INTRODUCTION

Biology is the branch of science concerned with the study of life. The discipline is dynamic, diverse and expanding with the integration of molecular approaches, information technology and concerns for the environment. Through the study of biology students will: learn principles that govern the function of their own body and those of other organisms; explore how complex organisms develop from a single cell and how genes and the environment govern these events; and learn how plants capture the energy from the sun and, ultimately, sustain almost all life on Earth through intricate relationships with other organisms, including humans. In addition, in Southern California, proximity to a variety of businesses, ranging from biotechnology and biomedical companies to environmental consulting firms provides biology majors with diverse employment opportunities.

The department has designed a curriculum that builds on a core of biology and supporting courses for students who: (1) seek careers in industry and state or federal agencies; (2) wish to prepare for secondary school teaching; or (3) desire to enter graduate and professional schools. The curriculum beyond the basic core experience will be developed through individual advising. Each semester, students are required to meet with their designated faculty adviser in order to develop an appropriate program of study. After discussion with their adviser, students will elect upper-division courses in one of four concentrations that will satisfy their individual interests and professional goals.

LEARNING GOALS AND STUDENT LEARNING OUTCOMES

Bachelor of Science in Biological Science

The following goals and learning outcomes have been established for students pursuing a Bachelor of Science in Biological Science:

Content Knowledge
- Explain (i.e., expound, explicate, elucidate, and interpret) fundamental concepts and principles in the following areas of biological knowledge: biodiversity, cell biology, developmental biology, ecology, evolution, genetics, molecular biology, organismal biology, and physiology
- Interpret the following unifying themes in the context of the above areas of biological knowledge: complexity of biological systems, cycles, feedback loops, energy flow, homeostasis, information flow, networks, and structure-function relationships
- Demonstrate specialization and thus be able to explain advanced concepts in one or more of the areas of biological knowledge in the first bullet above
- Interpret connections between science and technology, past scientific discoveries and current scientific progress, academic requirements and careers or professional advancement, the scientific method including its limitations and the discovery of new knowledge, and bioethics/scientific integrity and the advancement of science
Skills

- **Communication** – Communicate effectively orally; communicate effectively in writing; write in scientific format acceptable by scientific journals
- **Teamwork** – Work cooperatively to solve problems in a group of diverse composition
- **Finding biological information** – Find, evaluate, use, and integrate published information; use databases and information technology
- **Critical thinking and problem-solving** – Make an argument and support it; recognize and use deductive and inductive reasoning; integrate concepts within and among disciplines; recognize patterns; identify unifying principles; solve problems; distinguish between data and inferences based on data; distinguish information from scientific versus pseudo- and non-scientific sources and methods
- **Use of the scientific method** – Use deductive methods of inquiry; apply the scientific method to problems by generating hypotheses and designing experiments to test these hypotheses
- **Analytical and quantitative skills** – Create data sets from observations; objectively analyze data; interpret data; use quantitative methods for the analysis of data
- **Lab and field work** – Use appropriate technology; use equipment properly; follow safety procedures; apply government regulations

Attitudes

- **Embrace lifelong learning** by being capable of self-directed learning, having a continual interest in biology, and having confidence in one’s knowledge, skills and abilities
- **Value learning** by being open-minded, appreciating the value of knowledge, appreciating and respecting alternative possibilities and explanations, and experiencing the joy of discovery
- **Demonstrate knowledge of careers** by defining potential career paths and being aware of the requirements for career or professional advancement
- **Be aware of impacts of biological issues** on society by valuing the support of science by society, appreciating the relevance of biology to society and recognizing the connectedness of science, society and history
- **Demonstrate awareness of bioethics** by identifying and evaluating ethical issues in biology, appreciating the value of integrity and valuing ethical behavior
- **Demonstrate appropriate stewardship and advocacy** by respecting biodiversity, contributing to the understanding of true science, helping the public make informed decisions and being responsible stewards of biological resources
- **Demonstrate biological literacy** by distinguishing science from pseudoscience, recognizing that science is a way of viewing the world and is not just a collection of facts, understanding the limitations of science, applying scientific thinking to everyday problems and recognizing the impermanence of “truths”

All students will progress through lower-division core courses and select an upper-division concentration. Details of learning goals for the core and each concentration may be found at biology.fullerton.edu.

**Master of Biotechnology (MBt)**

The following goals and learning outcomes have been established for students pursuing a Master of Biotechnology (MBt):

**Content Knowledge**

- Demonstrate knowledge in a primary area of expertise
- Identify and critically evaluate the literature in the primary area
- Understand the basic processes of product life cycles

**Information Literacy Skills**

- Determine what kind of information is needed to solve a problem
- Identify how to obtain the relevant information from literature/information databases
- Critically assess the information for its rigor
- Cite the information gathered appropriately in written and oral formats

**Communications Skills**

- Work effectively as a member of an interdisciplinary team
- Converse with colleagues in all disciplines related to the mission of PABS
- Write and present project proposals and technical reports that communicate effectively with all levels of an organization
- Communicate effectively with individuals at governmental and public entities

**Applications**

- Demonstrate mastery of basic application skills in biotechnology disciplines
- Develop experimental or practical designs for solving problems in product or process development
- Analyze the driving forces for product development
- Use knowledge effectively in new situations and diverse contexts

**Biotechnology Industry**

- Demonstrate knowledge of commercialization of biotechnology in pharmaceuticals, biomedical devices, diagnostics/assays systems, clinical trial management, and related companies
- Understand the essential processes of project management
- Understand the essential processes of regulatory affairs and clinical trials management
Master of Science in Biology

The following goals and learning outcomes have been established for students pursuing a Master of Science in Biology:

Content Knowledge
- Demonstrate knowledge in a primary area of expertise and place the thesis research in the context of the current state of knowledge of the field
- Critically evaluate the primary and secondary literature in a primary area of expertise
- Gain an appreciation for the diversity and multidisciplinary nature of biological science through participation in workshops, seminars and small working groups

Information Literacy Skills
- Use library and electronic resources to obtain virtually all of the literature sources published in a primary area of expertise in biology
- Cite the information gathered appropriately in written and oral formats

Scientific Research Skills
- Work independently to conduct and complete original research
- Demonstrate mastery of research approaches and techniques appropriate to a primary area of expertise
- Demonstrate mastery of key elements of research and study design and apply them to an independent research project
- Analyze and interpret data appropriately and present results properly in written, tabular and graphical formats

Communication Skills
- Write a thesis proposal that contains the key elements of a competitive grant proposal
- Prepare and give high-quality, professional presentations (oral and poster) about the results of independent research
- Write a scholarly thesis containing key elements of a published article in one’s primary area of expertise

Special Programs
In addition to the usual course offerings, the Department of Biological Science participates in the Center for Applied Biotechnology Studies and four consortial programs with other California State University campuses. These are: CSUPERB (California State University Program for Education and Research in Biotechnology); the CSU Council on Ocean Affairs, Science & Technology (COAST); the Ocean Studies Institute (through the Southern California Marine Institute); and the California Desert Studies Consortium. Each of these centers is described in this catalog under “Research Centers.”

