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**Biology Program**

**Program Advisors: Dr. Jolene Cogbill, Dr. Michael Dohm, Dr. Joan Kuh, Ms Lisa Perry, Mr. Ron Iwamoto, Dr. Helen Turner**

**Pre-health advisors: Ms Patricia Lee-Robinson; Ms Lisa Perry, Ms Janet Jensen.**

**Biology Mission Statement**

Biology is the study of living organisms and is an increasingly dynamic and wide-ranging discipline. The mission of the Biology Major program at Chaminade is to deliver an excellent education in the biological sciences, preparing students to be innovative, rigorous and well-trained scientists, educators or health practitioners. The biology degree program recognizes that sophisticated intellectual content and practical experiences are central to the goal of equipping tomorrow's scientists. Students will be exposed to contemporary ideas in biology and challenging laboratory courses involving modern techniques and advanced instrumentation. Application of the scientific method, statistical and presentation skills, and critical evaluation of data are foundational to the course progression in the major, which can culminate in a capstone research experience. Reflecting the research interests and expertise of the faculty, our undergraduate students experience an education specifically targeting the areas of cell and molecular biology, signal transduction, genetics and genomics, and integrative biology. Undergraduate students are fully integrated in research activities and participate directly in the process of discovery. The curriculum is synthesized with a rich program of available development activities including internships, conference attendance and preparation activities for the health professions and graduate school.

The vision of the Biology major is linked to key components of the Chaminade educational experience. Our close-knit faculty fosters education in the family spirit, and the rapid progress in techniques and ideas that hallmarks biology drives our determination to prepare students who can adapt and change.

Ultimately, the goal of science is to understand the mysteries of nature and improve the human condition, and so our program prepares students to serve society and promote justice.

**Biology Program Learning Outcomes.**

Upon completion of the B.S. degree program in Biology the student will demonstrate:

1. An understanding of the scientific method and the ability to design and test a hypothesis;
2. The ability to visualize, statistically evaluate, validate and interpret scientific data, and to communicate science effectively both orally and in writing;
3. The ability to acquire and comprehend information from published scientific literature and to employ computational resources in the resolution of biological problems;
4. An understanding of the chemical and physical principles that unite all life forms, and of biological organization at the molecular, cellular, tissue, organ, organism and system levels;
5. The ability to define the components and processes of genetic and epigenetic information transmission, and their determinant effects on the adaptive and evolutionary processes that they drive.
6. An understanding of the etiology of major human disease burdens in terms of pathophysiological mechanisms, epidemiology within populations and possible therapeutic approaches;
7. An understanding of the entry requirements, career pathways and progression for the major post-graduate fields of research, education and the health professions.

**Biology Program Features:**

The biochemistry program is supervised collaboratively between the Biology and Chemistry faculty at Chaminade University. Two degree programs are supported by the Biology discipline, the BS in Biology and the BS in Biochemistry. Two tracks are available within the BS in Biology, emphasizing Cellular and Molecular Biology and Integrative and Organismal Biology, respectively. The BS in Biochemistry is supervised collaboratively between the Biology and Chemistry faculty at Chaminade University. When selecting a major program, students should be aware that the individual curricula are tailored to specific post-graduate preparation for careers. These are outlined in the table below.

Degree Awarded	B.S. in Biochemistry	B.S. in Biology	
		Cell and Molecular Biology Track	Integrative and Organismal Biology Track
Is there an undergraduate research requirement?	One semester Second semester elective	One semester Second semester elective	Optional as one semester elective
Is there an internship requirement?	Optional*	Optional *	Yes
What are the target post-graduate destinations for which this degree is designed?	Health professions (MD, Pharm.D etc)  Graduate School in Chemistry/Biochemistry/Biomedical Sciences/Pharmacology  Pharmaceutical Industry Biotechnology Industry	Health professions (MD, Pharm.D etc)  Graduate School in Biological/Biomedical Sciences  Pharmaceutical Industry Biotechnology Industry	Health professions (MD, Pharm.D etc)  Graduate School in Biology  Biotechnology Industry State and Federal Agencies
Is this program suitable for students who seek to enter medical or other health professional schools?	Yes – specifically pre-med seminar series, other enrichment activities and candidacy for Medical and other health professions Early Admissions Program.  <i>*students who intend to apply for medical, dental, veterinary or other professional schools are encouraged to use internships to complete a professional shadowing experience.</i>		

