals of life processes at the cellular level. Topics include cell structure, chemical composition, metabolism, reproduction, genetics, and development with emphasis on humans. Not recommended for natural science majors. Either BIOL 002 or BIOL 003 may be taken as a breadth requirement in biology; together they provide a general introduction to the field of biology. Credit is not awarded for BIOL 002 if it has already been awarded for BIOL 005A, BIOL 05LA or BIOL 020.

**BIOL 003 Organisms in Their Environment (4)** Lecture, 3 hours; laboratory, 3 hours. Prerequisite(s): none. An introduction to the physiology, ecology, and evolution of living organisms with emphasis on humans. Not recommended for natural science majors. Either BIOL 002 or BIOL 003 may be taken as a breadth requirement in biology; together they provide a general introduction to the field of biology. Credit is not allowed for both BIOL 003 and BIOL 005B.

**BIOL 005A Introduction to Cell and Molecular Biology (4)** Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): BIOL 05LA (may be taken concurrently) or BIOL 020 (may be taken concurrently) with grades of "C-" or better; CHEM 001A and CHEM 01LA with grades of "C-" or better or CHEM 01HA and CHEM 1HLA with grades of "C-" or better; consent of instructor is required for students repeating the course. An intensive course designed to prepare for upper-division courses in cell and molecular biology. Covers biochemical, structural, metabolic, and genetic aspects of cells. Required for Biology majors; recommended for science majors desiring an introduction to biology. Credit is not awarded for BIOL 005A if it has already been awarded for BIOL 002.

**BIOL 005B Introduction to Organismal Biology (4)** Lecture, 3 hours; laboratory, 3 hours. Prerequisite(s): BIOL 005A and BIOL 05LA or BIOL 020 with grades of "C-" or better; CHEM 001A or CHEM 01HA; CHEM 001B or CHEM 01HB; consent of instructor is required for students repeating the course. An intensive course designed to prepare for upper-division courses in organismal biology. Covers developmental biology, physiology, and regulation at the level of the organism. Required for Biology majors; recommended for science majors desiring an introduction to biology. Credit is awarded for only one of BIOL 003 or BIOL 005B.

**BIOL 005C Introductory Evolution and Ecology (4)** Lecture, 3 hours; laboratory, 3 hours. Prerequisite(s): BIOL 005A, BIOL 020 or BIOL 05LA, and BIOL 005B (or BIOL 002 and BIOL 003 for non-Biology majors) with grades of "C-" or better; MATH 009A with a grade of "C-" or better or equivalent; consent of instructor is required for students repeating the course. An intensive introduction to the subjects of evolution and ecology. Covers population dynamics, community ecology, population genetics, and evolutionary theory. Recommended for science majors desiring an introduction to biology. Students who take equivalent first-year biology at another institution may enter directly into BIOL 005C without critical handicap.

**BIOL 010 Headlines in the History of Life (4)** Lecture, 3 hours; laboratory, 3 hours. Prerequisite(s): none. Evolution of life beginning with precellular life. Topics include the origin of sex; multicellularity; vertebrate classes; morphological specializations; adaptive radiations; extinction dynamics; and the biology of dinosaurs. Cross-listed with GEO 003.

**BIOL 020 Dynamic Genome (2) F** Laboratory, 6 hours. Prerequisite(s): CHEM 001A or CHEM 01HA, MATH 009A (may be taken concurrently); freshman standing. Introduces computational and experimental approaches in investigating the genomes of plants and animals. Explores scientific discovery using the tools of bioinformatics and genomics. Includes participation

in research projects being conducted on campus. Credit is not awarded for BIOL 020 if it has already been awarded for BIOL 002 or BIOL 05LA.

**BIOL 030 Human Reproduction and Sexual Behavior (4)** Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): none. A consideration of human anatomy, physiology and behavior as related to sexual reproduction, including discussion of fertility, pregnancy, childbirth and birth control. Consideration will also be given to homosexuality, venereal diseases, sex education, sexual intercourse and response.

**BIOL 034 Human Heredity and Evolution (4)** Lecture, 3 hours; discussion and problem solving, 1 hour; audio-visual aids plus discussion, 1 hour. Basic human genetics and evolution, emphasizing their relationship to physical and emotional health. Political, philosophical and ethical implications of human heredity and evolution.

**BIOL 040 Disease and History: From the Bubonic Plague to AIDS (4)** Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): none. This lecture course for nonscience majors will deal with the natural history of infectious diseases and how plagues have influenced the course of human history. It will cover the biology, pathology, epidemiology, and immunology of viruses, bacteria, and protozoan parasites causing smallpox, yellow fever, influenza, AIDS, syphilis, bubonic plague, tuberculosis, leprosy, malaria, and African sleeping sickness. The role of scientific inquiry in the conquest of human disease will be emphasized.

**BIOL 05LA Introduction to Cell and Molecular Biology Laboratory (1)** Laboratory, 3 hours. Prerequisite(s): BIOL 005A (may be taken concurrently); consent of instructor is required for students repeating the course. An introduction to laboratory exercises on fundamental principles of and techniques in cell and molecular biology. Illustrates the experimental foundations of the topics covered in BIOL 005A. Credit is not awarded for BIOL 05LA if it has already been awarded for BIOL 002 or BIOL 020.

## Upper-Division Courses

**BIOL 100 General Entomology (4)** Lecture, 3 hours; laboratory, 3 hours. Prerequisite(s): BIOL 005B, BIOL 005C, or equivalents; or consent of instructor. Introductory study of insects, Earth's most diverse group of animals (75 percent of animal species are insects). Lecture covers the anatomy, physiology, ecology, behavior, and diversity of insects. Laboratory focuses on insect identification. Cross-listed with ENTM 100.

**BIOL 102 Introductory Genetics (4)** Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): BIOL 005A, BIOL 020 or BIOL 05LA, and BIOL 005B with grades of "C-" or better. An introductory course that includes classical Mendelian genetics, linkage and recombination, sex-linked traits, cytogenetics, developmental genetics, and molecular genetics. Also includes some probability theory and statistics.