Single Subject Teaching Credential Information
The Bachelor’s Degree in Biology may be effectively combined with subject matter studies necessary for the Single Subject Teaching Credential in Biological Sciences. Contact the Center for Careers in Teaching (657-278-7130, fullerton.edu/cct) and the Science Education Programs Office (657-278-2307, nsm.fullerton.edu/scied/) for early advisement and to plan efficient course selections for general education, the major and credential program coursework. Additional information is found under Science Education Programs in the University Catalog, as well as at http://mast.wikispaces.com.

Recommendations for Transfer Students
Students planning to transfer from another college or university should take biology, chemistry, mathematics and/or physics courses that are equivalent to those required for the B.S. in Biological Science (refer to assist.org). Prospective transfer students should contact the Biology Department as soon as possible prior to transfer to select appropriate courses.

Upper-Division Baccalaureate Writing Requirement
To meet the upper-division baccalaureate writing requirement, students must pass with a “C” (2.0) or better ENGL 301 or six units from the following: BIOL 411, 414, 417, 422, 426, 427, 445, 446, 447, 449, 465, 466, 468, 470, 495, 498.

BACHELOR OF SCIENCE IN BIOLOGICAL SCIENCE

The Bachelor of Science in Biological Science requires 43 units in the major, 34 units of supporting courses in physical sciences and mathematics and an exit exam on biology in the spring semester of the senior year. All courses must be passed with a “C” (2.0) or better. Those seeking careers in the health professions should speak to a health professions adviser about specific course recommendations. For more information, visit: fullerton.edu/health_professions.

Core Requirements for the Major (20 units)
BIOL 171 Evolution and Biodiversity (5)
BIOL 172 Cellular Basis of Life (5)
BIOL 273 Genetics and Molecular Biology (5)
BIOL 274 Principles of Physiology and Ecology (5)

Upper-Division Courses (23 units)
(Choose from four concentrations below)
The upper-division program is designed to provide students with depth in a chosen concentration. The upper-division program requires at least five units of laboratory- or field-based activities, six units of 400-level biology courses and two units of a specified capstone course.

Students with junior or senior standing will be permitted to enroll in BIOL 480, 482, 495, 498 and 499L. However, no more than a combined total of six units of BIOL 480 (2 units max), 482 (2 units max), 495 (3 units max), 498 (2 units max) and 499L (6 units max) shall be counted toward the 23 upper-division biology units required for the major, and no more than three of these units may count toward the requirement to complete at least five units of upper-division biology laboratory/field electives.
CONCENTRATION IN CELL AND DEVELOPMENTAL BIOLOGY (23 UNITS)

Required Upper-Division Courses (7 units)
BIOL 302 General Microbiology (4)
BIOL 303 Intermediate Cell Biology (3)

Upper-Division Biology Electives (10 units minimum)
Cell Biology Courses (7 units minimum)

Associated Courses
One of the following may be used to complete the 10-unit minimum:
BIOL 309, 402, 407, 411*, 412, 413, 414*, 430, 445*, 448
CHEM 421 OR 423A

Free Upper-Division Biology Electives
Although it is recommended that Cell and Developmental Biology Concentration majors select additional elective units from courses listed under Upper-Division Biology Electives under this concentration, any upper-division biology majors course may be utilized to complete the concentration’s 23-unit requirement.

Capstone Courses (2 units minimum)
BIOL 400, 401, 447*, 450, 465**, 481, 482, 495*, 498*, 499L

CONCENTRATION IN ECOLOGY AND EVOLUTIONARY BIOLOGY (23 UNITS)

Required Upper-Division Courses (6 units)
BIOL 314 Population and Community Ecology (3)
BIOL 325 Principles of Evolution (3)

Upper-Division Electives (11 units minimum)
Ecology Courses (4 units minimum)
BIOL 419 and 419L
OR BIOL 422*
Organismal/Systematics Courses (4 units minimum)
BIOL 446*, 461, 475
Other Marine Biology Courses (3 units minimum)
BIOL 301, 302, 317, 402, 404 or 409, 405, 436, 468*, or additional courses listed above

Free Upper-Division Biology Electives
Although it is recommended that Marine Biology majors select additional units from the courses listed under Upper-Division Biology Electives under this concentration, any upper-division biology majors course may be utilized to complete the concentration’s 23-unit requirement.

CONCENTRATION IN MARINE BIOLOGY (23 UNITS)

Required Upper-Division Courses (3 units)
BIOL 314 Population and Community Ecology (3)
OR BIOL 325 Principles of Evolution (3)

Upper-Division Electives (11 units minimum)
Ecology Courses (4 units minimum)
BIOL 419 and 419L
OR BIOL 422*
Organismal/Systematics Courses (4 units minimum)
BIOL 446*, 461, 475
Other Marine Biology Courses (3 units minimum)
BIOL 301, 302, 317, 402, 404 or 409, 405, 436, 468*, or additional courses listed above

Free Upper-Division Biology Electives
Although it is recommended that Marine Biology majors select additional units from the courses listed under Upper-Division Biology Electives under this concentration, any upper-division biology majors course may be utilized to complete the concentration’s 23-unit requirement.
Capstone Courses (2 units minimum)
BIOL 400, 401, 422*, 450, 482, 495*, 498*, 499L

Selected approved courses from the Ocean Studies Institute (see scmi.us/category/ocean-studies-institute) taken as part of the CSU Catalina Semester may be used to fulfill many requirements for this concentration.

1 Course that counts as elective or capstone, but not both.
* courses that meet the upper-division writing requirement (6 units required)

CONCENTRATION IN MOLECULAR BIOLOGY AND BIOTECHNOLOGY (23 UNITS)

Required Upper-Division Courses (6-7 units)
BIOL 309 Intermediate Molecular Biology (3) AND
One or more of the following:
BIOL 302 General Microbiology (4)
CHEM 421 Biological Chemistry (3)
CHEM 423A General Biochemistry (3)

Upper-Division Biology Electives (10 units minimum)
Molecular Biology Courses (6 units minimum)
CHEM 421 OR 423A

Associated Courses
The following may be used to complete the 10-unit minimum;

Free Upper-Division Biology Electives
Although it is recommended that Molecular Biology and Biotechnology Concentration majors select additional elective units from courses listed under Upper-Division Biology Electives under this concentration, any upper-division biology majors courses may be utilized to complete the concentration's 23-unit requirement

Capstone Courses (2 units minimum)
BIOL 400, 412*, 429*, 430*, 472A*, 472B*, 482, 495*, 498*, 499L

1 courses that count as either electives or capstone, but not both.
* courses that meet the upper-division writing requirement (6 units required)

MINOR IN BIOTECHNOLOGY (31 UNITS)
The biotechnology minor is appropriate for students majoring in biological science or biochemistry and interested in gaining employment in nearly any area of the medical and agricultural biotechnology industries, working in academic research laboratories, or pursuing postgraduate degrees in basic molecular biology or biochemistry.

The biotechnology minor requires chemistry and biology courses that must be completed with a minimal overall grade-point average of 2.0 and include 12 units unique to the minor that are not used to meet requirements for the biological science or biochemistry major.

