

of 3.00 or higher may apply to enroll in BIOL 197 (Introduction to Research), since the purpose of this course is to enable the student to do preliminary reading and laboratory research to explore with the professor the feasibility of undertaking a project for later enrollment in BIOL 199. Enrollment in BIOL 197 is not required before enrollment in BIOL 199, but the former course is available for those situations where preliminary work will be helpful.

For BIOL 194 and BIOL 199, the student writes a report of the library study or laboratory results for the quarter, which is reviewed by the sponsoring professor and submitted to the CNAS Academic Advising Center by the last day of instruction of the quarter.

BIOL 194, BIOL 197, and BIOL 199 are graded "S/NC", and up to 9 units of credit may be counted as part of the 16 substantive units related to the major for the B.S. degree.

## Natural Reserve System

This system was formed by the UC in 1965 to preserve for study a series of undisturbed natural areas representing the state's vast ecological diversity. Since then the system has grown to include thirty-seven reserves, eight of them administered by the UCR campus. See Research Opportunities in this catalog.

Most of the reserves are undeveloped except for fencing, roads and trails, but laboratory facilities, housing and campgrounds for class use are available at some sites. The reserves are used as outdoor classrooms and laboratories by students, teachers and researchers from educational institutions, public and private, throughout the state, across the nation and around the world. Some of the courses offered by the UCR Department of Biology include field trips and overnight camping trips to the reserves. In the field, students are introduced to the great diversity of plant and animal organisms in Southern California, and to the effect of environmental factors on this diversity.

Undergraduate and graduate students who wish to use the reserves in their individual research projects should contact Dr. John T. Rotenberry, Department of Biology, 3372 Spieth Hall, (951) 827-3953, to obtain an application, map and list of rules and regulations.

## Graduate Program

The Department of Biology administers programs leading to the M.S. and Ph.D. degrees in Evolution, Ecology, and Organismal Biology, with specializations in Evolutionary Biology, Ecology, and Physiology and Biophysics.

**Admission** Applicants must submit GRE scores for the General Test (verbal, quantitative, and analytical). In addition, submission of the Subject Test score may improve chances of admission and is recommended.

All graduate students entering the department meet with a guidance committee during

the first quarter of enrollment so that their educational background can be addressed. Considering the requirements of the student's specialization, the committee recommends a program of study to be followed in pursuit of graduate work. Because of the diversity among the specializations, course requirements for advanced degrees are specified by the student's guidance committee in accordance with the specific requirements of each track.

## Doctoral Degree

The Department of Biology offers the Ph.D. degree in Evolution, Ecology, and Organismal Biology, with specializations in Evolutionary Biology, Ecology, and Physiology & Biophysics. In addition to the general requirements of the Graduate Division, students intending to become candidates for the Ph.D. degree in Evolution, Ecology, and Organismal Biology must complete the following.

**Course Work** Course requirements are determined in consideration of the requirements of the student's area of specialization. Selection of specific courses is done by the guidance committee in consultation with the student.

Each track requires EEOB 400, two 200-level disciplinary courses, a core course (or core course series) and two current research topics courses: EEOB 265 and a disciplinary colloquium series seminar (BIOL 252 or equivalent).

### A. Evolutionary Biology

1. Disciplinary core course in Evolutionary Theory (EEOB 216 or the equivalent)
2. At least two disciplinary courses (EEOB 211, BIOL 212/ENTM 212/GEO 212, EEOB 213, EEOB 214 EEOB 217, EEOB 219)
3. Two current research topics courses (BIOL 252 or another disciplinary colloquium and EEOB 265), each for a minimum of 5 quarters prior to advancement to candidacy and a total of 12 quarters prior to completion of the doctoral degree.

### B. Ecology

1. Disciplinary core course in Ecology (EEOB 211)
2. At least two disciplinary courses (BIOL 212/ENTM 212/GEO 212, EEOB 213, EEOB 217, BPSC 246, BPSC 247, BPSC 243, ENSC 232, SWSC 211/MCBL 211)
3. Two current research topics courses (BIOL 252 or another disciplinary colloquium and EEOB 265), each for a minimum of 5 quarters prior to advancement to candidacy and a total of 12 quarters prior to completion of the doctoral degree.