**BIOL 104 Foundations of Plant Biology (4)** Lecture, 3 hours; laboratory, 3 hours. Prerequisite(s): BIOL 005C. A study of the plant world from cells to ecosystems. Examines the structure and function of organisms from the major plant groups and their role in the biosphere. The laboratory explores the unique properties of plants. Cross-listed with BPSC 104.

**BIOL 105 Evolution (4)** Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): BIOL 005C with a grade of "C-" or better, BIOL 102, CHEM 12C or CHEM 12HC, MATH 009B or MATH 09HB, PHYS 002C, PHYS 02LC, BCH 100 or BCH 110A, one course in statistics; or consent of instructor. Covers the causal interpretation of organic diversity and adaptation. Topics include inference of evolutionary change from the fossil record and from genomic and molecular patterns; microevolution and macroevolution; systematics and the species problem; and natural selection, drift, and other forces of evolution.

**BIOL 105V Evolution Online (4)** Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): BIOL 005C with a grade of "C-" or better; BIOL 102 with a grade of "D-" or better; CHEM 112C with a grade of "D-" or better; MATH 009B with a grade of "D-" or better; PHYS 002C with a grade of "D-" or better; PHYS 02LC with a grade of "D-" or better; BCH 100 with a grade of "D-" or better or BCH 110A with a grade of "D-" or better. Covers the causal interpretation of organic diversity and adaptation. Topics include inference of evolutionary change from the fossil record and from genomic and molecular patterns; microevolution and macroevolution; systematics and the species problem; and natural selection, drift, and other forces of evolution. Credit is awarded for only one of BIOL 105 or BIOL 105V.

**BIOL 106 Biology of Human Variation (4)** Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): BIOL 102; BIOL 105 or BIOL 108; STAT 100B (STAT 100B may be taken concurrently); or consent of instructor. A survey of variation within and among contemporary human populations arising from genetic and environmental factors. Covers single-locus and polygenic inheritance, developmental plasticity, and physiological acclimatization. Includes biogeographic and demographic influences; variation in pigmentation, stature, physiology, disease susceptibility, behavior, and IQ; and critical evaluation of racial and ethnic classifications.

**BIOL 107A Molecular Biology (4)** Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): BIOL 005A, BIOL 005B, BIOL 005C; CHEM 001C or CHEM 01HC; CHEM 12C or CHEM 12HC; MATH 009B or MATH 09HB; PHYS 002C, PHYS 02LC; BCH 100 or BCH 110A. The study of the structure and function of the genetic material, including DNA structure, DNA replication and recombination, regulation of gene expression, and protein synthesis. Examines both prokaryotic and eukaryotic systems including contemporary recombinant DNA technology and applications of molecular cloning procedures.

**BIOL 107B Advanced Molecular Biology (3)** Lecture, 2 hours; discussion, 1 hour. Prerequisite(s): BIOL 107A or BCH 110C or equivalents. An advanced treatment of the functional architecture of genetic material. Topics include genome structure and chromosome organization, DNA replication and gene expression, cloning organisms, molecular medicine, protein engineering, and application of modern molecular biology to agricultural problems. Coverage of each topic includes discussion of the impact of the emergent molecular technology on society.

**BIOL 108 Introductory Population Genetics (4)** Lecture, 3 hours; discussion and demonstration, 1 hour per week. Prerequisite(s): BIOL 005A, BIOL 005B, BIOL 005C, CHEM 001C or CHEM 01HC, CHEM 12C or CHEM 12HC, MATH 009B or MATH 09HB, PHYS 002C, PHYS 02LC, one course in statistics. A study of the factors influencing the genetic structure of natural populations. Topics discussed include the incidence of genetic disease, inbreeding, conservation genetics, molecular evolution, adaptation in a changing environment, and how natural selection acts at different levels of organization.

**BIOL 110 Biology of Human Problems (4)** Seminar, 4 hours. Prerequisite(s): BIOL 005A, BIOL 005B, BIOL 005C; CHEM 001C or CHEM 01HC; CHEM 12C or CHEM 12HC; MATH 009B or MATH 09HB; PHYS 002C, PHYS 02LC; BCH 100 or BCH 110A; one course in statistics. Devoted to selected human problems that have a large biological component and relate to medicine, ethics, and human existence. Topics covered vary and include issues of major bioethical importance such as euthanasia, national health care, effects of industrial pollution on individuals and communities, population problems, abortion, and genetic engineering.

**BIOL 111 Infectious Disease Epidemiology (4) S** Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): BIOL 005A, BIOL 005B, and BIOL 005C with a grade of "C-" or better, BIOL 102 with a grade of "C-" or better, STAT 100A or equivalent (or consent of instructor) with a grade of "C-" or better. Introduces epidemiological methods used to investigate infectious diseases. Includes examples and case studies presented for a variety of human infectious diseases.

**BIOL 112 Systematics (4)** Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): BIOL 005C or equivalent. Principles and philosophy of classification: phylogenetic and phenetic methods, species concepts, taxonomic characters, evolution, hierarchy of categories, and nomenclature. Cross-listed with BPSC 112 and ENTM 112.

**BIOL 113 Advanced Cell Biology: Membranes, Organelles, and the Cytoskeleton (4)** Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): BIOL 005A, BIOL 005B, BIOL 005C, BIOL 102, CHEM 001C or CHEM 01HC, CHEM 12C or CHEM 12HC, MATH 009B or MATH 09HB, PHYS 002C, PHYS 02LC, BCH 100 or BCH 110A, one course in statistics. An examination of the organization, function, and behavior of eukaryotic cells. Topics include membrane systems, protein targeting, the cytoskeleton, motility, and cell division. Emphasis is on the experiments that form the basis of the current understanding of the cell. The discussion section focuses on reading and analyzing original journal articles.