Within the BS programs in biology and biochemistry, it is possible to elect the ‘pre-med’ area of emphasis. Here, students are enrolled in a seminar series and other activities that specifically prepare for standardized tests such as MCAT, and for entry into professional areas such as medicine, dentistry, pharmacy, physical therapy and others. In addition, this election admits the student to candidacy for the Chaminade Medical School Early Admissions Program. Here students may be guaranteed seats at medical schools including Western University College of Osteopathic Medicine, A.T. Stills College of Medicine and Boston University School of Medicine, following the successful completion of a specific course of study at Chaminade. Interested students should contact a pre-health advisor at their earliest opportunity to discuss this program.

## **Degree Requirements.**

For BS in Biochemistry see Biochemistry Major description.

### **BS in Biology Major Requirements:**

#### **Cellular and Molecular Track**

*Pre-major:* BI 100, BI 104, BI 105L, BI 205, BI 205L, BI 206, BI 206L, BI 207, BI 207L, BI 208, BI 208L, BI 210L, BI 211L, CH 203, CH 203L, CH 204, CH 204L, CH 323, CH 323L, CH 324, CH 324L, PHY 251, PHY 251L, PHY 252, PHY 252L, MA 210, MA 211.

*Major:* BI 300, BI 302, BI 311, BI 312, BI 320, BI 320L, BI 321, BI 321L, BI 410, BI 410L, BI 411, BI 411L, BI 420, BI 495 and *two upper division electives chosen from:* BI 430, BI 433/L, BI 360/L, CH 447, BI 435, BI 499.

#### **Integrative and Organismal Biology Track**

*Pre-major:* BI 100, BI 104, BI 105L, BI 205, BI 205L, BI 206, BI 206L, BI 207, BI 207L, BI 208, BI 208L, BI 210L, BI 211L, CH 203, CH 203L, CH 204, CH 204L, CH 323, CH 323L, CH 324, CH 324L, PHY 251, PHY 251L, PHY 252, PHY 252L, MA 210.

*Major:* BI 300, BI 302, BI 311, BI 312, BI 320, BI 320L, BI 321, BI 3121L, BI 387, BI 410, BI 410L, BI 411, BI 411L, BI 420, BI 471, BI 471L and *two upper division electives chosen from:* BI 430, BI 433/L, BI 360/L, BI 435, CH 447, BI 495.

**Pre-medical area of emphasis.** Students who intend post-graduate studies at medical, dental, pharmacy or other health professional schools ('pre-med' students) are recommended to prepare with the BS in Biochemistry or BS in Cellular and Molecular Biology track. Pre-medical students are required to take BI 190 and other seminar courses recommended by faculty as part of the pre-medical preparation program. In addition, pre-medical students are recommended to use BI 387 internships (may be repeated for credit) in order to perform professional shadowing.  
unity and diversity of life on earth.

### **Biology Minor Requirements:**

*Minor:* 12 semester hours of upper division biology including either BI 321/L or BI 410/L and two other lecture/laboratory courses.

## **Course Descriptions.**

### **Biology (BI)**

#### **BI 100 Principles of evolution and ecology (1)**

Biology is the study of diverse forms and processes of life. Emphasis on how evolutionary studies relate to broader understanding of conservation, ecology, genetics, and human biology. Survey of the applications of evolutionary and ecological theory to our understanding of the

#### **BI 101, BI 102 General Biology (3)**

Overview of basic biological principles, human concerns of overpopulation, environmental pollution, genetic engineering. *Recommended for non-majors. BI 101 is not a prerequisite for BI 102. BI 101 and BI 102 offered annually. Concurrent registration in BI 101L and BI 102L necessary for lab science credit.*

#### **BI 101L, BI 102L General Biology Lab (1)**

One three-hour laboratory period per week to accompany BI 101 and BI 102. Laboratory work and field trips related to lecture topics. *BI 101L and BI 102L offered annually.*

**BI 103 Botany (3) with Laboratory (1)**

Distribution, identification, structure, use and physiology of plants with special attention to plants of Hawaii. *AEOP program only. Recommended for non-science majors. Concurrent registration in BI 103L necessary for lab science credit.*

**BI 104 Digital Biology (1)**

Biological and biomedical inquiry is increasingly dependent on computers. Survey of the role of text mining and biological databases, bioinformatics, modeling, and visualization of biological data in investigations of biological phenomena.

