

DEPARTMENT OF BIOLOGY

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Mission: The Department of Biology seeks to provide training in a Christian environment needed to prepare students for teaching careers, research positions in industry/academia, admission into medical and health professional schools, and graduate studies in biological sciences.

Biology Undergraduate Major

The Bachelor of Science (B.S.) program provides undergraduate preparation for technical employment, post-baccalaureate study in graduate school, professions such as medicine, and other health professions, and for work in natural resource management. Two B.S. degrees are offered in the department: Biology and Biotechnology. Within the Biology B.S. program, there are three possible concentrations that one could specialize in including: Neurobiology, Biomedical Science, and Biology Teacher Education Program. Students pursuing the Biotechnology major are eligible to apply to the 4+1 BS/MS program. All majors in Natural and Physical Sciences are expected to make satisfactory academic progress toward graduation. In addition to the requirements established by the University, students must maintain a 2.0 in all major coursework. Further, the Department also requires a minimum grade of C- as completion for pre-requisites in science-related coursework for all students enrolled in MATH, BIOL, ENVR, CHEM, and PSCI courses, regardless of major.

A Biology major considering graduate or professional school should confer with a Biology advisor to plan a program to meet the student's needs for entrance into such a school or profession. In addition, it is strongly recommended that the student meet with their advisor to make sure that the student is aware of the additional requirements imposed by the Pre-Med Committee.

Biomedical Concentration

This concentration is aimed to prepare students for superior education in most professional health care programs (medicine, dentistry, veterinary medicine, pharmacy etc.), associated health programs (physician assistant, nursing, physical therapy, occupational therapy) and other graduate programs in the biomedical sciences. This is also suitable for students desiring careers in biomedical research, academic or commercial laboratories. Experiential learning opportunities are encouraged and could include participating in laboratory research, volunteer experiences and leadership positions within student clubs. The basic science curriculum meets the requirements for entrance into professional schools. We also subject the students to "Mock interviews" to help them get ready for the medical school admission process.

Neurobiology Concentration

This concentration provides an emphasis on the study of the nervous system, and provides students a chance to learn how neurobiologists use cellular, molecular, systems and behavioral analyses to improve the understanding of how the brain works. A special emphasis is placed on understanding the cellular mechanisms responsible for learning and memory, and the application of this information to enhance learning. Students will also develop a fundamental understanding of

neuroanatomy, neurophysiology and neuropharmacology through brain dissections, lab exercises, and simulations. Hand-on experimentation through use of animal models to study neurological disorders will also allow students to develop their analytical and critical thinking skills.

ITEP: Biology Teacher Education Program

The Integrated Teacher Education Program (ITEP) allows for students to complete not only their bachelor's degree but also the California Teaching Credential within four years. This is a great option for students preparing to teach biology at the secondary school level. The Bachelor of Science in Biology degree with this option is approved by the California Commission on Teacher Credentialing. Completion of this option will satisfy the subject matter requirement for the Single Subject Teaching Credential in Life Sciences within four years. Students wishing to graduate on a four-year plan are still eligible to enroll in the fifth-year credential program at Vanguard University or some other accredited college or university to complete subject requirements for the California Clear Teaching Credential in Mathematics (see the Graduate Program in Education for these requirements). Students under this option must include BIOL-111 Principles of Cell and Molecular Biology, BIOL-112 Principles of Organismal Biology, BIOL-112L Principles of Organismal Biology Lab, BIOL-309 Microbiology, BIOL-309L Microbiology Laboratory, BIOL-311 Genetics, BIOL-311L Genetics Laboratory, and an Ecology Course as a part of their degree program. They should also take ENGL-453 Language, Culture, and Linguistics and POLS-155C American Democracy (see program requirements).

Biotechnology Undergraduate and Graduate Programs Undergraduate Major

The undergraduate major will prepare students to enter a growing industry. The program aims to prepare students with the technical skills for a career in Biotechnology and the ability to critically assess biotechnology advances and applications. Biotechnology students will receive hands-on training, research experience and internship opportunities. Program graduates will be prepared to enter the workforce as a laboratory technician or pursue further training in a graduate program to focus on becoming a skilled researcher or laboratory manager. A dedicated biotechnology lab was remodeled in 2020 to house all biotechnology equipment and projects.