**BIOL 114 Advanced Cell Biology: Cellular Reproduction and Signaling (4)** Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): BIOL 005A, BIOL 005B, BIOL 005C, BIOL 102, CHEM 001C or CHEM 01HC, CHEM 12C or CHEM 12HC, MATH 009B or MATH 09HB, PHYS 002C, PHYS 02LC, BCH 100 or BCH 110A, one course in statistics. Examines organization, function, and behavior of eukaryotic cells. Explores the molecular mechanisms used by cells to control reproduction, growth, and responses to extracellular signals. Emphasis is on experiments that form the basis of the current understanding of the cell. The discussion section focuses on reading and analyzing original journal articles.

**BIOL 116 Ecology and Conservation Biology (4)** Lecture, 3 hours; discussion, 1 hour; field, 9 hours per quarter. Prerequisite(s): BIOL 005C with a grade of "C-" or better, CHEM 001C (or CHEM 01HC), MATH 009B (or MATH 09HB); or consent of instructor. Introduces principles of ecology with emphasis on implications for the conservation of biodiversity. Topics include physiological ecology, organismal adaptations to the environment, life histories, the niche concept, population growth, interspecific interactions, and the structure and functioning of communities and ecosystems. Also covers topics in applied ecology and conservation biology.

**BIOL 118 Laboratory in Molecular Phylogenetics and Evolution (4)** Lecture, 2 hours; discussion, 1 hour; laboratory, 3 hours. Prerequisite(s): BCH 100 or BCH 110A, BIOL 005C with a grade of "C-" or better, CHEM 12C or CHEM 12HC, MATH 009B or MATH 09HB, PHYS 002C, PHYS 02LC, STAT 100A; or consent of instructor. Covers theory, techniques, and analytical methods for interpreting patterns of molecular evolution and phylogeny. Explores the comparative analysis of DNA and tests of evolutionary hypotheses using modern computational methods. Includes polymerase chain reaction (PCR), cloning, gel electrophoresis, and restriction site analysis.

**BIOL 119 Introduction to Genomics and Bioinformatics (4)** Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): BIOL 005C with a grade of "C-" or better, BIOL 102, CHEM 001C or CHEM 01HC, CHEM 12C or CHEM 12HC, MATH 009B or MATH 09HB, PHYS 002C, PHYS 02LC, BCH 100 or BCH 110A, one course in statistics. An introduction to the science of genomics and bioinformatics. Includes genome sequencing; database techniques; structural, com-

parative, and evolutionary genomics; and microarray analysis.

**BIOL 120 Introduction to Plant Pathology (3)** Lecture, 3 hours. Prerequisite(s): BIOL 005A, BIOL 05LA, BIOL 005B, BIOL 005C, CHEM 001C or CHEM 01HC, CHEM 12C or CHEM 12HC, MATH 009B or MATH 09HB, PHYS 002C, PHYS 02LC, BCH 100 or BCH 110A, one course in statistics; or consent of instructor. An introduction to the study of plant diseases. Topics include diseases and disease-causing agents, host-pathogen interaction during disease development, and strategies for disease management. An optional, separate laboratory is offered. Cross-listed with MCBL 120 and PLPA 120.

**BIOL 120L Introduction to Plant Pathology Laboratory (1)** Laboratory, 4 hours. Prerequisite(s): BIOL 005A, BIOL 005B; concurrent enrollment in BIOL 120/MCBL 120/PLPA 120 or consent of instructor; BIOL 121/MCBL 121 and BIOL 124/MCBL 124 recommended. Covers fundamentals in the use of laboratory instruments and techniques for the detection, isolation, and identification of representative infectious agents that cause disease in plants. Cross-listed with MCBL 120L and PLPA 120L.

**BIOL 121 Introductory Microbiology (4)** Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): BIOL 005A, BIOL 05LA, BIOL 005B, BIOL 005C, CHEM 001C or CHEM 01HC, CHEM 12C or CHEM 12HC, MATH 009B or MATH 09HB, PHYS 002C, PHYS 02LC, BCH 100 or BCH 110A (BCH 100 or BCH 110A may be taken concurrently); or consent of instructor. An intensive introduction to the fundamental physiology and molecular biology of bacteria and viruses. Covers evolutionary origins of metabolic diversity, bacterial and viral molecular genetics, and an introduction to microbial pathogenesis. Cross-listed with MCBL 121.

**BIOL 121L Microbiology Laboratory (3)** Lecture, 1 hour; laboratory, 6 hours. Prerequisite(s): BIOL 121/MCBL 121 with a grade of "C-" or better. Laboratory exercises in diagnostic bacteriology, basic virology, and epidemiology. Includes fundamental quantitative and diagnostic microbiological procedures, basic mechanisms of microbial genetic exchange, and a project examining bacterial epidemiology. Cross-listed with MCBL 121L.

**BIOL 122 Food Microbiology (4)** Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): BIOL 121/MCBL 121 with a grade of "C-" or better; BIOL 121L/MCBL 121L. Covers spoilage and preservation of food; food quality and indicator organisms; the role of microorganisms in the production of dairy goods and fermented beverages; food-borne pathogens and microbiological production of toxins; and classical and modern molecular methods for detection of food microorganisms. Cross-listed with MCBL 122.

**BIOL 123 Introduction to Comparative Virology (4)** Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): BIOL 005A, BIOL 05LA, BIOL 005B, BIOL 005C, CHEM 001C or CHEM 01HC, CHEM 12C or CHEM 12HC, MATH 009B or MATH 09HB, PHYS 002C, PHYS 02LC, BCH 100 or BCH 110A, one course in statistics; or consent of instructor. Considers viruses as infectious agents of bacteria, plants, and animals (vertebrates and invertebrates). Compares the major groups of viruses to each other with respect to their biological and biochemical properties, molecular and genetic characteristics, and modes of replication. Cross-listed with MCBL 123 and PLPA 123.

**BIOL 124 Pathogenic Microbiology (4)** Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): BIOL 121/MCBL 121 with a grade of "C-" or better or consent of instructor. An intensive introduction to the fundamental physiology and molecular biology of bacteria and viruses. Covers research strategies for examining microbial pathogenic mechanisms. Cross-listed with MCBL 124.