**BI 105L Introduction to laboratory techniques (1)**

This course is an introduction to laboratory safety, and basic laboratory practice including liquid manipulations, calculations and correct usage of small instrumentation. Compulsory course for all students intending a biology or biochemistry major. *Six week course, one hour per week. Pass/fail.*

**BI 110 People and Nature (3)**

Addresses biological, ecological and public health questions which may have social, ethical, religious, or political implications. *Recommended for non-majors. Offered annually. Concurrent registration in BI 110L required for lab science credit.*

**BI 110L People and Nature Laboratory (1)**

One three-hour laboratory period per week to accompany BI 110. Laboratory work such as testing for water quality, field trips to aquaculture farms, estuaries, and the like. *Offered annually.*

**BI 115 Introduction to Marine Biology (3)**

Life in various marine habitats studied with regard to its relationship to the ocean and to man. Various zones in the ocean and its inhabitants, the impact of man on the marine environment, and food sources from the sea will be discussed. *Recommended for non-science majors. Concurrent registration in BI 115L necessary for lab science credit.*

**BI 115L Introduction to Marine Biology Laboratory (1)**

One three-hour laboratory period per week to accompany BI 115. Classification, anatomy, and physiology of live and preserved marine animals. Field trips are included.

**BI 130 Ethnobotany (3)**

Common native and introduced flora of Hawaii are investigated. Endangered and threatened species, identification, communities and uses are stressed. *AEOP program only. Recommended for non-science majors. Concurrent registration in BI 130L required for lab science credit.*

**BI 130 Ethnobotany Laboratory (1)**

One three-hour laboratory period per week to accompany BI 130. Field trips and nature walks are included. *AEOP program only. Recommended for non-science majors.*

**BI 131 Human Nutrition (3)**

An introduction to basic concepts and current research in nutrition. The nature and roles of nutrients, nutrient requirements throughout the human life cycle, diseases resulting from over and under nutrition, food safety, and food sources. *Recommended for non-majors. Offered annually. Concurrent registration in BI 131L necessary for lab science credit.*

**BI 131L Human Nutrition Laboratory (1)**

One three-hour laboratory period per week to accompany BI 131. Survey of methodology and instrumentation involved in the analysis and evaluation of foods, their nutritional value, and diets. *Offered annually.*

**BI 151-BI 152 Human Anatomy and Physiology (3-3)**

Structure and function of the human body, to include basic biochemistry, cells, tissues, and a detailed and comprehensive study of the integumentary, skeletal, muscular, circulatory, immune, and digestive systems, and metabolism. Organ systems will include the nervous, urinary, endocrine, respiratory, and reproductive systems. *Required course for nursing majors. Prerequisites: BI 151 for BI 152. Concurrent registration in BI 151L-152L required.*

**BI 151L-BI 152L Human Anatomy and Physiology Laboratory (1-1)**

Laboratory to accompany BI 151-152. One three-hour laboratory per week will include examination of models and slides, dissection, and physiological exercises. *Prerequisites: BI 151L for BI 152L. Concurrent registration in BI 151-152 required.*

**BI 190 Pre-health and professional sciences seminar I (1)**

Introduction to the course of study and preparations necessary for making application to schools of medicine or schools of other health professions or graduate schools. The course will include an overview of the entrance requirements for such schools. Coursework will include experiences preparing for standardized examinations, resume writing and co-curricular enrichment activities.