### C. Physiology and Biophysics

1. Disciplinary core course in Physiology (EEOB 297; two units each in the first four quarters of residence for a total of 8 quarters)

2. At least two disciplinary courses (CMDB 200 or CBNS 200A, CMDB 201, CBNS 200B, CMDB 202, CBNS 200C, BIOL 203, EEOB 216, ENTM 201, ENTM 243)
3. Two current research topics courses (BIOL 252 or another disciplinary colloquium and EEOB 265), each for a minimum of 5 quarters prior to completion of the doctoral degree.

### Written and Oral Qualifying Examinations

Students must pass a written examination in their specialized field of interest not later than the end of the second year of residence. Written Qualifying Examinations must be completed by the eighth week of the sixth quarter in residence for each track. Upon successful completion of the Written Qualifying Examination, an Oral Qualifying Examination is administered wherein students defend a proposal detailing the rationale, specific aims, and approaches to be undertaken for their proposed dissertation research.

**Dissertation** Candidates may be required to successfully defend their dissertation research in a public oral presentation.

**Teaching Requirement** Students must have at least one year of approved teaching experience.

**Normative Time to Degree** 18 quarters

## Master's Degree

The Department of Biology offers the M.S. degree in Evolution, Ecology, and Organismal Biology, with specializations in Evolutionary Biology, Ecology, and Physiology & Biophysics. To qualify for the M.S. degree in Evolution, Ecology, and Organismal Biology, candidates must meet the requirements of the Department of Biology.

These requirements are as follows:

**Plan I (Thesis)** Thirty-six (36) quarter units of approved courses in the 100 or 200 series, of which at least 24 units must be in the 200 series courses in the biological sciences. Not more than 12 units of EEOB 299 may be applied to the degree. A minimum of 12 units of course work other than courses in the 290 series must be completed in fulfillment of the requirement for 24 units of graduate courses. Students must present an acceptable thesis and undergo a final oral examination in defense of the thesis.

## 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 or BIOL 05LA.

**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); 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 students 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 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.

**BIOL 005B. Introduction to Organismal Biology (4)** Lecture, 3 hours; laboratory, 3 hours. Prerequisite(s): BIOL 005A and BIOL 05LA 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 students 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 and BIOL 005B (or BIOL 002 and BIOL 003 for non-Biology majors) with grades of "C-" or better; MATH 008B with a grade of "C-" or better or 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, ENGL 001A, MATH 009A (may be taken concurrently), NASC 092 or NASC 093 (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. **Wessler**

**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 non-science 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.

## 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 and BIOL 005B with grades of "C-" or better. An introductory course, including 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 112C, 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 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 112C, 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. Both prokaryotic and eukaryotic systems are examined, 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. Prerequisite(s): BIOL 005A, BIOL 005B, BIOL 005C, CHEM 001C or CHEM 01HC, CHEM 112C, 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 112C, 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 that relate to medicine, ethics, and human existence. Topics covered vary from year to year 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. **Walter**

**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 112C, 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. Students read original journal articles, an analysis of which is the focus of the discussion section.

**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 112C, 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. 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. Students read original journal articles, an analysis of which is the focus of the discussion section.

**BIOL 115. Human Genetics (3)** Lecture, 3 hours. Prerequisite(s): BCH 110A; BCH 110B; BCH 110C or BIOL 107A (may be taken concurrently); BIOL 121/MCBL 121; STAT 100A or equivalent; or consent of instructor. An introduction to human genetics. Topics include human gene organization and expression, chromosome structure, karyotyping, chromosomal aberrations, sex determination and sex chromosome abnormalities, patterns of single gene inheritance, linkage analysis, human gene mapping, inborn errors in metabolism, human population genetics, polymorphic cell surface antigens, multifactorial inheritance genetics of cancer, prenatal diagnosis, and uses of recombinant DNA in medical genetics.