**BIOL 127 Insect Ecology (4)** Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): BIOL 005A, BIOL 05LA, BIOL 005B, BIOL 005C, CHEM 001C or CHEM 01HC, CHEM 12C or CHEM 12HC, MATH 009B or MATH 09HB, PHYS 002C, PHYS 02LC, BCH 100 or BCH 110A, one course in statistics; or consent of instructor. Introduces principles of insect ecology with examples emphasizing the Arthropoda. Topics include factors governing population growth; ecological and evolutionary interactions with hosts, competitors, and natural enemies; structure of ecological communities; and adaptations to different environments. Cross-listed with ENTM 127.

**BIOL 128 Immunology (3)** Lecture, 3 hours. Prerequisite(s): BIOL 005C; PHYS 002C; PHYS 02LC; BCH 100 or BCH 110A. A study of humoral and cellular immunology. Topics include lymphoid systems, cells, antigens, antibodies, antibody formation, cellular immunity, and tumor and transplantation immunology. Diseases and altered immune states associated with each topic are discussed in detail. Cross-listed with CBNS 128.

**BIOL 132 Plant Anatomy (4)** Lecture, 3 hours; laboratory, 3 hours. Prerequisite(s): BIOL 005A and BIOL 005B; BPSC 104 or BIOL 104; or consent of instructor. Functional and developmental aspects of plant cell, tissue, and organ structure. Covers all aspects of the flowering plant life cycle from germination to pollination and fruit and seed development. Cross-listed with BPSC 132.

**BIOL 134 Introduction to Mycology (3)** Lecture, 3 hours. Prerequisite(s): BIOL 005A, BIOL 05LA, BIOL 005B, BIOL 005C, CHEM 001C or CHEM 01HC, CHEM 12C or CHEM 12HC, MATH 009B or MATH 09HB, PHYS 002C, PHYS 02LC, BCH 100 or BCH 110A, one course in statistics; or consent of instructor. Introduction to the morphology, taxonomy, genetics, physiology, ecology, and economic importance of the major groups of the fungi. Cross-listed with PLPA 134.

**BIOL 134L Introduction to Mycology Laboratory (1)** Laboratory, 3 hours. Prerequisite(s): BIOL 005A, BIOL 005B, BIOL 005C, or equivalents; concurrent enrollment in BIOL 134/PLPA 134; or consent of instructor. Introduces fundamentals in the use of laboratory instruments and techniques for the isolation, cultivation, and identification of representatives of the major taxa of fungi. Cross-listed with PLPA 134L.

**BIOL 138 Plant Developmental Morphology (4)** Lecture, 3 hours; laboratory, 3 hours. Prerequisite(s): BIOL 005B, BIOL 005C, CHEM 12C, BCH 100 or BCH 110A (BCH 100 or BCH 110A may be taken concurrently), PHYS 002C, PHYS 002LC; or consent of instructor. Introduces the key areas of research in plant morphology and developmental biology. Emphasizes flowering plants (angiosperms). Cross-listed with BPSC 138.

**BIOL 143 Plant Physiology (4)** Lecture, 3 hours; laboratory, 3 hours. Prerequisite(s): BIOL 005A, BIOL 005B, BIOL 005C, CHEM 001C or CHEM 01HC, CHEM 12C, MATH 009B or MATH 09HB, PHYS 002C, PHYS 02LC, BCH 100 or BCH 110A (BCH 100 or BCH 110A may be taken concurrently), BIOL 104/ BPSC 104; or consent of instructor. A survey of the fundamental principles of plant physiology including photosynthesis, respiration, water relations, mineral nutrition, growth, morphogenesis, plant hormones, dormancy, and senescence. Cross-listed with BPSC 143.

**BIOL 148 Quantitative Genetics (4)** Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): BIOL 005A, BIOL 05LA, BIOL 005B, BIOL 005C, BIOL 102, CHEM 001C or CHEM 01HC, CHEM 12C, MATH 009B or MATH 09HB, PHYS 002C, PHYS 02LC, BCH 100 or BCH 110A, STAT 100B; or consent of instructor. Examines approaches to studying the genetic basis of polygenic, metric traits. Includes types of gene action, partitioning of variance, response to selection, and inferring the number and location of quantitative trait loci. Cross-listed with BPSC 148.

**BIOL 151 Invertebrate Zoology (5)** Lecture, 3 hours; discussion, 1 hour; laboratory, 3 hours. Prerequisite(s): BIOL 005A, BIOL 005B, BIOL 005C, PHYS 002A with grades of "C-" or better. Structure, classification, and biology of the invertebrates.

**BIOL 152 Principles of Invertebrate Paleobiology and Paleocology (4)** Lecture, 2 hours; laboratory, 3 hours; three 1-day field trips. Prerequisite(s): BIOL 005C with a grade of "C-" or better or BIOL 010/GEO 003 with a grade of "C-" or better. Topics include evolution and the fossil record, paleoecology, classification theory, the nature of adaptive radiations, and extinctions. Cross-listed with GEO 152.

**BIOL 153 Plant Genomics and Biotechnology Laboratory (4) F, Even Years** Lecture, 1 hour; discussion, 1 hour; laboratory, 6 hours. Prerequisite(s): BCH 110C or BIOL 107A; upper-division standing; consent of instructor. A study of modern techniques in plant genome modification. Topics include nucleic acid cloning and sequencing; plant tissue culture and genetic transformation; controlled-environment plant growth; gene mapping; and germplasm collections. Also explores the history of plant biotechnology; economic, agricultural, nutritional, medicinal, and societal relevance; and regulatory issues. Cross-listed with BCH 153 and BPSC 153.

**BIOL 155 Chromosomes (4)** Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): BIOL 005A, BIOL 005B, BIOL 005C, CHEM 001C or CHEM 01HC, CHEM 12C, MATH 009B or MATH 09HB, PHYS 002C, PHYS 02LC, BCH 100 or BCH 110A (BCH 100 or BCH 110A may be taken concurrently); or consent of instructor. An examination of the structure, function, and behavior of eukaryotic chromosomes. Cross-listed with BPSC 155.