**BI 205 Cellular and Organismal Biology I – Cellular Biology (3)**

Introduction to the cell biology of prokaryotic and eukaryotic organisms, with particular reference to the relationships between structure and functions. Cell cycle and mitosis. Organization of cells, roles of cell signaling and extracellular environment in establishing structures in animals and plants. *Concurrent registration in BI 100, BI 105.*

**BI 205L Cellular and Organismal Biology I Laboratory – Cellular Biology (1)**

Laboratory section accompanying BI 205. *Concurrent registration in BI 100 and BI 105L required.*

**BI 206 Cellular and Organismal Biology II – Organs and Organisms (3)**

Introduction to animal and plant diversity, with emphasis on form and function, mechanisms of regulation in biological systems, and how organisms exchange materials and energy with their environment. *Prerequisites: BI 100, BI 105L, BI 205.*

**BI 206L Cellular and Organismal Biology II Laboratory – Organs and Organisms (1)**

Laboratory section accompanying BI 206. *Concurrent registration in BI 206 required. Prerequisites: BI 100, BI 105L, BI 205.*

**BI 207 Molecular Biology I– Genes and Genetics (3)**

Life cycles and meiosis. Mendelian inheritance. Population genetics. Chromosomal and molecular basis of inheritance. Flow of genetic information. Determining structure and function of genes. Mutation and DNA repair systems. Genetic basis of disease. DNA technology. *Prerequisites: BI 206/BI 206L.*

**BI 207L Molecular Biology I Laboratory – Genes and Genetics (1)**

Laboratory section accompanying BI 207. *Concurrent registration in BI 207 required. Prerequisites: BI 206/BI 206L.*

**BI 208 Molecular Biology II– Genomics and Epigenomics (3)**

Components and architecture of genomes. Linkage, physical mapping, and DNA sequencing. Comparing genomes of different species. Role of gene expression and gene networks in differentiation and morphogenesis. Role of DNA methylation and chromatin remodeling in regulation of genes. Role of regulatory RNAs in gene expression. *Prerequisites: BI 207/BI 207L. Materials intensive fee applies.*

**BI 208L Molecular Biology II Laboratory – Genomics and Epigenomics (1)**

Laboratory section accompanying BI 208. *Concurrent registration in BI 208 required. Prerequisites: BI 207/BI 207L. Materials intensive fee applies.*

**BI 210L Biotechniques Laboratory I – DNA/RNA/Protein (2)**

Introduction to biological techniques. Techniques used in the fields of molecular and cellular biology are covered, including DNA, RNA and Protein purification and manipulation. One three-hour period per week. *Offered annually. Prerequisites: BI 100, BI 105L, BI 206/BI 206L. Materials intensive fee applies.*

**BI 211L Biotechniques Laboratory II – Advanced Instrumentation (2)**

Practical introduction to instruments used in biological research, including advanced separation, microscopy and molecular biology, and bioassays. One three-hour period per week. *Offered annually. Prerequisites: BI 210L. Materials intensive fee applies.*

**BI 287 Introductory Field Experience (1-3)**

Supervised work at a cooperating agency by arrangement with 45 hours of work required per credit hour. Student journal, progress reports, final paper, agency supervisor's evaluation, and faculty supervisor's visits used in grading. Offered for program teach out only. *Prerequisites: freshman or sophomore standing and consent of instructor.*

**English 102 and COM 101 are prerequisites for all upper division courses****BI 300 Science Writing Seminar I – research proposal and publications (1)**

Intensive introduction to science writing. Overview of the purpose and process of scientific publications, peer review and criteria for inclusion in the literature. Students will focus upon the development of written arguments, discussion of data and interpretation/analysis. Course will culminate in production and review of a grant proposal. *Prerequisites: BI 206/BI 206L.*

**BI 302 Science Writing Seminar II – bioethics and conduct (1)**

Continuation of BI 300. Students will focus upon contemporary issues in science including funding policies, ethics and conduct of research. Course will culminate in writing of an authoritative review paper on an issue of interest selected by the student. *Prerequisites: BI 300.*

**BI 304 Clinical Nutrition (3)**

Nursing required course. Study of nutrients and their respective functions, food sources, and physiological needs. Dietary guidance and nutritional requirements through the lifespan are explored. Role of nutrition in prevention of, and intervention in, chronic diseases. *Prerequisites: BI 152/152L, CH 254/CH 254L, NUR 202, NUR 203.*