Required Courses (28 units)
BIOL 273 Genetics and Molecular Biology (5)
BIOL 309 Intermediate Molecular Biology (3)
OR CHEM 421 Biological Chemistry (3)
CHEM 301A,B Organic Chemistry (6)
CHEM 302 or CHEM 302A,B Organic Chemistry Laboratory (2)
BIOL 412 Principles of Gene Manipulation (3)
BIOL/ CHEM 472A,B Advances in Biotechnology Laboratory (6)
CHEM/BIOI 477 Advances in Biotechnology (3)

Supporting Courses (3-4 units)
One of the following:
BIOL 309, 413, 424
CHEM 421, 423A, 423B

MINOR IN CELL AND MOLECULAR BIOLOGY (26 UNITS)

Science has become increasingly interdisciplinary with biophysics, biochemistry, bioengineering, psychology and kinesiology as examples of disciplines that rely heavily on knowledge of biological science in the area of cell and molecular biology. Students majoring in these disciplines will be more competent and more competitive for graduate programs of employment with evidence of a minor that requires extensive education in cell and molecular biology. All courses must be passed with a “C” (2.0) or better.

Lower-Division Core (10 units)
BIOL 172 Cellular Basis of Life (5)
BIOL 273 Genetics and Molecular Biology (5)

Upper-Division Required Courses (10 units)
BIOL 303 Intermediate Cell Biology (3)
BIOL 309 Intermediate Molecular Biology (3)
BIOL 302 General Microbiology (4)
OR 362 Mammalian Physiology (4)

Upper-Division Cell and Molecular Electives (6 units)
BIOL 402, 405, 411, 412, 413, 414, 417, 418L, 424, 426, 427, 428, 445, 448, 470
CHEM 421
MINOR IN ENVIRONMENTAL BIOLOGY (22 UNITS)

Understanding and controlling our environment has become an important career path in the 21st century. Understanding the biological science relevant to studying the environment is needed for students majoring in other disciplines to be more competitive for entry into graduate programs or into the work force. The minor will also provide students planning careers in secondary education science teaching with an expanded knowledge of environment-related issues. All courses must be passed with a "C" (2.0) or better.

Lower-Division Core (10 units)
BIOL 171 Evolution and Biodiversity (5)
BIOL 274 Physiology and Ecology (5)

Upper-Division Required Course (3 units)
BIOL 314 Population and Community Ecology (3)

Upper-Division Ecology Course (3 units minimum)
BIOL 419 & 419L, 422, 443, 444, 449, 466

Upper-Division Elective (3 units minimum)
BIOL 317, 325, 340, 401, 441, 446, 447, 450, 461, 467, 475, 476, 478, 479

At least one upper-division biology laboratory course from the list above must be completed.

Related Courses (3 units maximum to meet total units)
CHEM 313A, 313B, 313C, 436, 437, 448
ECON 362
GEOG 323, 450, 481
GEOL 333, 335, 380
HESC 415
PHIL 313

MASTER OF BIOTECHNOLOGY (40 UNITS)
The Master of Biotechnology (MBt) is a Professional Science Master’s Program that prepares graduates for careers in biomedical device, pharmaceutical and biopharmaceutical industries. The two-year program provides training in the science and skills fundamental to industry, including knowledge of molecular and cellular biology, mathematical modeling, biological database mining and relevant technology. Students receive instruction in regulatory affairs, project management, cross-functional teamwork, communication and group leadership skills. They also participate in an industry-based internship, complete an industry-related project, and specialize in one of six concentrations. They are Applications to Biotechnology of: Analytical Chemistry; Business/Law; Engineering; Informatics/Biomathematics; Molecular Biology/Biochemistry; and Regulatory Affairs/Quality Assurance.

The MBt degree is coordinated by the Program for Applied Biotechnology Studies (PABS) and is a joint program among three CSU campuses: Fullerton, Los Angeles and Pomona (see calstate.edu/pabs/). Each campus will offer at least one required course, as well as advanced elective courses.

Admission Requirements
Students must meet the CSU requirements for admission to a master’s degree program. Please consult the Graduate Admissions section in this catalog for complete information. In addition, acceptance into this program is contingent upon the following: (1) a B.A. or B.S. from an accredited institution with a 3.0 GPA in major courses in biological science or related area, engineering or related area, chemistry or related area, business or related area, or mathematics or related area; (2) submitting scores from the Graduate Record Examination General Test, Medical College Admission Test, Dental Admission Test or Graduate Management Admission Test; (3) completing the departmental application; and (4) submitting two letters of recommendation from faculty members. Students with deficiencies may be considered for conditional acceptance into the program. For conditionally accepted students, the specific conditions and a deadline for their completion are determined at the time of admission; continuation in the master’s program is dependent upon completing the admission conditions by the specified deadline.

Classified Standing
Students should achieve classified graduate standing as soon as they are eligible, because no more than nine units of graduate work taken before classification can be included on the study plan (see below) for the degree. A student who meets the admission requirements may apply for classified standing, which requires developing a study plan approved by the department MBt graduate program adviser, department chair, and associate vice president for Graduate Studies and Research.

Advancement to Candidacy
Advancement to candidacy is attained by requesting a graduation check and receiving subsequent approval of the department MBt graduate program adviser, department chair, and associate vice president for Graduate Studies and Research.

Study Plan
Students must meet the Graduate Level Writing Requirement, which is described in this catalog under "Graduate Regulations." MBt candidates meet this requirement by passing BIOL 570. A minimum of 28 units of the student’s graduate study plan must consist of 500-level courses. All study plans must include BIOL 463*, 463L*, 518*, 570, 571, 572, 576*, 580, MGMT 554*, 570, EGGN 520L*, nine units of approved concentration courses, and six units of BIOL 597. An Applied Masters Project (AMP) comprising 480 hours of on-site work addressing a topic or issue of importance to the sponsoring business, a written project report and a public presentation of the AMP are also required to complete the MBt degree. The AMP projects’ design, execution and report-out require the close

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attention of both the MBt graduate adviser and the project mentor(s) representing the business. To insure that space is available within the program for new students, all students are expected to complete the MBt curriculum within two years of classification.

For more information or advisement, students should contact the MBt program graduate adviser in the Department of Biological Science at ddyer@fullerton.edu or consult calstate.edu/pabs/

* course is offered at one of the other two PABS campuses, Los Angeles or Pomona

MASTER OF SCIENCE IN BIOLOGY (30 UNITS)

The M.S. in Biology is a thesis-based degree for which the student completes original, independent research in one of the following areas: Cell and Developmental Biology, Ecology and Evolutionary Biology, Marine Biology, Molecular Biology and Biotechnology, or Biology Pedagogy Research.

Admission Requirements

Students must meet the CSU requirements for admission to a master's degree program. Please consult the Graduate Admissions section in this catalog for complete information. In addition, acceptance into this program is contingent upon the following: (1) a B.A. or B.S. in Biological Science or related area at an accredited institution with a 3.0 GPA in biology courses and 2.5 GPA in the related courses in mathematics, chemistry and physics; (2) submitting scores from the Graduate Record Examination General Test, Medical College Admission Test or Dental Admission Test; (3) completing the departmental application; (4) submitting two letters of recommendation; and (5) acceptance by a thesis adviser.

Students with deficiencies may be considered for conditional acceptance into the program. For conditionally accepted students, the specific conditions and a deadline for their completion are determined at the time of admission; continuation in the M.S. program is dependent upon completion of the admission conditions by the specified deadline.