**BIOL 157 Parasitology (4)** Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): BIOL 005A, BIOL 005B, BIOL 005C, CHEM 001C or CHEM 01HC, CHEM 12C or CHEM 12HC, MATH 009B or MATH 09HB, BCH 100 or BCH 110A, one course in statistics. Surveys the biology of protozoan and helminth interactions with their human hosts.

**BIOL 158 Medical Molecular Parasitology (4)** Lecture, 3 hours; seminar, 1.5 hours. Prerequisite(s): BCH 110C or BIOL 107A. An overview of genome organization and gene expression, with aspects of biochemistry, evolution, natural history, and clinical manifestations of human parasites *Trypanosoma*, *Leishmania*, *Plasmodium*, and others. Emphasizes the molecular and biochemical adaptations to parasitism. Prior knowledge of classical parasitology is not assumed. Students present original research papers during the seminar.

**BIOL 159 Biology of Nematodes (3)** Lecture, 2 hours; discussion and demonstration, 1 hour per week. Prerequisite(s): BIOL 005A, BIOL 005B, BIOL 005C, CHEM 001C or CHEM 01HC, CHEM 12C or CHEM 12HC, MATH 009B or MATH 09HB, PHYS 002C, PHYS 02LC, BCH 100 or BCH 110A, one course in statistics. An introduction to the biology of nematodes. Topics include the morphology, physiology, development, genetics, behavior, and ecology of nematodes from parasitic and free-living habitats. In the discussion and demonstration section, students observe the comparative morphology and biology of nematodes and give oral presentations on selected nematode life histories. Cross-listed with NEM 159.

**BIOL 160 Animal Behavior (4)** Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): BIOL 005A, BIOL 005B, BIOL 005C, and BIOL 102 with grades of "C-" or better, CHEM 001C or CHEM 01HC, CHEM 12C or CHEM 12HC, MATH 009B or MATH 09HB, PHYS 002C, PHYS 02LC, BCH 100 or BCH 110A, one course in statistics. An examination of behavior from an evolutionary and ecological perspective. Topics include the inheritance of behavior, evolution of communication and displays, migration and habitat selection, foraging ecology, mating systems, and the evolution of social behavior.

**BIOL 160 Laboratory in Animal Behavior (1)** Laboratory, 4 hours. Prerequisite(s): BIOL 160 (may be taken concurrently). Laboratory and field exercises in animal behavior. Covers topics such as foraging behavior, aggression, and territoriality.

**BIOL 161A Functional Anatomy of the Vertebrates (5)** Lecture, 3 hours; discussion, 1 hour; laboratory, 3 hours. Prerequisite(s): BIOL 005A, BIOL 005B, BIOL 005C, CHEM 001C or CHEM 01HC, CHEM 12A or CHEM 12HA, MATH 009B or MATH 09HB, PHYS 002A, and one course in statistics with grades of "C-" or better. A study of the functional anatomy of vertebrates including humans. Examines each organ system from a developmental and evolutionary perspective. Topics include phylogeny, the skeleton, muscles, and the nervous system. BIOL 161A, BIOL 161B, BIOL 171, and BIOL 171L provide a one-year sequence in vertebrate and human anatomy and physiology. Recommended for sophomores and juniors.

**BIOL 161B Functional Anatomy of the Vertebrates (5)** Lecture, 3 hours; discussion, 1 hour; laboratory, 3 hours. Prerequisite(s): BIOL 161A, CHEM 12B or CHEM 12HB, and PHYS 002B with grades of "C-" or better. A study of the functional anatomy of vertebrates, including humans. Examines each organ system from a developmental and evolutionary perspective. Topics include circulation, sense organs, the integument, and the respiratory, digestive, and urogenital systems. BIOL 161A, BIOL 161B, BIOL 171, and BIOL 171L provide a one-year sequence in vertebrate and human anatomy and physiology. Recommended for sophomores and juniors.

**BIOL 162 Insect Behavior (4)** Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): BIOL 005A, BIOL 005B, BIOL 005C, or BIOL 100/ENTM 100; or consent of instructor. An analysis of the mechanisms that cause and control behavioral reactions of insects. Emphasizes ethological and physiological knowledge concerning orientation mechanisms, communication systems, learning, and the role of the nervous system in integrating behavior in insects. Cross-listed with ENTM 162.

**BIOL 163 Evolutionary Ecology of Terrestrial Vertebrates (5)** Lecture, 3 hours; laboratory, 6 hours. Prerequisite(s): BIOL 005B, BIOL 005C, CHEM 001C or CHEM 01HC, MATH 009B or MATH 09HB. Topics include ecology, evolution, and behavior of birds, mammals, reptiles, and amphibians. Laboratory covers systematics, morphology, and identification and includes indoor labs and field trips to local habitats.

**BIOL 165 Restoration Ecology (4)** Lecture, 3 hours; two 1-day field trips; three half-day field trips. Prerequisite(s): BIOL 104/BPSC 104 or BIOL 116 or ENSC 100; CHEM 12A; STAT 100A (STAT 100A may be taken concurrently); or consent of instructor. BIOL 102 and CHEM 12C are recommended. An examination of the basic ecological principles related to land restoration. Topics include enhanced succession, plant establishment, plant adaptations, ecotypes, weed colonization and competition, nutrient cycling, functions and reintroduction of soil microorganisms, restoration for wildlife, and the determination of successful restoration. Includes field trips to restored sites. Cross-listed with BPSC 165.

**BIOL 168 Developmental Biology (4)** Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): BCH 110C or BIOL 107A; a course in cell biology is recommended. An advanced description of the embryonic development of animals. Covers the basic concepts of fertilization, gastrulation, and neurulation. Analyzes topics in current developmental research, with an emphasis on the molecular mechanisms of pattern formation and differentiation.