**BI 305 Genetics and Genomics (3)**

Nursing required course. Basic concepts in genetics and genomics, Current research, new ways to diagnose genetic conditions and genetic technologies that provide understanding of the genetic component to common chronic diseases are explored. Topics include family history, risk assessment, interventions, genetic testing and counseling, ethical and social issues and use of genetics and genomics to improve clinical practice. *Prerequisites: BI 152/BI 152L, CH 254/CH 254L, NUR 202, NUR 203.*

**BI 311 Biostatistics (3)**

Lecture course devoted to rigorous grounding in biological statistics, and in the application of statistical models to global health problems. Biostatistics is a lecture and hands-on course designed to provide students with the opportunity to develop statistical reasoning skills appropriate to analyze and implement biological experiments. Exemplars and case studies will be primarily derived from the public health field. Topics include principles of experimental design, sampling and variables, data categories and assumptions of parametric statistics, risk analysis, repeated measures, goodness of fit and contingency table analyses, and the general linear model. *Prerequisites: BI 206/BI 206L, MA 211.*

**BI 312 Epidemiology (3)**

This course covers epidemiologic concepts such as disease prevalence, penetration and risk. Epidemiological methodology will be addressed, including study design and interpretation for infectious and chronic diseases. Real data will be used to study an outbreak investigation, natural history of infectious diseases, validity of clinical tests, survival analysis, and clinical trial and etiologic studies. Epidemiologic concepts as applied to cohort and case-control studies will emphasize interpretation critical evaluation of observational study designs and data analysis. These concepts include measures of association, bias, confounding, and interaction/effect modification and determination of risk. *Prerequisites: BI 310. Recommended: MA 331.*

**BI 320 Developmental Biology I – Genetic control and patterning (3)**

Cellular and molecular processes that govern the production of an embryo and the patterning of individual tissues and organs in a manner that is consistent with their physiological functionality. The effect of exogenous stimuli on body patterning in both physiological and pathophysiological situations will be addressed. *Prerequisites: BI 206/BI 206L, BI 208/BI 208L.*

**BI 320L Developmental Biology Laboratory I – Genetic control and patterning (1)**

Laboratory section accompanying BI 320. *Concurrent registration in BI 320 required. Materials intensive fee applies*

**BI 321 Developmental Biology II – Comparative anatomy (3)**

Comparative study of vertebrate structure, organization and adaptation. *Concurrent registration in BI 321L required. Prerequisites: BI 320/BI 320L.*

**BI 321L Developmental Biology Laboratory II – Comparative anatomy (1)**

One three-hour laboratory period per week to accompany BI 321. Laboratory dissections of organisms including lamprey, dogfish, and cat, as well as simulated gross anatomy of the human. *Concurrent registration in BI 321L required. Prerequisites: BI 320/BI 320L. Materials intensive fee applies*

**BI 331 Advanced Human Nutrition (3)**

Basic biochemistry and physiology of human nutrition with emphasis on nutrient requirements of healthy individuals through the life cycle, functions and food sources of nutrients, and current topics pertaining to food science and human nutrition such as food safety, energy imbalance, malnutrition, and nutrition and chronic diseases. Offered for program teach out only. Concurrent registration in BI 331L required. *Prerequisites: BI 205/205L, BI 206/206L.*

**BI 331L Advanced Human Nutrition Laboratory (1)**

Laboratory to accompany BI 331. Laboratory includes nutrient analyses and nutritional assessment. Offered for program teach out only. Concurrent registration in BI 331 required. *Prerequisites: BI 205/205L, BI 206/206L. Materials intensive fee applies*

**BI 351 Comparative Vertebrate Anatomy (3)**

Comparative study of vertebrate structure, organization and adaptation. Concurrent registration in BI 351L required. Prerequisites: BI 205/205L, BI 206/206L.