Graduate Programs

The Master of Science in Biotechnology has two formats: a two (2) year master's degree and an accelerated 4+1 undergraduate and graduate combined program. The 4+1 BS/MS program is a combined Biotechnology BS major/Biotechnology MS degree that students complete in 5 years.

The Biotechnology master's degree is geared for those seeking a career in the biotechnology industry. Students in the program take core classes in both biotech science-related and bio-entrepreneurship curricula. This program combines molecular biology rigor with soft skills to provide the essential background for interfacing research with successful workplace interactions in the biotech industry. Our mission is to provide motivated students with the knowledge and skills needed to successfully enter or advance their careers in the biotechnology industry.



Programs

Undergraduate Majors:

- B.S., Biology (<https://catalog.vanguard.edu/cas/biological-sciences/biology-bs/>)
- B.S., Biology with a Concentration in Biomedical Science (<https://catalog.vanguard.edu/cas/biological-sciences/biology-bs-biomedical/>)
- B.S., Biology with a Concentration in Ecology (<https://catalog.vanguard.edu/cas/biological-sciences/biology-bs-ecology/>)
- B.S., Biology with a Concentration in Neurobiology (<https://catalog.vanguard.edu/cas/biological-sciences/biology-bs-neurobiology/>)
- B.S., Biology with an Integrated Teacher Education Program (ITEP) (<https://catalog.vanguard.edu/cas/biological-sciences/biology-bs-education/>)
- B.S., Biotechnology (<https://catalog.vanguard.edu/cas/biological-sciences/biotechnology/>)
- B.S. and M.S., Biotechnology (4+1) (<https://catalog.vanguard.edu/cas/biological-sciences/biotechnology-ms-1/>)

Minor:

- Biology Minor (<https://catalog.vanguard.edu/cas/biological-sciences/biology-minor/>)

Graduate Program:

- Biotechnology B.S./M.S. (4 +1) (<https://catalog.vanguard.edu/cas/biological-sciences/biotechnology-ms-1/>)
- Biotechnology M.S. (<https://catalog.vanguard.edu/cas/biological-sciences/biotechnology-ms-2/>)

Courses

BIOLOGY

BIOL-100C Fundamentals of Biology for Non-Majors 3 Credits

An introduction to the structures and functions of the major plant and animal groups. Focus is directed toward biological principles and problems facing humans in dynamic ecosystems. Lecture three hours. This course fulfills the core curriculum lecture requirement in natural sciences.

Co-Requisite: BIOL-100CL

Terms Typically Offered: Fall, Spring, and Summer.

BIOL-100CL Fundamentals/Biology for Non-Majors Lab 1 Credit

Introduction to biological laboratory procedures. Laboratory exercises in molecular biology, metabolism and physiology, structure, ecology, and taxonomic groups. Laboratory four hours. Lab fee. This course fulfills the core curriculum laboratory requirement in natural sciences.

Pre- or Co-Requisite: BIOL-100C

Terms Typically Offered: Fall, Spring, and Summer.

BIOL-111 Principles of Cell and Molecular Biology 3 Credits

An introductory course for the biological sciences which covers the scientific method, basic biological chemistry, cell structure and function, metabolism and energy transformation, evolution, classification, and other related topics. This course fulfills the core curriculum lecture requirement in Natural Sciences; however, this course is designed for Biology majors.

Co-Requisite: BIOL-111L

Terms Typically Offered: Fall and Spring.

BIOL-111L Principles of Biology Lab 1 Credit

Pre- or Co-Requisite: Take BIOL-111

BIOL-112 Principles of Organismal Biology 3 Credits

An introductory course for the biological sciences which covers the kingdoms of living organisms, plant and animal physiology, population genetics, biodiversity, ecology, and other related topics.

Prerequisite: BIOL-111C and BIOL-111CL or equivalent.

Co-Requisite: BIOL-112L

Terms Typically Offered: Spring.

BIOL-112L Principles of Organismal Biology Lab 1 Credit

Topics in this course are designed to complement lectures presented in BIOL-112. Students will conduct a broad survey of investigations selected to optimize the understanding of basic laboratory techniques and biological principles including field trips, dissection, collections, ecosystem classification and evaluation. Lab and field trip fee.

Co-Requisite: BIOL-112

Terms Typically Offered: Spring.