**BIOL 171 Human Anatomy and Physiology (4)** Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): BIOL 161A; CHEM 12C or CHEM 12HC; MATH 009B or MATH 09HB; PHYS 002C; PHYS 02LC; BCH 100 or

## 129 / Programs and Courses

BCH 110A; one course in statistics; concurrent enrollment in BIOL 171L is recommended. An analysis of cell, tissue, and organ structure and function in normal and diseased conditions. Topics include the musculoskeletal, circulatory, and autonomic nervous systems; glands and hormones; body fluids and the kidney; digestion and absorption; and pharmacology and hematology. BIOL 161A, BIOL 161B, BIOL 171, and BIOL 171L provide a one-year sequence in vertebrate and human anatomy and physiology.

**BIOL 171L Human Anatomy and Physiology Laboratory (1)** Laboratory, 3 hours. Prerequisite(s): BIOL 161A (may be taken concurrently), CHEM 12C or CHEM 12HC, MATH 009B or MATH 09HB, PHYS 002C, PHYS 02LC, BCH 100 or BCH 110A, one course in statistics; BIOL 161B is recommended; concurrent enrollment in BIOL 171. Involves laboratory experiments in physiology and study of human anatomy and histology (normal and diseased). Covers experimentation, data collection, and analysis that incorporates hematology, blood proteins, urinalysis, neuromuscular control, cardiac excitation and pharmacology, blood pressure, electrocardiography, and electroencephalography. BIOL 161A, BIOL 161B, BIOL 171, and BIOL 171L provide a one-year sequence in vertebrate and human anatomy and physiology.

**BIOL 173 Insect Physiology (4)** Lecture, 3 hours; laboratory, 3 hours. Prerequisite(s): BIOL 005A and BIOL 005B or equivalents; CHEM 12A or CHEM 12HA, CHEM 12B or CHEM 12HB, CHEM 12C or CHEM 12HC, or equivalents; or consent of instructor. Introduction to principles of insect physiology. Subjects include growth, development and hormones, cuticle, nervous system, circulation, respiration, digestion, nutrition, excretion, reproduction, water balance, and temperature relations. Prior knowledge of insects is not assumed. Cross-listed with ENTM 173.

**BIOL 174 Ecological and Evolutionary Physiology (4)** Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): BIOL 005A, BIOL 005B, BIOL 005C, CHEM 001C or CHEM 01HC, CHEM 12C or CHEM 12HC, MATH 009B or MATH 09HB, PHYS 002C, PHYS 02LC, BCH 100 or BCH 110A, one course in statistics. Examines the interactions between organisms and their environments, emphasizing coadaptation of physiological, morphological, and behavioral phenotypes. Includes allometry and scaling, metabolism and locomotion, heat and water exchange, evolution of endothermy, artificial selection experiments, and phylogenetically based statistical methods.

**BIOL 175 Comparative Animal Physiology (4)** Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): BIOL 005A, BIOL 005B, BIOL 005C, BIOL 161A, CHEM 001C or CHEM 01HC, CHEM 12C or CHEM 12HC, MATH 009B or MATH 09HB, PHYS 002C, PHYS 02LC, BCH 100 or BCH 110A, STAT 100A; recommended: BIOL 151 and BIOL 161B. Topics include nutrition and energy metabolism, gas exchange, circulation, and regulation of body fluid composition.

**BIOL 176 Comparative Biomechanics (4)** Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): BIOL 005C, PHYS 002C or PHYS 040C; BCH 100 or BCH 110A. Applies principles from physics and engineering to the study of the relationship between organismal form and function. Covers examples from diverse plant and animal systems. Includes fundamental properties of solids and fluids, viscoelasticity, drag, biological pumps, locomotion, and muscle mechanics.

**BIOL 178 Hormones and Behavior (4)** Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): BIOL 005A, BIOL 005B, BIOL 005C, CHEM 001C or CHEM 01HC, CHEM 12C or CHEM 12HC, MATH 009B or MATH 09HB, PHYS 002C, PHYS 02LC, BCH 100 or BCH 110A, one course in statistics. An examination of the interactions between hormones and behavior in animals, including humans. Provides an overview of endocrine physiology, and examines the roles of hormones in sexual differentiation, sex differences in behavior, sexual behavior, parental behavior, affiliation, aggression, stress, and mood.

**BIOL 190 Special Studies (1-4)** Individual study, 3-12 hours. Prerequisite(s): consent of instructor and departmental chairperson. To be taken as a means of meeting special curricular needs. Grading basis to be selected in consultation with the instructor and departmental chairperson. Course is repeatable.

**BIOL 191 Seminar in Biology (2-4)** Seminar, 2-4 hours. Prerequisite(s): upper-division standing; consent of instructor. A critical study of selected topics in biology. Course is repeatable.

**BIOL 194 Independent Reading (1-4)** Consultation, 1-4 hours. Prerequisite(s): junior or senior standing and consent of instructor and departmental chairperson. Independent study under faculty supervision. Graded Satisfactory (S) or No Credit (NC). Course is repeatable to a maximum of 4 units.

**BIOL 197 Introduction to Research (1-2)** Consultation, 1-2 hours. Prerequisite(s): sophomore, junior or senior standing and consent of instructor and departmental chairperson. Reading, planning and preliminary laboratory work to develop a research project suitable for BIOL 199, Junior/Senior Research. Graded Satisfactory (S) or No Credit (NC). Course is repeatable.

**BIOL 199 Junior/Senior Research (1-4)** Laboratory, 1-4 hours. Prerequisite(s): junior or senior standing, a minimum GPA of 3.0 and consent of instructor and departmental chairperson. Special problems and research in biology performed under the supervision of members of the faculty of the Department of Biology. Graded Satisfactory (S) or No Credit (NC). Course is repeatable.

## Graduate Courses

**BIOL 200 Cell Biology (4)** Lecture, 3 hours; seminar, 1 hour. Prerequisite(s): BCH 110A or BCH 110B or equivalent (may be taken concurrently); BIOL 102 or equivalent; BIOL 113 or BIOL 114 or CBNS 101 or equivalent. An examination of the structure and function of eukaryotic cells and their components with emphasis on the key experiments that provide the foundation for our current knowledge. Covers topics such as cell membranes, intracellular trafficking, cell-to-cell interactions, motility, and the cytoskeleton. Cross-listed with CMDB 200.