**BIOL 116. Ecology and Conservation Biology (4)** Lecture, 3 hours; discussion, 7 hours per quarter; field, 9 hours per quarter. Prerequisite(s): BIOL 005A, BIOL 05LA, BIOL 005B, BIOL 005C, 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. An optional related laboratory course, BIOL 116L, is available.

**BIOL 116L. Laboratory in Ecology and Conservation (2)** Lecture, 1 hour; laboratory, 1.5 hours; field, 1.5 hours. Prerequisite(s): BIOL 005A, BIOL 05LA, BIOL 005B, BIOL 005C, BIOL 116 (BIOL 116 may be taken concurrently), CHEM 001C or CHEM 01HC, MATH 009B or MATH 09HB, STAT 100A (STAT 100A may be taken concurrently). Offers laboratory and field exercises in ecology and conservation. Students design, execute, and analyze several projects that explore topics such as population dynamics, life tables, abundance and distribution, succession, diversity, conservation, and restoration.

**BIOL 117. Population and Community Ecology (4)** Lecture, 3 hours; discussion, 1 hour. Prerequisite(s): BIOL 005A, BIOL 05LA, BIOL 005B, BIOL 005C, BIOL 116, CHEM 001C or CHEM 01HC, CHEM 112C, MATH 009B or MATH 09HB, PHYS 002C, PHYS 02LC, BCH 100 or BCH 110A, one course in statistics. Introduces models of population growth, interspe-

cific interaction, and biotic communities and their implications for applied fields such as pest control, epidemiology, and conservation of biodiversity. Topics include population growth and regulation, life history evolution, metapopulation dynamics, extinction, competition, predation, and the role of ecological interactions in adaptation and evolutionary change.

**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 112C, 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 005A, BIOL 05LA, BIOL 005B, BIOL 005C, BIOL 102, CHEM 001C or CHEM 01HC, CHEM 112C, MATH 009B or MATH 09HB, PHYS 002C, PHYS 02LC, BCH 100 or BCH 110A, one course in statistics. Introduction to the science of genomics and bioinformatics, including genome integrated sequencing, database techniques, comparative 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 112C, 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 112C, 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 112C, 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 112C, 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 (5)** Lecture, 3 hours; laboratory, 6 hours. Prerequisite(s): BIOL 005A and BIOL 005B, or consent of instructor. Functional and developmental aspects of plant cell, tissue, and organ structure. All aspects of the flowering plant life cycle are covered 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 112C, 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 112C, 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. **Smith, Springer**

**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 112C, 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 112C, 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 Paleogeology (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, paleogeology, 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 112C, 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 112C, 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. **Platzer**

**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. Prerequisite(s): BIOL 005A, BIOL 005B, BIOL 005C, CHEM 001C or CHEM 01HC, CHEM 112C, 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 112C, 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 160L. 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 112A, 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 112B, 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. **Carde**

**BIOL 163. Evolutionary Ecology of Terrestrial**

**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 112C, MATH 009B or MATH 09HB, PHYS 002C, PHYS 02LC, BCH 100 or BCH 110A, one course in statistics. Topics include ecology, evolution, and behavior of birds, mammals, reptiles, and amphibians. Laboratory covers systematics, morphology, and identification, and includes 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/SWSC 100 or ENSC 100H/SWSC 100H; CHEM 112A; STAT 100A (STAT 100A may be taken concurrently); or consent of instructor. BIOL 102 and CHEM 112C 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 166. Conservation Ecology (3)** Lecture, 2 hours; field, 3 hours. Prerequisite(s): BIOL 005A, BIOL 05LA, BIOL 005B, BIOL 005C, BIOL 116, CHEM 001C or CHEM 01HC, CHEM 112C, MATH 009B or MATH 09HB, STAT 100A. PHYS 002C and PHYS 02LC are recommended. Introduces ecological concepts and strategies for conserving biodiversity. Covers topics ranging from genetics and evolution in small populations to community assembly, landscape structure, ecosystem processes, human impacts, and global change.