BIOL-204C Human Anatomy 3 Credits

Introductory study of the gross physical structure, cellular makeup and physiological function of elements within the nine major organ systems. Lecture three hours. This course fulfills the core curriculum lecture requirement in Natural Sciences; however, this course is designed for Biology majors

Co-Requisite: BIOL-204CL

Terms Typically Offered: Fall and Spring.

BIOL-204CL Human Anatomy Laboratory 1 Credit

Laboratory study introducing the primary functional and supportive components within the skeletal, muscular, digestive, urinary, nervous, respiratory, reproductive, and cardiovascular systems. Laboratory three hours. Lab fee. This course fulfills the core curriculum laboratory requirement in Natural Sciences; however, this course is designed for Biology majors.

Co-Requisite: BIOL-204C

Terms Typically Offered: Fall and Spring.

BIOL-205 Principles of Human Physiology 4 Credits

Investigates the fundamental physiological processes in humans using a systems approach to student integrated functions. The course will explore the functions of the human body emphasizing homeostasis and integration at the biochemical, cellular, organ, and system levels. The systems studied will include nervous, cardiovascular, respiratory, renal, gastrointestinal, endocrine, reproductive, and immunity. This course is a combined lecture and laboratory course fulfilling the physiology requirement for RN to BSN student. This is not a suitable course for Pre-Licensure Nursing students or Biology Majors. This requirement meets the science lab requirement for all other students. Lab fee required.

Terms Typically Offered: Spring.

BIOL-208 Biology of Nutrition 4 Credits

The course emphasizes the biology of nutrition as applied to metabolic and physiologic principles underlying digestion and absorption of nutrients, chemical structure, and metabolism of nutrients, the biochemical role of nutrients in maintaining health, and the effects of over- and under-nutrition on health and on disease pathogenesis. The students will gain an understanding of the biology of macronutrients (carbohydrates, lipids, and proteins) and micronutrients (vitamins, minerals, and water). Weight management and dietary analysis will also be discussed. Laboratory activities provide real-world insight into the biology of nutrition and will assist students in understanding how proper nutrition can optimize body system functions. This course is a combined lecture and laboratory course fulfilling the physiology requirement for RN to BSN student. This is not a suitable course for Pre-Licensure Nursing students or Biology Majors. This requirement meets the science lab requirement for all other students. Lab fee required. (School for Professional Studies Course).

Terms Typically Offered: Spring and Summer.

BIOL-209 Principles of Microbiology 3 Credits

An introduction to the study of micro-organisms: their occurrence and importance to humans. Major concepts of general microbiology are discussed, including prokaryotic and eukaryotic cell types: structural organization of cells; cellular metabolism, regulation of metabolism, and genetics; host-parasite relationships, nutrition, growth, control mechanisms, immunology and serology; recombinant DNA technology; growth of microbial cells; and controlling growth by chemical and physical means. Bacteria, fungi, algae, protozoa, and viruses are studied. Special emphasis is given to infectious diseases and the organisms that cause these diseases.

Co-Requisite: BIOL-209L

Pre- or Co-Requisite: BIOL-100C/BIOL-100CL

Terms Typically Offered: Spring.

BIOL-209L Principles of Microbiology Lab 1 Credit

The laboratory course will introduce students to basic microbiology techniques and principles. Students will learn procedures for handling micro-organisms and establishing pure cultures. Additionally, the following basic microbiology laboratory protocols will be covered: specimen collection, cultivation, analysis, identification, and reporting. Laboratory three hours. Lab fee.

Prerequisite: BIOL-100C/BIOL100-CL

Co-Requisite: BIOL-209

Terms Typically Offered: Spring.

BIOL-210C Fundamentals of Biology 3 Credits

An introduction to the structures and functions of the major plant and animal groups. Focus is directed toward biological principles and problems facing humans in dynamic ecosystems. Lecture three hours. This course fulfills the core curriculum lecture requirement in Natural Sciences; however, this course is designed for non-science majors.

Co-Requisite: BIOL-210CL

BIOL-210CL Fundamentals of Biology Lab 1 Credit

Introduction to biological laboratory procedures. Laboratory exercises in molecular biology, metabolism and physiology, structure, ecology, and taxonomic groups. Laboratory three hours. Lab fee. This course fulfills the core curriculum laboratory requirement in Natural Sciences; however, this course is designed for non-science majors.