**BIOL 201 Molecular Biology (4)** Lecture, 3 hours; seminar, 1 hour. Prerequisite(s): BCH 110A or BCH 110B or equivalent (may be taken concurrently); BIOL 102 or equivalent; BIOL 107A or equivalent. Covers the structure and inheritance of genetic material, the regulation of gene expression at the cellular and molecular level including molecular mechanisms for regulation of gene transcription, posttranscriptional regulation at the level of messenger RNA stability, processing, editing and translation, methods for gene mapping, and positional cloning. Cross-listed with CMDB 201.

**BIOL 203 Cellular Biophysics (3)** Lecture, 3 hours. Prerequisite(s): BIOL 200/CMDB 200; BIOL 201/CMDB 201; CHEM 109 or equivalent; or consent of instructor. Biophysical principles that determine cellular structure and function including diffusion, electrochemical gradients, transport, macromolecular interactions, and genetic recombination. Illustrative examples are used to highlight the importance of these principles in modern cell biology and physiology.

**BIOL 221 Microbial Genetics (4) W** Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): BCH 110C or BIOL 107A; BIOL 102. In-depth coverage of the genetics of microbes. Emphasizes the primary data and the foundation of modern techniques using viruses, archaea, prokaryotes, and eukaryotes. Includes genome sequences and organization, plasmids and other vectors, and mutation and genetic screens. Also covers transposable elements, recombination, and regulation of gene expression, development, and pathogenesis. Cross-listed with MCBL 221 and PLPA 226.

**BIOL 250 Special Topics in Biology (1-2)** Seminar, 1-2 hours. Prerequisite(s): graduate standing and consent of instructor. Oral presentations and intensive small-group discussion of selected topics in the area of special competence of each staff member. Course content will emphasize recent advances in the special topic area and will vary accordingly. Graded Satisfactory (S) or No Credit (NC). May be repeated for credit.

**BIOL 252 General Colloquium in Biology (1)** Seminar, 1 hour; discussion, 1 hour. Prerequisite(s): graduate standing. Oral reports by visiting scholars on current biological research. Graded Satisfactory (S) or No Credit (NC). May be repeated for credit.

**BIOL 261 Seminar in Genetics, Genomics, and Bioinformatics (1)** Seminar, 1 hour. Prerequisite(s): graduate standing or consent of instructor. Oral reports by visiting scholars, faculty, and students on current research topics in Genetics, Genomics, and Bioinformatics. Graded Satisfactory (S) or No Credit (NC). Course is repeatable. Cross-listed with BCH 261, BPSC 261, ENTM 261, GEN 261, and PLPA 261.

**BIOL 281 (E-Z) Seminar in Cell Development, Structure, and Function (2)** Seminar, 2 hours. Prerequisite(s): graduate standing; consent of instructor. Lectures, discussions, and demonstrations by students, faculty, and invited scholars on selected subjects concerned with the principles of cell development, structure, and function. E. Cell Biology; F. Molecular Biology; G. Developmental Biology. Segments are repeatable. Cross-listed with CMDB 281 (E-Z).

**BIOL 284 Seminar in Biology (2-4)** Seminar, 2-4 hours. Prerequisite(s): graduate standing; consent of instructor. Consists of lectures, discussions, and demonstrations by students, faculty, and invited scholars on selected topics concerned with the principles of biology. Course is repeatable.

**BIOL 289 Special Topics in Neuroscience (2)** Seminar, 2 hours. Prerequisite(s): graduate standing or consent of instructor. An interdisciplinary seminar consisting of student presentations and discussion of selected topics in neuroscience. Content and instructor(s) vary each time course is offered. Students who present a seminar receive a letter grade; other students receive a Satisfactory (S) or No Credit (NC) grade. Course is repeatable. Cross-listed with BCH 289, CHEM 289, ENTM 289, NRSC 289, and PSYC 289.

**EEOB 210 Organismal Biology (4)** Lecture, 4 hours. Prerequisite(s): At least one upper division undergraduate course that covers the principles of physiology (such as animal physiology, plant physiology, human physiology, or comparative anatomy and physiology), or a similar course, AND an upper division undergraduate course that covers the principles of evolution, or a similar course, OR consent of instructor. Explores the historical development of modern ideas in organismal biology. Topics include homeostasis, scaling, energetics, structure-function relationships, control systems, and response systems. Examines recent research in the context of the classic studies.

**EEOB 211 Foundations of Ecology (4)** Lecture, 4 hours. Prerequisite(s): BIOL 116 or consent of instructor. Examination of the history, theory, and interrelationships of fundamental ecological principles through readings and discussions of classic and recent literature. Topics include quantitative, population, community, ecosystem, evolutionary, and conservation ecology.

**EEOB 212 Ecological Systems in Space and Time (4)** Lecture, 3 hours; field, 30 hours per quarter. Prerequisite(s): One upper-division undergraduate course in population or community ecology or paleoecology; or consent of instructor. Focuses on how ecological systems are interpreted and reconciled at the community, landscape, and paleontological scales. Addresses the role of extrinsic factors operating at each of these scales. Also examines the historical development of our understanding of ecological systems at various scales. Cross-listed with ENTM 212 and GEO 212.

**EEOB 213 Behavioral Ecology (4)** Lecture, 4 hours. Prerequisite(s): BIOL 160 or consent of instructor. Examines animal behavior in an evolutionary context. Traces the historical development of the study of behavior, drawing from ethology, comparative psychology, and sociobiology. Topics include evolution of sociality, sexual selection, predator-prey behavior, and parental care.

**EEOB 214 Evolutionary Genetics (4)** Lecture, 4 hours. Prerequisite(s): BIOL 108 or consent of instructor. Traces the historical development of modern ideas in evolutionary genetics. Focuses on the influence of Fisher, Haldane, and Wright on current views of genetic variation in natural populations, by examining recent research in the context of their classic works.