Application Deadlines

Departmental applications for fall admissions are usually due April 1. Check the Department of Biological Science website at biology.fullerton.edu for annual deadlines and additional information. A completed departmental application and all required documents must be received by the published deadlines.

Classified Standing

Students should achieve classified graduate standing as soon as they are eligible, because no more than nine units of graduate work taken before classification can be included on the study plan (see below) for the degree. A student who meets the admission requirements may apply for classified standing, which requires the development of a study plan approved by the thesis adviser, thesis committee, department M.S. graduate program adviser and associate vice president for Graduate Studies and Research. Students admitted with conditional acceptance must meet conditions (see above) before being considered for classified standing.

Advancement to Candidacy

Advancement to candidacy is attained by requesting a graduation check and receiving subsequent approval of the department M.S. graduate program adviser and associate vice president for Graduate Studies and Research.

Study Plan

Students must meet the Graduate Level Writing Requirement, which is described in this catalog under "Graduate Regulations." Biology M.S. candidates will meet this requirement by passing BIOL 500A,B. At least one-half of the study plan's total units must be at the 500 level. All study plans must include BIOL 500A,B, 580D, 598, 599 and at least two graduate seminars. A thesis acceptable to the adviser and committee, covering a research problem, as well as a thesis defense and a public presentation on the thesis research, are required to complete the degree program. Supervising the work of graduate students requires the personal attention of advisers. To insure that advisers are available for new graduate students, a graduate student is expected to complete the requirements for graduation within three years after classification.

For more detailed information or advisement, students should contact the Department of Biological Science or the department M.S. graduate program adviser at biogradadv@fullerton.edu.

BIOLOGICAL SCIENCE COURSES

Courses are designated as BIOL in the class schedule. Unless otherwise designated, prerequisites may be waived by the instructor of the course if the instructor is satisfied that the student is qualified for the course.

101 Elements of Biology (3)

Underlying principles governing life forms, processes and interactions. Elements of biology and reasoning skills for understanding scientific issues on personal, societal and global levels. For the non-science major. No credit toward biological science major. One or more sections offered online.

101L Elements of Biology Laboratory (1)

Pre- or corequisite: BIOL 101. Laboratory experiments demonstrating the principles presented in the lecture course. Scientific inquiry, cell structure and function, physiology, genetics, biodiversity, evolution and ecology. For the non-science major. (3 hours laboratory or fieldwork; weekend field trips may be required)

102 Biology for Future Teachers (3)

Designed especially for the prospective teacher, this activity-based course examines biological concepts in real-world contexts, such as the medical examination, genes and evolution, and the environment. Lecture and laboratory form a single unified learning experience. No credit toward biological science major. (6 hours activity)
171 Evolution and Biodiversity (5)
Prerequisites: must be eligible to take MATH 115 or higher and have passed/be eligible to take ENGL 101, and must be exempt from or have completed remedial MATH and ENGL.
Introduction to scientific processes and methods of biology. Unifying principles of evolution processes leading to biodiversity, and principles of conservation biology. (Primarily for majors in the Colleges of Natural Science/Mathematics and Engineering/Computer Science; 3 hours lecture, 6 hours laboratory/fieldwork; weekend field trips are required)

172 Cellular Basis of Life (5)
Prerequisites: Completion of (or be eligible to take) ENGL 101 with a “C” (2.0) or better, completion of MATH 115 (or equivalent) and BIOL 171 or CHEM 120A with a “C” or better. Structure and function of prokaryotic and eukaryotic cells including: evolutionary relationships; cell membranes; compartmentation; signaling and metabolic pathways; cellular reproduction; cell differentiation, multicellularity and development. (For majors in Colleges of Natural Science/Mathematics and Engineering/Computer Science; 3 hours lecture, 6 hours laboratory)

191A Integrated Human Anatomy and Physiology (4)
(Same as KNES 191A)

191B Integrated Human Anatomy and Physiology (4)
Prerequisite: KNES/BIOl 191A. Corequisite: CHEM 200. Second semester of integrated concepts in human anatomy and physiology for nursing, allied health, and kinesiology majors. Nutrition, water and ion balance, and homeostatic regulation by the digestive, renal, cardio-respiratory, endocrine, nervous systems. No credit toward biological science major. (3 hours lecture, 3 hours laboratory) (Same as KNES 191B)

202 Microbiology for Nursing and Allied Health Professionals (4)
Prerequisite: BIOL 101, 191A or equivalent. Corequisite: CHEM 100 (for non-nursing majors) or 200 (for nursing majors). Introduction to bacteria, fungi, protozoa and viruses with emphasis on pathogenic agents and how they are controlled by host defenses and human intervention. Laboratory provides practice with basic microbiological skills. No credit toward biological science major. (3 hours lecture, 3 hours laboratory)

210 Human Anatomy and Physiology (3)
Introductory anatomy and physiological concepts for Kinesiology and Health Science majors. Gross and micro-level human anatomy as well as the structure and function of selected systems. Preparation for KNES 260, 300, 348, 371, and the major in Health Science. No credit toward biological science major. (Same as KNES 210)

273 Genetics and Molecular Biology (5)
Prerequisites: BIOL 172 and CHEM 120A or MATH 130 or 150A with a “C” (2.0) or better. Underlying principles of inheritance, structure and functions of nucleic acids, regulation of gene expression, the mechanisms by which populations evolve, and the impact of biotechnology on society. (3 hours lecture, 6 hours laboratory)

274 Principles of Physiology and Ecology (5)
Prerequisites: BIOL 171, 172, 273, CHEM 120A, and MATH 130 or 150A with a “C” (2.0) or better. Principles of organisms’ interactions with their environments: physiological and evolutionary mechanisms of change in response to environmental factors; population and community ecology; energy and material flow through ecosystems. (3 hours lecture, 6 hours laboratory/fieldwork; weekend field trips are required)

280R Research Preparatory Proseminar (1)
Introduction to the culture of science and research. Read and discuss research articles, write brief reports, give oral presentations and learn about lab safety, research ethics, scientific discourse and future career prospects.

299L Directed Laboratory Study (1-3)
Intended for students (especially lower division) who may not have completed sufficient coursework to allow them to work independently, but who are eager for laboratory research experience. May be repeated for university credit. (3 hours laboratory per unit)

300 Environmental Biology and Sustainability (3)
Prerequisite: BIOL 101. Biological consequences of human intervention in ecosystems: Endangered and threatened species, pollution impact on organisms, pest control, population dynamics, genetic engineering of agricultural species, management of natural areas and urban ecosystem dynamics. No credit toward biological science major. One or more sections offered online.

301 Problems in Environmental Biology (3)
Prerequisite: admission into the Southern California Ecosystems Research Program in environmental biology. Environmental problems in Southern California ecosystems. Effects of human activities on desert, foothill, and wetland ecosystems. Offered as an intensive four-week summer field experience. (Equivalent to 1 hour lecture, 6 hours laboratory/fieldwork during a normal semester)

302 General Microbiology (4)
Prerequisites: biology majors, BIOL 274 and CHEM 120B with a “C” (2.0) or better; all others, BIOL 273 and CHEM 120B with a “C” or better. Introduction to structure and function of bacteria and viruses including beneficial and detrimental activities and interactions with other organisms. Laboratory provides investigations with microscopy, culture, physiology and genetics of microbes. (2 hours lecture, 6 hours laboratory)
303 Intermediate Cell Biology (3)
Prerequisites: biology majors, BIOL 274 and CHEM 120B with a “C” (2.0) or better; all others, BIOL 273 and CHEM 120B with a “C” (2.0) or better. Evidence-based examination of cells in action, roles of information, matter and energy flow as driving forces for compartmentation, protein sorting, metabolic and signaling pathways, motility and adhesion; examples taken from developmental, neural and cancer processes.