**BI 351L Comparative Vertebrate Anatomy Laboratory (1)**

One three-hour laboratory period per week to accompany BI 351. Laboratory dissections of lamprey, dogfish, and cat. Offered for program teach out only. *Materials intensive fee applies*

**BI 360 Biochemistry (3)**

Chemistry of carbohydrates, proteins, lipids, enzymes, and DNA; metabolism of carbohydrates, lipids, and amino acids; cycles thermodynamics, biosynthesis, and degradation; nucleic acids; physiological applications. Concurrent registration in BI 360L. Cross-listed as BC/CH 360. Offered alternate years. *Prerequisites: BI 205/205L, BI 206/206L and CH 324/324L.*

**BI 360L Biochemistry Laboratory (1)**

Laboratory techniques, methods, and instrumentation used in analysis of carbohydrates, proteins, lipids, and nucleic acids. Cross-listed as BC/CH 360L. Offered alternate years. Concurrent registration in BI 360 required. *Materials intensive fee applies.*

**BI 363 General Entomology (3)**

Structure and function of the insects and closely related arthropods with emphasis on taxonomy, life cycles, distribution, and ecological relationships. Special emphasis will be given to groups of special significance to human health and well being. *Prerequisites: BI 208/BI 208L. Concurrent registration in BI 363L required.*

**BI 363L General Entomology Laboratory (1)**

One three-hour laboratory period per week to accompany BI 363. The laboratory will provide experience in collecting, mounting, and identification of insects to the family level, in addition to their structure. *Concurrent registration in BI 363 required.*

**BI 387 Internship or field experience (1-3)**

Supervised research work at a cooperating agency by arrangement; 45 hours of work required per credit. Student journal, progress reports, final paper, and agency supervisor's reports used in grading. May be repeated. No more than six semester hours of internship experience may be applied to graduation in biology. Offered every semester. *Prerequisites: junior or senior standing, one year of biology, and consent of instructor.*

**BI 410 Physiology I – metabolism and nutrition (3)**

Physiology of energetic and metabolic processes and endocrine control of metabolism in both healthy and disease states. Biochemistry of metabolism and the role of macro- and micronutrients in maintenance of homeostasis are examined. *Prerequisites: BI 208/BI 208L.*

**BI 410L Physiology I Laboratory – metabolism and nutrition (1)**

Laboratory section accompanying BI 410. *Concurrent registration in BI 410 required. Prerequisites: BI 208/BI 208L.*

**BI 411 Physiology II - neurophysiology (3)**

Fundamentals of neurophysiology from the cellular to the system levels. Discussion of neuroanatomy followed by the ionic and pharmacological basis of nerve and synaptic function. Specialized neuronal geometries and synaptic circuitries associated with a variety of sensory, motor and central systems. The laboratory covers extracellular and intracellular techniques in neurophysiology as well as sectioning and immunocytochemistry. *Prerequisites: BI 410/BI 410L*

**BI 411L Physiology II Laboratory - neurophysiology (1)**

Accompanying laboratory section to BI 411. *Concurrent registration in BI 411 required. Prerequisites: BI 410/BI 410L.*

**BI 420 Systems Biology (3)**

This course will focus on the frontiers of our understanding of the multi-level networks that underlie biological systems. Lecture course reviewing the key concepts of the systems biology approach to ecological, organismal and cellular systems. Contribution of cornerstone technologies such as genomics, bioinformatics, proteomics and metabolomics will be reviewed, along with their computational foundations. *Prerequisites: BI 208/BI 208L, BI 311.*

**BI 430 Infection and Immunity (3)**

This course covers molecular and cellular immunology, including antigen and antibody structure and function, effector mechanisms, complement, major histocompatibility complexes, B- and T-cell receptors, hypersensitivity reactions, antibody formation and immunity, cytotoxic responses, and regulation of the immune response. Mechanisms of disease are also covered, including principles of microbiology and virology. *Prerequisites: BI 208/BI 208L.*

**BI 431 Genetic Biology (3)**

Nature of the gene; molecular, physiological mechanisms of inheritance, molecular biology, and modern and classical principles. Offered for program teach out only. Concurrent registration in BI 431L required. *Prerequisites: BI 205/205L, BI 206/206L. Recommended: CH 203/CH 203L and CH 204/CH 204L.*