**EEOB 215 Advanced Methods of Data Analysis in Evolution, Ecology, and Behavior (4)** Lecture, 3 hours; laboratory, 3 hours. Prerequisite(s): PSYC 212 or STAT 100B or equivalent. Introduces students to new methods of data analysis in the fields of evolution, ecology, and behavior. Covers theory and practical application using relevant examples. Topics include maximum likelihood, randomization, the jackknife, bootstrapping, Monte Carlo approaches, and meta-analysis.

**EEOB 216 The Theory of Evolution (4)** Lecture, 4 hours. Prerequisite(s): BIOL 105 or consent of instructor. Traces the historical development of modern ideas in evolutionary theory. Focuses on the influence of Darwin and the various authors of the modern synthesis on current views of macroevolution by examining recent research in the context of their classic works.

**EEOB 217 Advanced Population and Community Ecology (4)** Lecture, 4 hours. Prerequisite(s): One upper-division undergraduate class in population or community ecology; or consent of instructor. Traces the development of the major concepts in ecology. Focuses on the influence of pioneers in the field, historical roots of key concepts, and key controversies. Evaluates current research with reference to these historical origins.

**EEOB 219 Theory of Systematics (4)** Lecture, 4 hours. Prerequisite(s): BIOL 112/BPSC 112/ENTM 112 or equivalent or consent of instructor. Examines topics developed around a series of classical and recent papers on the principles, philosophy, and methodology of modern systematics and phylogenetic methods. Cross-listed with ENTM 219 and GEO 219.

**EEOB 220 Evolutionary Physiology (4) S, Even Years** Lecture, 4 hours. Prerequisite(s): an upper-division course in evolution and animal physiology or behavior, an upper-division course in statistics that covers analysis of covariance; or consent of instructor. Covers evolutionary approaches to the study of animal physiology. Includes organismal and organ-system physiology; biomechanics and locomotor mechanisms; cell physiology; the development of physiological systems; and behavioral neuroscience.

**EEOB 230 Analysis of Ecological Communities (5)** Lecture, 3 hours; discussion, 2 hours. Prerequisite(s): PSYC 212 or STAT 231B or equivalent; consent of instructor. Covers principles of multivariate analysis and its application to the interpretation of ecological community data. Topics include multiple and partial correlation and regression, canonical correlation, detrended and canonical correspondence analysis, multidimensional scaling, similarity indices and cluster analysis, and discriminant analysis.

**EEOB 265 Advances in Population and Evolutionary Biology (1 or 2)** Seminar, 1 hour; outside research, 0-3 hours. Prerequisite(s): graduate standing or consent of instructor. Presentations by visiting scholars, faculty, and students on current research topics in population and evolutionary biology. Graded Satisfactory (S) or No Credit (NC). Course is repeatable.

**EEOB 282 Seminar in Genetics and Evolution (2-4)** Seminar, 2-4 hours. Prerequisite(s): graduate standing; consent of instructor. Presentations by students, faculty, and invited scholars on selected topics concerned with the principles of genetics and evolution. Course is repeatable.

**EEOB 283 Seminar in Organismal Biology (1-4)** Seminar, 1-4 hours. Prerequisite(s): graduate standing; consent of instructor. Presentations by students, faculty, and invited scholars on selected topics concerned with the principles of organismal biology, including physiology, behavior, morphology, biomechanics, and related topics. Course is repeatable to a maximum of 18 units.

**EEOB 290 Directed Studies (1-6)** Individual study, 3-18 hours. Prerequisite(s): graduate standing; consent of instructor and graduate advisor. Individual studies on specially selected topics in evolution, ecology, and organismal biology under the direction of a faculty member. Graded Satisfactory (S) or No Credit (NC). Course is repeatable.

**EEOB 291 Individual Study in Coordinated Areas (1-6)** Individual study, 3-18 hours. Prerequisite(s): graduate standing. Provides a program of study designed to advise and assist candidates who are preparing for examinations. Graded Satisfactory (S) or No Credit (NC). Course is repeatable.

**EEOB 292 Concurrent Analytical Studies in Evolution, Ecology, and Organismal Biology (2-4)** Outside research, 6-12 hours. Prerequisite(s): consent of instructor. Elected concurrently with an appropriate undergraduate course but on an individual basis. Devoted to one or more graduate papers based on research or criticism related to the course. Faculty guidance and evaluation provided throughout the quarter. Course is repeatable.

**EEOB 297 Directed Research (1-6)** Outside research, 3-18 hours. Prerequisite(s): graduate standing; consent of instructor. Directed research in evolution, ecology, and organismal biology. Experimental studies on specially selected topics under the direction of a faculty member. Graded Satisfactory (S) or No Credit (NC). Course is repeatable.

**EEOB 299 Research for the Thesis or Dissertation (1-12)** Outside research, 3-36 hours. Prerequisite(s): graduate standing; consent of instructor. Original research in an area selected for the advanced degree. Graded Satisfactory (S) or No Credit (NC). Course is repeatable.

## Professional Courses

**BIOL 301 Teaching of Biology at the College Level (1)** Seminar, 1 hour. Prerequisite(s): graduate standing. A program of weekly meetings and individual formative evaluations required of new Biology Teaching Assistants. Covers instructional methods and classroom/section activities most suitable for teaching Biology. Conducted by the TA Development Program. Graded Satisfactory (S) or No Credit (NC).

**BIOL 303 Philosophy and Pedagogy of Teaching Undergraduate Life Sciences (3)** Lecture, 1 hour; laboratory, 3 hours; workshop, 1 hour. Prerequisite(s): graduate standing in life sciences. Explores the opportunities and challenges associated with developing an undergraduate course in the life sciences. Emphasizes determining how students learn, as well as exploring contemporary instruction methods that foster student engagement in the classroom. Graded Satisfactory (S) or No Credit (NC). Cross-listed with ENTM 303.

**EEOB 400 Introduction to Graduate Study in Biology (2)** Lecture, 1 hour; discussion, 1 hour. Prerequisite(s): graduate standing; consent of instructor. Introduces opportunities and requirements for successful graduate study. Emphasis is placed on effective strategies for developing and implementing a program of professional development and graduate research. Graded Satisfactory (S) or No Credit (NC).