Co-Requisite: BIOL-210C

BIOL-220 Cell Biology 3 Credits

This course provides an introduction to the fundamental principles of biology that center on the cell. Focus will be placed on cellular structure and function, fundamental metabolism, and molecular genetics. Lecture three hours.

Prerequisite: BIOL-112

Co-Requisite: BIOL-220L

Terms Typically Offered: Fall.

BIOL-220L Cell Biology Lab 1 Credit

This course provides a working understanding of basic principles paramount to the study of biological sciences. Students will have a fundamental understanding of the scientific method, the cell, cellular structure, cellular respiration, DNA processes, protein synthesis, cellular reproduction, and genetics. This course prepares the student to think critically and analyze data. Laboratory three hours. Lab fee.

Prerequisite: BIOL-112L

Co-Requisite: BIOL-220

Terms Typically Offered: Fall.

BIOL-234 Principles of Neuroscience 4 Credits

The course is an introduction to the human nervous system and how the brain processes sensory information, controls actions, and learns through experience and emotions. Each lesson provides a broad understanding of the fundamentals of brain structures and its role in behavior. The course also aims to introduce the student to brain science behind sensory development, language acquisition and learning. (School for Professional Studies Course).

Terms Typically Offered: Fall, Spring, and Summer.

BIOL-291 Special Topic in Biology 1 Credit

Study of a special topic in life science. May be repeated for credit. Lab fee.

BIOL-292 Special Topic in Biology 2 Credits

Study of a special topic in life science. May be repeated for credit. Lab fee.

BIOL-293 Special Topic in Biology 3 Credits

Study of a special topic in life science. May be repeated for credit. Lab fee.

BIOL-294 Special Topic in Biology 4 Credits

Study of a special topic in life science. May be repeated for credit. Lab fee.

BIOL-302 Comparative Vertebrate Anatomy 3 Credits

Study of the similarities and differences in the structure and function of chordates (fish, amphibians, reptiles, birds, mammals) in both ancient and modern forms, with particular emphasis on human organ systems. Embryological development and features are integrated into the discussion of each organ system. Lecture three hours. Offered in alternate years.

Prerequisite: BIOL-112

Co-Requisite: BIOL-302L

Terms Typically Offered: Fall, odd years.

BIOL-302L Comp Vertebrate Anatomy Lab 1 Credit

Study of the essential embryological and morphological features of representative chordates (fish, amphibians, reptiles, birds, mammals), with particular emphasis given to human organ systems. Laboratory exercises incorporate dissection on preserved specimens. Laboratory three hours. Lab fee. Offered in alternate years.

Prerequisite: BIOL-112

Co-Requisite: BIOL-302

Terms Typically Offered: Fall, odd years.

BIOL-303 Neurobiology Learning & Memory 3 Credits

This course introduces students to the methods, theories, and concepts that are central to the field of learning and memory. The course uses a combination of lectures and student-led discussions. The course highlights the molecular and cellular processes that are responsible for the synaptic changes that are responsible for learning and the formation of memory. Students will learn how changes in synapses generate, stabilize, consolidate, and maintain memories. Topics covered include system and synaptic consolidation, reconsolidation, memory systems, and the neural pathways involved in different types of memories.

Prerequisite: BIOL-220

BIOL-304 Human Physiology 3 Credits

This course will investigate the fundamental physiological processes in humans using a systems approach to study integrated functions. It will explore the functions of the human body emphasizing homeostasis at biochemical, cellular, organ, and system levels. The systems studied will include nervous, cardiovascular, respiratory, renal, gastrointestinal, endocrine, and reproductive. Lecture three hours.

Prerequisite: BIOL-111C; BIOL-204C; or other college biology course with permission of instructor.

Co-Requisite: BIOL-304L

Terms Typically Offered: Fall and Spring.

BIOL-304L Human Physiology Lab 1 Credit

This course is designed to complement BIOL-304 investigating fundamental physiological processes in humans. The systems studied will include nervous, cardiovascular, respiratory, renal, gastrointestinal, endocrine, and reproductive. Laboratory three hours. Lab fee.

Co-Requisite: BIOL-304

Terms Typically Offered: Fall and Spring.

BIOL-305 Physiology of Vertebrates 3 Credits

Principles of animal physiology with emphasis on vertebrates. Lecture three hours. Offered in alternate years.

Prerequisite: BIOL-112 and BIOL-220

Co-Requisite: BIOL-305L

Terms Typically Offered: Spring, odd years.