**BI 431L Genetic Biology Laboratory (1)**

One three hour laboratory period per week to accompany BI 431. Laboratory work such as fruit fly crosses, isozyme and nucleic acid, electrophoresis, and genetic experiments with microorganisms. Offered for program teach out only. Concurrent registration in BI 431 required. *Materials intensive fee applies*

**BI 433 Molecular Evolution (3)**

Investigations in the molecular basis of variation in populations. Association between selection, genetic drift, and other processes at molecular level and higher level patterns of diversity. Gene duplication and other genome alterations and novel gene function. Use of sequences and bioinformatic algorithms to study relatedness among groups of organisms. *Prerequisites: BI 208/BI 208L, BI 311. Materials intensive fee applies.*

**BI 433L Molecular Evolution Laboratory (1)**

Laboratory section accompanying BI 433. *Concurrent registration in BI 433 required. Prerequisites BI 208/BI 208L. Materials intensive fee applies.*

**BI 435 Cancer Biology (3)**

This course provides students with knowledge of the fundamental principles of the molecular and cellular biology of cancer cells. Lectures and demonstrations explain the role of growth factors, oncogenes, tumor suppressor genes, angiogenesis, and signal transduction mechanisms in tumor formation. Discussion of aspects of cancer epidemiology, prevention, and principles of drug action in cancer management is part of the course. *Prerequisites: BI 208/BI 208L.*

**BI 444 Forensic Biology (3)**

A scientific examination of biological evidence. Includes examining the scientific basis of many types of biological evidence, applying scientific methods to and interpretation of biological evidence. Cross-listed as BI 444. Offered annually. *Prerequisites: BI 205/L, BI 206/L, BI 207/BI 207L, CJ/FS 330. CH 203/CH 203L and CH 204/CH 204L* Concurrent registration in BI/FS 444L is required.

**BI 444L Forensic Biology Laboratory (1)**

One three-hour laboratory period per week to accompany FS 444. Laboratory work includes such topics as blood analysis and identification, use of chromatographic and electrophoretic techniques, and PCR as applicable to forensic identification. Concurrent registration in FS 444 required.

**BI 471 Ecology (3)**

Environmental-biological interrelations. Concepts of populations, communities, ecosystems, and conservation of resources by man. *Concurrent registration in BI 471L required. Prerequisites: BI 208/BI 208L.*

**BI 471L Ecology Laboratory (1)**

Laboratory section accompanying BI 471. *Concurrent registration in BI 471 required. Pre-requisites BI 208/BI 208L. Materials intensive fee applies.*

**BI 480 Special Topics (1-3)**

Selected topics in biology. Lecture or seminar topic in selected area of contemporary biology. May be repeated. *Prerequisites BI 208/BI 208L.*

**BI 487 Field Experience (1-3)**

Supervised research work at a cooperating agency by arrangement; 45 hours of work required per credit. Student journal, progress reports, final paper, and agency supervisor's reports used in grading. No more than six semester hours of internship experience may be applied to graduation in biology. Offered for program teach out only. Prerequisites: junior or senior standing, one year of biology, and consent of instructor.

**BI 490 Senior Seminar (1)**

Readings and discussion of special topics or procedures for planning a directed research project and presenting an oral and written report or results. Offered for program teach out only. Prerequisites: senior standing in biology or consent of program advisor.

**BI 495 Research I (3)**

Weekly seminar course accompanying research project (approximately 10 hours per week) performed in Chaminade or other research laboratory under supervision of a practicing research scientist. Prerequisites: senior standing in biology and consent of program advisor. *Materials intensive fee applies.*

**BI 496 Topics Seminar (1)**

Individualized in-depth research, readings and discussions on current topics. Includes intensive library and computer-based searches and several oral reports. Offered annually. *Prerequisites: Biology senior standing or approval of program advisor.*

**BI 499 Research II (3)**

Second semester of research project (approximately 10 hours per week) performed in Chaminade or other research laboratory under supervision of a practicing research scientist. Offered annually. Prerequisites: BI 495. *Materials intensive fee applies*