304 Supervised Biology Laboratory Instruction (2)
Prerequisites: BIOL 172, 273 or 274 and permission of instructor. For students interested in assisting in lower division biology lab that they have completed. Practical experience in laboratory teaching and introduction to major topics in biology education.

305 Human Heredity and Development (3)
Prerequisite: completion of General Education (G.E.) category B.2. Principles of human heredity and embryology relating to human development. Mendelian genetics, single gene effects, genetics, prenatal diagnosis, and human embryology. No credit toward biological science major.

306 Biology of Aging (3)
Prerequisite: BIOL 101. Biological changes in cells, tissues, organs and the whole body associated with aging. Theories of aging will be discussed with primary emphasis on mammals. No credit toward biological science major.

309 Intermediate Molecular Biology (3)
Prerequisites: biology majors, BIOL 274 and CHEM 120B with a “C” (2.0) or better; all others, BIOL 273 and CHEM 120B with a “C” or better. Molecular and genetic basis of cellular functions. Role of gene expression and protein function in metabolism, physiology, growth, development. Introduction to recombinant DNA and its uses, and to critical analysis of primary literature.

310 Human Physiology (3)
Prerequisites: BIOL 101 and 210, or BIOL 171 or 172 with a “C” (2.0) or better. Human physiological systems and their relationship to human function for non-biology majors and students in Kinesiology and Health Sciences. No credit for biological science major.

310L Human Physiology Laboratory (1)
Prerequisite: BIOL 310 with a “C” (2.0) or better, or concurrent enrollment. Investigation of human physiology; the cellular to organ system level of muscular, cardiovascular, respiratory and renal systems; the neural and endocrine control of these systems. Labs emphasize functional aspects of each organ system. No credit toward biological science major. (3 hours laboratory)

311 Nutrition and Disease (3)
(Same as CHEM 311)

314 Population and Community Ecology (3)
Prerequisites: completion of biology lower-division core. Introduction to the quantitative description of populations and communities, as well as the use of mathematical models to understand the dynamics of populations and communities. Links comparative, experimental and theoretical approaches to understanding the abundance and distribution of organisms and their interactions.

317 Field Marine Biology (4)
Prerequisites: completion of biology lower-division core. Field biology and natural history of local marine plants and animals. Identification of common species and factors determining their distributions and abundance in marine habitats. Effects of human activities on marine organisms. (2 hours lecture, 6 hours laboratory/fieldwork; weekend field trips may be required)

318 Wildlife Conservation (3)
Prerequisite: completion of G.E. Category B.2. Causes and consequences of loss of biological diversity, with an emphasis on wildlife populations and science-based conservation. Threatened and endangered species/ecosystems, ecosystem management, habitat restoration, captive species reintroductions and conservation legislation. No credit toward biological science major.

319 Marine Biology (3)
Prerequisite: completion of G.E. Category B.2. Survey of marine plants and animals in their habitats. No credit toward biological science major.

322 Human Behavioral Ecology (3)
(Same as ANTH 322)

325 Principles of Evolution (3)
Prerequisites: completion of biology lower-division core. Mechanisms of evolutionary change, including mutation, selection, migration, and drift. Introduces methods for studying adaptations. Sexual selection, kin selection and evolution of life history strategies. Uses modern examples, including antibiotic resistance, to illustrate the relevance of understanding evolution.

327 Stem Cells and Regenerative Medicine (3)
Prerequisite: BIOL 101. Introduction to stem cell biology and current research with human stem cells for treating chronic and neurodegenerative diseases (regenerative medicine). Ethical and social issues related to various types of stem cells. No credit toward biological science major.

330 Sustainability Ecology: American Indian Models (3)
Prerequisite: completion of G.E. Category B.2. Interrelationships of native peoples of the Americas with the local flora and fauna and the natural environment. Roles of American Indians in predator-prey interactions, ecological hierarchy, nutrient cycling, successional change and resource management. No credit toward biological science major.
340 Field Botany (3)
Prerequisite: completion of biology lower-division core. Native flora of Southern California. Identification, natural history and factors that determine the distribution of species. (1 hour lecture, 6 hours laboratory or fieldwork; weekend field trips are required)

344 Survey of the Land Plants (4)
Prerequisite: completion of biology lower-division core. Anatomical and morphological characteristics of the land plants as they relate to the evolutionary development and ecological strategies of these plants. (2 hours lecture, 6 hours laboratory)

352 Plants and Life (3)
Prerequisite: completion of G.E. Category B.2. Importance of plants in our lives, including such things as plant domestication and the origin of agriculture. Why plants are fascinating organisms. No credit toward biological science major.

360 Biology of Human Sexuality (3)
Prerequisite: completion of G.E. Category B.2. Biology of the human reproductive system, sexual differentiation, anatomy and physiology, sexual behaviors, procreation, contraception and sexually transmitted diseases. No credit toward biological science major. One or more sections offered online.

361 Human Anatomy (4)
Prerequisites: biology majors, BIOL 274 with a "C" (2.0) or better; all others, BIOL 172, 273 and CHEM 120B with a "C" or better, or BIOL 310 with a "B" (3.0) or better. Systems approach to the structure and function of the human body. For biology majors and related health sciences. (2 hours lecture, 6 hours laboratory)

362 Mammalian Physiology (4)
Prerequisites: biology majors, BIOL 274 and CHEM 120B with a "C" (2.0) or better; all others, BIOL 172, 273 and CHEM 120B with a "C" or better. Fundamental mechanisms of mammalian and human physiology. Integration of cellular and organ system functions with emphasis on regulatory processes. For biology majors and related health sciences. (3 hours lecture, 3 hours laboratory)

400 Seminar in Biology Education (2)
Prerequisites: BIOL 302, 303, 309, 314, 325 with a "C" (2.0) or better, or acceptance in MATS program. For students interested in biology education/science education. Students discuss major topics in biology education and conduct research. (2 hours lecture/discussion)

401 Biogeography (3)
Prerequisite: BIOL 314 or 325 with a "C" (2.0) or better, or graduate standing. Evolutionary patterns and mechanisms of the distribution of plants and animals in the major habitats of the world. Current concepts and theories.

402 Computer Lab in Molecular Systematics (3)
Prerequisite: BIOL 303, 309, 314 or 325 with a "C" (2.0) or better, or graduate standing. Gain practical and theoretical experience with software-based methods in molecular systematics, with emphasis on Internet resources for molecular biologists, acquisition of gene protein sequences, multiple sequence alignment, PCR primer design, phylogenetic analysis, and controversies in the field. (2 hours lecture, 3 hours laboratory)

404 Evolution (3)
Prerequisite: BIOL 309 or 325 with a "C" (2.0) or better, or graduate standing. History of evolutionary thought; origin of universe, earth and life; geological and paleontological history of the earth; evidence derived from comparative anatomy, embryology, genetics, zoogeography; mechanisms of evolution.