**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 112C; MATH 009B or MATH 09HB; PHYS 002C; PHYS 02LC; BCH 100 or 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

112C, 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, incorporating 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 112A, CHEM 112B, CHEM 112C 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 112C, 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, CHEM 001C or CHEM 01HC, CHEM 112C, MATH 009B or MATH 09HB, PHYS 002C, PHYS 02LC, BCH 100 or BCH 110A, one course in statistics; recommended: BIOL 151 or both BIOL 161A 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 112C, 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 185 (E-Z). Advanced Undergraduate Seminar in Biology (2-4)** Seminar, 2-4 hours. Prerequisite(s): upper-division standing with a major in biology or related field. A seminar course offered to provide biology majors and others that can meet the prerequisite of the course, an opportunity for an in-depth consideration of special topics in biology and related areas.

Topics are selected as faculty interest, student interest, and opportunity permit. (Limited enrollment) G. Biology of Development (2); N. Biology of Food (3); P. Psychobiology (2).

**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 208. Host-Parasite Relationships (3)** Lecture, 3 hours. Prerequisite(s): BIOL 100/ENTM 100 or BIOL 157 or consent of instructor. Explores the fundamental biochemical and developmental requirements for "successful" host-parasite relationships in insects. Emphasizes wasp and nematode parasites of insects and vector-parasite interactions involved in transmission of parasites in malaria, trypanosoma, and Lyme disease. Cross-listed with ENTM 208.

**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, archae, 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. **Borkovich**

**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 211. Ecology: Genes to Ecosystems (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, landscape, restoration, conservation, and human or social ecology.

**EEOB 212. Ecological Systems in Space and Time (4)** Lecture, 3 hours; field, 30 hours per quarter. Prerequisite(s): BIOL 117 or BIOL 152/GEO 152 or equivalent 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 of 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): BIOL 117 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. **Redak, Rotenberry**

**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. **Altshuler, Garland, Jr.**

**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 Physiology and Physiological Ecology (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 organismal physiology and physiological ecology. Course is repeatable.

**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. **Cardullo, Paine, Regan**

**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).

# Biomedical Sciences

**Subject abbreviation: BMSC**  
**Division of Biomedical Sciences**

G. Richard Olds, M.D., Vice Chancellor for Health Affairs and Dean of the School of Medicine  
Craig V. Byus, Ph.D., Senior Associate Dean, Academic Affairs and Research, UCR School of Medicine and Divisional Dean of the UCR/UCLA Thomas Haider Program in Biomedical Sciences  
Neal L. Schiller, Ph.D., Senior Associate Dean, Student Affairs, UCR School of Medicine  
Dan S. Straus, Ph.D., Chair of the Faculty  
Stewart W. Shankel, M.D., Director of Clinical Instruction  
Lawrence K. Loo, M.D., Associate Director of Clinical Instruction  
Program Office, 2626 School of Medicine Education Bldg., (951) 827-4333 or 4334; biomed.ucr.edu

### Professors

Craig V. Byus, Ph.D. *Pharmacology* (Biomedical Sciences/Biochemistry), *Salma Haider Endowed Chair in Biomedical Sciences*  
David A. Johnson, Ph.D. *Pharmacology*  
David Lo, M.D., Ph.D. *Genetics (Distinguished Professor)*  
G. Richard Olds, M.D., FACP  
Paul M. Quinton, Ph.D. *Physiology*  
Neal L. Schiller, Ph.D. *Microbiology/Immunology*  
John Y.-J. Shyy, Ph.D. *Pharmacology/Physiology*  
Daniel S. Straus, Ph.D. *Human Genetics* (Biomedical Sciences)  
Ameae M. Walker, Ph.D. *Microanatomy*

### Professors Emeriti

Mary Ann Baker, Ph.D. *Neurosciences*  
Richard A. Luben, Ph.D. *Endocrinology* (Biomedical Sciences/Biochemistry)  
Anthony W. Norman, Ph.D. *Endocrinology* (Biomedical Sciences/Biochemistry)