BIOL-305L Physiology of Vertebrates Lab 1 Credit

Laboratory course examining the principles of animal physiology with emphasis on vertebrates. Laboratory three hours. Lab fee. Offered in alternate years.

Prerequisite: BIOL-112L and BIOL-220L

Co-Requisite: BIOL-305

Terms Typically Offered: Spring, odd years.

BIOL-309 Microbiology 3 Credits

Biology of micro-organisms: their occurrence and importance to humans. Topics will include microbial cell structure and function, metabolism, microbial genetics, and the role of micro-organisms in disease and immunity. Lecture three hours.

Co-Requisite: BIOL-309L

Terms Typically Offered: Fall.

BIOL-309L Microbiology Laboratory 1 Credit

Laboratory three hours. Lab fee.

Co-Requisite: BIOL-309

Terms Typically Offered: Fall.

BIOL-311 Genetics 3 Credits

A study of the principles and the physical basis of heredity, biochemical aspects of gene actions, and social implications of heredity. Lecture three hours. Offered in alternate years.

Prerequisite: BIOL-220 and BIOL-220L

Co-Requisite: BIOL-311L

Terms Typically Offered: Spring.

BIOL-311L Genetics Laboratory 1 Credit

Laboratory three hours. Lab fee. Offered in alternate years.

Co-Requisite: BIOL-311

Terms Typically Offered: Spring.

BIOL-315 General Ecology 3 Credits

An introduction to the interactions between organisms and their physical and biological environment. Important factors and processes influencing organisms within both terrestrial and aquatic ecosystems will be studied. Lecture three hours.

Prerequisite: BIOL-112

Co-Requisite: BIOL-315L

Terms Typically Offered: Spring, odd years.

BIOL-315L Ecology Field and Lab Practicum 1 Credit

This class provides hands-on experiences in the laboratory and in the field, enhances the student's understanding of basic environmental science and ecological concepts presented in BIOL-315. The laboratory experiments are oriented towards demonstrated basic principles of ecology and mastering modern research and field techniques. The individual exercises are from an excellent notebook on current protocols used in ecology. Occasional field sampling will be required. Three hours of lab per week. Lab fee.

Prerequisite: BIOL-112L

Co-Requisite: BIOL-315

Terms Typically Offered: Spring, odd years.

BIOL-335 Biology of Cancer 3 Credits

This course is designed to study cancer from both a cellular and a clinical perspective. Characteristics of aberrant cell growth, proliferation and metastasis will be studied with a focus on the genetic changes that occur in cancer cells. Clinical aspects of cancer that will be discussed will include the classification, carcinogenesis, epidemiology, prevention and treatment of cancer. Course fee.

Prerequisite: BIOL-112, BIOL-210C, BIOL-220, CHEM-112C or permission of instructor.

Terms Typically Offered: Spring, even years.



BIOL-345C Mountain Field Biology 4 Credits

A study of biota and communities of the mountains and factors affecting distributions, reproductions, and physiology of plant and animal life.

A significant component of the course focuses on geology and the geological forces involved in mountain and land formation. Lab fee. Much of the course consists of a 2-week field trip through the Sierra Nevadas typically during May. Lab and field trip fee. Lab fee covers lab project materials, food, transportation, and accommodations during the two-week long trip. Any special diet or physical accommodations must be approved by the instructor prior to enrollment. This course fulfills the core curriculum lecture and lab science requirement in natural sciences. Terms Typically Offered: Spring.

BIOL-346C Desert Field Ecology 4 Credits

A study of biota and communities of desert environments and factors affecting distributions, reproduction, and physiology of plant and animal life. A significant component of the course focuses on geology and the geological forces involved in mountain and land formation. One week of the course consists of a field trip through the arid regions of Southern California typically during spring break. Course will fulfill core curriculum science requirement. Lab fee. Lab fee will cover lab project materials, food, transportation, and accommodations during the two-week long trip. Any special diet or physical accommodations must be approved by the instructor prior to enrollment. This course fulfills the core curriculum lecture and lab science requirement in Natural Sciences. Terms Typically Offered: Spring.