405 Developmental Biology (3)
Prerequisite: BIOL 303 or 309 with a "C" (2.0) or better, or graduate standing. Molecular and cellular processes in embryonic development encompassing mechanisms of fertilization, cell and tissue interactions, morphogenesis, organogenesis, and the regulation of gene expression.

407 Genes and Genomes (3)
Prerequisite: completion of BIOL 303 or 309 with a "C" (2.0) or better, or graduate standing. Gain practical and theoretical experience at a molecular biology level, emphasizing applications in biology, such as investigating genetic change within populations, estimating phylogenies, charting the evolution of gene families and comparing the content and organization of genomes.

409 Teaching Evolution: Online Course for Teachers (3)
Prerequisites: completion of biology lower-division core, G.E. Category B.2. or consent of instructor. Concepts of evolution, methods of teaching evolution, information competence and ethics. Technology employed for communication, collaboration, investigation and organization. If both BIOL 404 and 409 are taken, only BIOL 404 counts for biological science major.

411 Medical Genetics and Systems Biology (3)
Prerequisite: BIOL 302, 309, CHEM 421 or 423A with a "C" (2.0) or better, or graduate standing. Advances in genetics, genomics, proteomics, and systems biology. Implications for the pharmaceutical industry, the clinic, and for genetic counseling. Uses of biological arrays in diagnosing and treating diseases.

412 Principles of Gene Manipulation (3)
Prerequisites: BIOL 309 and CHEM 301B with a "C" (2.0) or better, or graduate standing. Current approaches to and applications of recombinant DNA technology. Principles behind construction of recombinant molecules including vectors and enzymes, introduction into organisms, selection, expression of cloned genes, and impact of research on society.
413 Advances in Molecular Genetics (3)
Prerequisites: BIOL 309 and CHEM 301B with a “C” (2.0) or better, or graduate standing. Function of genetic material and informational macromolecules. Extensive analysis of recent scientific articles in molecular genetics illustrating mutagenesis, protein synthesis, protein structure and function, biogenesis of RNA molecules, regulation of gene expression and their relationship to important biological processes.

414 Microbial Genetics (3)
Prerequisite: BIOL 302, 309, CHEM 421 or 423A with a “C” (2.0) or better, or graduate standing. Perspective of genetics of microbial systems including background information, experimental methods, data interpretation, genetic analysis and applications to biotechnology.

417 Advances in Cell Biology (3)
Prerequisite: BIOL 303 with a “C” (2.0) or better, or graduate standing. Current topics in the cell biology of cell motility, cell multiplication and regulation, membranes and permeability, cell signaling, cell-to-cell contact and extracellular matrix, and cell differentiation using current journal articles.

418L Advances in Cell Biology Lab (2)
Prerequisite: BIOL 303 with a “C” (2.0) or better, or graduate standing. Use of current techniques like fluorescence microscopy, immunolabeling, ion-sensitive dye ratiometry, image processing, and 2-D and 3-D reconstruction to study problems in cell biology, cellular developmental biology, and cellular neurobiology. (6 hours laboratory)

419 Marine Ecology (3)
Prerequisite: BIOL 314 or 325 with a “C” (2.0) or better, or graduate standing. Ecology of planktonic, nektonic and benthic organisms; their communities and environments.

419L Marine Ecology Laboratory (1)
Corequisite: BIOL 419 or graduate standing. Field and laboratory studies of planktonic, nektonic and benthic communities. (3 hours laboratory or field work; weekend field trips may be required)

422 Coastal Ecology (4)
Prerequisite: BIOL 314 or 325 with a “C” (2.0) or better, or graduate standing. Ecology of coastal populations and communities with emphasis on rocky intertidal or other marine or ocean-influenced habitats. Field and laboratory experiments and studies of ecological processes affecting species distributions and abundances. (2 hours lecture, 6 hours laboratory/field work; weekend field trips may be required)

424 Immunology (4)
Prerequisites: BIOL 302, and 303 or 309 with a “C” (2.0) or better, or graduate standing. Molecular, cellular and organismic nature of the immune process. Inflammation, phagocytosis, antigens, immunoglobulins and cell-mediated immune phenomena. Modern immunology techniques. (2 hours lecture, 6 hours laboratory)

426 Virology (3)
Prerequisite: BIOL 303, 309, or graduate standing. Viral structure and replication and host-virus interactions in the viral replication process, with emphasis on animal and bacterial virus systems.

427 Stem Cell Biology (3)
Prerequisite: BIOL 303 or 309 with a “C” (2.0) or better, or graduate standing; BIOL 405 recommended. Historical context, principles, methodology, clinical impact on society and the individual, recent relevant scientific facts and progress, controversies and perspectives of stem cell biology, focusing on applications to regenerative medicine and tissue engineering.

428 Biology of Cancer (3)
Prerequisite: BIOL 302, and 303 or 309 with a “C” (2.0) or better, or graduate standing. Introduction to stem cell biology. Current research.

429 Techniques in Stem Cell Biology (3)
Prerequisites: BIOL 302, and 303 or 309 with a “C” (2.0) or better, or graduate standing. Introduction to cell culture and stem cell laboratory research techniques; focus on advanced-level biology experiments, fundamental characteristics of stem cells and differentiation of mouse or government-approved human stem cell-lines into several phenotypes. (1 hour discussion, 6 hours laboratory)

430 Advances in Microbiology (3)
Prerequisite: BIOL 302 with a “C” (2.0) or better, or graduate standing. Current topics in microbiology virulence mechanisms, antibiotics, host-bacterium interaction, mobile DNA elements, secretion systems, select agents, differentiation, and development.

436 Advanced Applied Statistics (4)
Prerequisites: MATH 337, 338 with a “C” (2.0) or better, or graduate standing. Linear models, including mixed models, applied to experimental and field data from current research projects. Poisson and logistic regression. Model fitting and checking; use of permutation tests as needed. Presentation of results suitable for publication. (3 hours lecture, 3 hours laboratory) (Same as MATH 436)

438 Public Health Microbiology (4)
Prerequisite: BIOL 302 with a “C” (2.0) or better, or graduate standing. Control and epidemiology of infectious diseases of public health importance, water and sewage microbiology. Control of current problems. (2 hours lecture, 6 hours laboratory)
441 Plant Taxonomy (4)
Prerequisites: completion of biology lower-division core or graduate standing. Classification and evolution of vascular plants; emphasis on the flowering plants. (2 hours lecture, 6 hours laboratory or fieldwork; weekend field trips may be required)

442 Pollination Biology (3)
Prerequisites: completion of biology lower-division core or graduate standing. Pollination in the plant kingdom. Floral cues, pollination syndromes, pollinator behavior, chemical and physical characteristics of pollination, energetics, gene flow, phenology, and ecological aspects of pollination. (2 hours lecture, 3 hours laboratory or fieldwork)

443 Plant Ecology (4)
Prerequisite: BIOL 314 with a "C" (2.0) or better, or graduate standing. Community and population ecology of terrestrial plants. Environmental factors and plant distribution with emphasis on California vegetation. (2 hours lecture, 6 hours laboratory or fieldwork; weekend field trips may be required)

444 Plant Physiological Ecology (4)
Prerequisites: completion of biology lower-division core or graduate standing. BIOL 445 recommended. Fundamental mechanisms of plant physiological responses to the environment with primary emphasis on whole plants and ecosystems. (2 hours lecture, 6 hours laboratory or fieldwork; weekend field trips may be required)

445 Plant Cell Physiology (3)
Prerequisite: BIOL 302, 309, 314, CHEM 421 or 423A with a "C" (2.0) or better, or graduate standing. Cellular and molecular mechanisms of behavior, growth, transport processes, and environmental responses in vascular plants. Plant cell development, nutrition, respiration, photosynthesis, hormones, photoperiodism, and stress biology.

446 Marine Phycology (4)
Prerequisites: completion of biology lower-division core or graduate standing. Biological aspects of marine algae; comparative development, morphology, taxonomy, physiology, and ecology. (2 hours lecture, 6 hours laboratory or fieldwork; weekend field trips may be required)

447 Ethnobotany (3)
Prerequisite: BIOL 314 or 325 with a "C" (2.0) or better. How people interact with plants and the environment, including such things as western medicinal plant use, traditional medicine and dentistry, exotic foods and conservation. (2 hours lecture, 3 hours laboratory; weekend field trips may be required)

448 Plant Molecular Biology (3)
Prerequisite: BIOL 302, 303, 309, CHEM 421 or 423A with a "C" (2.0) or better, or graduate standing. Genetic mechanisms in vascular plants controlling metabolism, growth, development, and responses to biotic/abiotic environmental stresses. Molecular regulation of gene expression and transduction of internal and external signals.

449 Desert Ecology (4)
Prerequisite: BIOL 314 or 325 with a "C" (2.0) or better, or graduate standing. Adaptations, distributions and interactions of desert plants, animals and microbes, including the influences of environmental factors. (2 hours lecture, 6 hours laboratory or fieldwork; weekend field trips may be required)

450 Conservation Biology (3)
Prerequisite: BIOL 314 or 325 with a "C" (2.0) or better, or graduate standing. Current topics involving theory, concepts and techniques in the conservation of biological diversity.

451 Advanced Human Evolution (3)
(Same as ANTH 451)

453 Life Science Concepts (3)
Prerequisites: BIOL 101 or 102 and junior or senior standing. Biological principles using science processes appropriate for elementary teachers. No credit for biological science major. (2 hours lecture, 2 hours activity)

456 Hormones and Behavior (3)
(Same as ANTH 456)

461 Marine Invertebrate Biology (4)
Prerequisites: completion of biology lower-division core, or graduate standing. Evolution, classification, phylogeny, morphological and physiological adaptations of marine invertebrate animals. Dissection, identification and observation of extant animals. (2 hours lecture, 6 hours laboratory or fieldwork; weekend field trips may be required)

462 General Parasitology (4)
Prerequisite: BIOL 302 with a "C" (2.0) or better, or graduate standing. Survey of various animal parasites with an emphasis on the morphology, physiology, and genetics of human protozoans and helminthes. Other topics will include vectors and common parasites of domestic animals. (3 hours lecture, 3 hours laboratory)

465 Integrative Biology of Spider Silk (3)
Prerequisite: BIOL 303, 309, 314 or 325 with a "C" (2.0) or better, or graduate standing. Inter-relationships and applications of diverse biological principles using spider silk as an organizing theme. Synthesis and use of silk from multiple perspectives, including but not limited to, molecular genetics, behavior and evolution.
466 Behavioral Ecology (3)
Prerequisites: completion of biology lower-division core, or graduate standing. Current problems in the evolution of animal behavior; the origin and maintenance of social systems and behavioral interactions of animals.

467 Entomology (4)
Prerequisites: completion of biology lower-division core, or graduate standing. Anatomy, physiology, evolution and biology of insects and other terrestrial arthropods. Dissection, collection, identification and observation of living arthropods. (2 hours lecture, 6 hours laboratory or fieldwork; weekend field trips may be required)

468 Comparative Animal Physiology (4)
Prerequisites: completion of biology lower-division core and CHEM 120B, or graduate standing. Comparative study of physiological and biochemical processes among representative animals. (3 hours lecture, 3 hours laboratory, weekend field trips may be required)

470 Cellular Neurobiology (3)
Prerequisites: BIOL 303 or 309, and 362 with a "C" (2.0) or better, or graduate standing. Processes of cell communication, particularly in nervous systems. Molecular biology of neurons, model sensory and motor systems, and cellular basis for behavior.

472A Advances in Biotechnology Laboratory (3)
Prerequisites: BIOL 302 and 309, CHEM 421 or 423A with a grade of "C" (2.0) or better, or graduate standing. Recommended corequisite: BIOL 412. First semester explores biotechnology techniques for DNA cloning and analysis: restriction enzyme action, DNA sequencing, sequence analysis by computer, plasmid cloning, genomic library production and screening, DNA probe hybridization. (1 hour discussion, 6 hours laboratory) (Same as CHEM 472A)

472B Advances in Biotechnology Laboratory (3)
(Same as CHEM 472B)

473 Bioinformatics (3)
Prerequisites: CHEM 301B, 302 and BIOL 325 or CHEM 421 with a "C" (2.0) or better, or graduate standing. Provides a research-based, problem-solving experience using the tools and algorithms of molecular and computational biology to analyze genetic and protein sequences retrieved from appropriate databases. (2 hours lecture, 3 hours computer laboratory) (Same as CHEM 473)

474 Natural History of the Vertebrates (4)
Prerequisites: completion of biology lower-division core, or graduate standing. Natural history of the vertebrates. Observation, identification, behavior, ecology and distribution of the vertebrates. (2 hours lecture, 6 hours laboratory/fieldwork; weekend field trips may be required)

475 Ichthyology (4)
Prerequisites: completion of biology lower-division core, or graduate standing. Systematics, evolution, morphology, physiology, ecology and behavior of fishes. (2 hours lecture, 6 hours laboratory/fieldwork; weekend field trips may be required)

476 Herpetology (4)
Prerequisites: completion of biology lower-division core, or graduate standing. Biology, structure, physiology, ecology, distribution, identification, collection, evolution and behavior of amphibians and reptiles. (2 hours lecture, 6 hours laboratory or fieldwork; weekend field trips may be required)

477 Advances in Biotechnology (3)
(Same as CHEM 477)

478 Mammalogy (4)
Prerequisites: completion of biology lower-division core, or graduate standing. Systematics, evolution, morphology, physiology, ecology and behavior of mammals. (2 hours lecture, 6 hours laboratory/fieldwork; weekend field trips may be required)

479 Ornithology (4)
Prerequisites: completion of biology lower-division core, or graduate standing. Anatomy, physiology, evolution, behavior, and ecology of birds. Laboratory and fieldwork in identification, anatomy, observational techniques and community composition. (2 hours lecture, 6 hours laboratory/fieldwork; weekend field trips may be required)

480 Advanced Topics in Undergraduate Biology (1-3)
Prerequisites: junior or senior students majoring in biological science and consent of instructor. Current topics, updating of concepts, recent advances and unification of the principles of biology. May be repeated for credit.

480D Colloquium: Diverse Topics in Biology (1)
Prerequisite: Must have passed at least one, or be concurrently enrolled in, any upper-division Biology course (300 or 400 level). Diverse research topics and perspectives in the biological sciences. Presented by biologists from CSUF and invited speakers from other universities, industries, governmental agencies or private organizations. May be repeated for credit.

480E SCERP Proseminar (1)
Prerequisite: selection as a Southern California Ecosystems Research Program (SCERP) Scholar. Increases the experience and skills of SCERP Scholars in working on problems in environmental biology. Discussion of publications, development and presentation of SCERP research. Offered Credit/No Credit only. May be repeated for credit.
480M MARC Proseminar (1)
Prerequisite: selection as MARC Fellow. Intended to increase the contact of MARC Fellows with minority scientists of national repute who will present seminars. Fellows will read and discuss relevant primary literature, attend the seminars, and meet with speakers before and after the seminars. May be repeated for credit. (Same as CHEM/MATH/PSYC 480M)

480S Howard Hughes Medical Institute Scholars Proseminar (1)
(Same as CHEM 480S)

481 Advances in Evolution and Ecology (3)
Prerequisite: BIOL 314 or 325 with a “C” (2.0) or better, or graduate standing. Current topics in evolutionary biology and ecology. Examination and analysis of current literature relating to evolutionary biology, population, community, and ecosystem ecology, behavioral ecology and evolutionary ecology.

482 Capstone Studies in Biology (2)
Prerequisite: consent of department; for Biological Science majors who have completed 90 units. Individualized practical experience related to the study of biology or pursuit of a biology career that reflects paradigms of the discipline. Application and integration of biological concepts and skills through library research, applied projects or community service activities. Not available for graduate degree credit.

495 Biological Internship (3)
Prerequisites: successful completion of 90 units, including all core requirements, and consent of instructor. Biological, ecological, and health-related fields. Ninety (90) hours of practical experience in student’s chosen field of interest with public or private agencies or businesses. May not be repeated for credit. (1 hour discussion, 6 hours laboratory work experience)

496 Biology Tutorials (1-3)
Prerequisites: completion of biology lower-division core and consent of instructor. Supervised experience in biological science teaching through tutoring or assisting in a laboratory or field class. No credit toward biological science major.

498 Senior Thesis (1-2)
Prerequisites: 6 units of BIOL 499L (two units may be taken concurrently). Thesis committee must approve research plan at least two semesters prior to enrollment in this course. Requires preparation, presentation and defense of a formal thesis. May be repeated for a total of 2 units.

499L Independent Laboratory Study (1-3)
Prerequisite: junior or senior standing with consent of instructor with whom the student wishes to pursue independent laboratory study in biology. May be repeated for credit.

500A Professional Aspects of Biology (1)
Prerequisites: graduate standing. Corequisite: BIOL 500B. Discussions concerning research protocol, scientific methodology and communication techniques. Ethics and social responsibilities of professional biologists. (1 hour discussion)

500B Professional Aspects of Biology (1)
Prerequisites: graduate standing. Corequisite: BIOL 500A. Individualized project work and experiences in scientific writing. Required of all students upon admission to the graduate program. (3 hours project work)

500C Professional Aspects of Biology: Teaching Effectiveness (2)
Pre- or corequisites: graduate standing; must have received a Graduate Teaching Associate appointment and attend two mandatory preparation meetings on the Thursday and Friday prior to beginning of classes. Assists graduate students in becoming effective classroom teachers and understanding the scholarship of teaching in higher education. Graduate Teaching Associates will learn pedagogy and a variety of teaching alternatives while concurrently teaching in a laboratory/discussion setting.

505T Seminar in Cellular and Molecular Biology and Physiology (3)
Prerequisite: graduate standing. Selected advanced topics. May be repeated for credit.

517T Seminar in Ecological and Organismic Biology (3)
Prerequisite: graduate standing. Selected advanced topics. May be repeated for credit.

520T Seminar in Microbiology (3)
Prerequisite: graduate standing. Selected advanced topics. May be repeated for credit.

537 Clinical Trials Project Management: Setting up Clinical Trials (3)
Prerequisite: BIOL 576 or equivalent. Implementation of Good Clinical Practices (GCP), documentation, Institutional Review Board (IRB) requirements, qualification of study sites, insurance requirements, statistical considerations in study design, ethical issues and global considerations. Team projects based on case studies/real world examples.

538 Clinical Trials Project Management: Managing Clinical Trials (3)
Prerequisites: BIOL 576 or equivalent; BIOL 537. Management, monitoring and closure of human clinical trials; preparing and managing regulatory agency audits, budget and project schedules; balancing business goals with ethical issues; managing regulatory and statistical issues; conflict resolution. Team projects based on case studies/real world examples.
539 Clinical Trials Project Management: Pre-Market Submission Process for Clinical Trials (3)
Prerequisites: BIOL 576, or equivalent; BIOL 538. Clinical trial reports for pre-market submission: developing timelines; project management principles; product labeling; best practices for negotiating with regulatory agencies; ethical considerations; statistical issues in submissions; post-market clinical study scenarios. Team projects based on case studies/real world examples.

570 Survey of Molecular Biology and Pharmacology/Toxicology (3)
Prerequisites: enrollment in Master of Biotechnology (MBt) degree program or consent of instructor; MGMT 540. Corequisites: BIOL/MATH 571 and CPSC/Biol 572. Molecular biology, pharmacology and toxicology concepts as applied to the development of pharmaceutical products and biomedical devices. Students work collaboratively toward a final project to propose a new pharmaceutical product and/or biomedical device. (Same as CHEM 570)

571 Survey of Mathematical Modeling and Bioinformatics (3)
Prerequisites: enrollment in Master of Biotechnology (MBt) degree program or consent of instructor; MGMT 540. Corequisites: BIOL/CHEM 570 and CPSC/BIOIL 572. Introduction to the strategies, approaches and computer applications utilized for drug discovery and design, database design and data mining. Case studies will illustrate specific applications of the methods of measuring, visualizing, representing, inferring, clustering, classifying, and modeling biotechnological data. (Same as MATH 571)

572 Survey of Pharmaceutical and Medical Devices Technology (3)
(Same as CPSC 572)

580 Advanced Topics in Graduate Biology (1-3)
Prerequisites: graduate standing in biology and consent of instructor. Current research topics, experimental design and problem solving in biological systems. May be repeated for credit.

580D Biology Colloquium (1)
Prerequisite: graduate standing. Series of scholarly presentations covering diverse research topics and perspectives in the biological sciences. Scientific presentations by biologists from CSUF and other universities, industries, governmental agencies or private organizations. May be repeated for credit.

597 Project (1-3)
Prerequisite: graduate standing in an appropriate master’s degree program. Planning, preparing and completing an applied master’s degree project. Credit only for completed written project report and oral presentation, both of which must be formally approved by the master’s program committee. (Not acceptable for research-based thesis master’s degree programs)

598 Thesis (1-3)
Open to graduate students with consent of instructor with whom the student is conducting graduate thesis research. May be repeated for a maximum of 6 units of credit.

599 Independent Graduate Research (1-3)
Open to graduate students with consent of instructor with whom the student wishes to pursue independent study in biology. May be repeated for credit.