BIOL-348C Coastal Ecology 4 Credits

Coastal Ecology examines the ecological processes at the interface between land and sea in order to provide an understanding of the coastal environment, how terrestrial and marine systems are intricately connected, and how human activities can impact both. Much of the course consists of local field trips in coastal and marine environments and in particular a week-long field trip usually during spring break. Course will fulfill core curriculum science requirement. Lab fee. Lab fee covers lab project materials, food, transportation, and accommodations during the week-long trip. Any special diet or physical accommodations must be approved by the instructor prior to enrollment. This course fulfills the core curriculum lecture and lab science requirement in Natural Sciences. Terms Typically Offered: Spring.

BIOL-353 Neuropharmacology 3 Credits

This course is designed to give students a fundamental understanding of the biochemical bases of behavior as well as the effects of drugs on the central nervous system and behavior. Topics covered include basic principles of neuropharmacology, pharmacokinetics, neurotransmitter systems, neural substrates of drug action, and neuropharmacology of neural disorders.

Prerequisite: BIOL-220

Terms Typically Offered: Fall, even years.

BIOL-365 Neurobiology of Learning and Memory 3 Credits

This course introduces students to the methods, theories, and concepts that are central to the field of learning and memory. The course uses a combination of lectures and student-led discussions. The course highlights the molecular and cellular processes that are responsible for the synaptic changes that are responsible for learning and the formation of memory. Students will learn how changes in synapses generate, stabilize, consolidate, and maintain memories. Topics covered include system and synaptic consolidation, reconsolidation, memory systems, and the neural pathways involved in different types of memories.

Prerequisite: BIOL-220, BIOL-220L

Terms Typically Offered: Fall, odd years.

BIOL-365L Neurobiology of Learning/Memory Lab 3 Credits

This course supports the BIOL-365 lecture and must be taken concurrently.

Prerequisite: BIOL-220, BIOL-220L

Co-Requisite: BIOL-365

Terms Typically Offered: Fall, even years.

BIOL-366 Plant Ecology 3 Credits

Ecology is the study of interrelationships between organisms and their biotic and abiotic environments. As a basic science, ecology informs us about the processes governing the patterns we observe in nature. From an applied perspective, it is critical that we understand ecology as it provides insights and solutions to many of the environmental issues we are confronted with in our daily lives. In this course we will focus specifically on the ecology of plants. Plant ecology is the study of the distribution and abundance of plants and their interactions with the abiotic environment and other organisms. In this course, we will examine plant life histories, populations, communities, and plant-animal interactions (pollination, dispersal, herbivory). Labs includes greenhouse, field experiments, and field trips with an exploration of plant biodiversity of the campus and region. Terrestrial systems are emphasized. A general background in ecology is assumed (Basic principles and foundations of the field will be considered as well as current research.

Prerequisite: BIOL-315 and BIOL-315L

Co-Requisite: BIOL-302L

Terms Typically Offered: Fall, odd years.

BIOL-366L Plant Ecology Lab 1 Credit

Laboratory exercises incorporate dissection on preserved specimens.

Laboratory three hours. Lab fee. Offered in alternate years.

Prerequisite: BIOL-315

Co-Requisite: BIOL-366

Terms Typically Offered: Fall, odd years.

BIOL-385 Research Methods in Neurobiology 3 Credits

This course provides students with an empirically-based research experience in the area of behavioural neuroscience. Students will be using an animal model of addition to study the neural mechanisms behind learning and memory. Students will gain a basic understanding of proper research methodology, memory consolidation, reconsolidation, conditioned place preference paradigm, brain anatomy, and pharmacology. Students will have hands-on experience learning various techniques, including animal handling and injection, and behavioral analysis. Terms Typically offered: Spring, even years.

Prerequisite: BIOL-365

Terms Typically Offered: Spring, even years.

BIOL-402 Histology 3 Credits

Study of the cells and tissues comprising each human organ system. Discussion focuses on structural and functional components in both intracellular and extracellular compartments, and cellular interaction within and among different organ systems. Lecture three hours. Offered in alternate years.

Prerequisite: BIOL-220

Co-Requisite: BIOL-402L

BIOL-402L Histology Lab 1 Credit

Laboratory study of the cells and tissues comprising each human organ system. Particular emphasis is placed upon learning to identify the features making each tissue and organ unique. Laboratory three hours. Lab fee. Offered in alternate years.

Prerequisite: BIOL-220L

Co-Requisite: BIOL-402

BIOL-403 Biotechnology 6 Credits

Methodology and application in biotechnology. The following topics will be covered: genetic engineering techniques for introducing a gene for a desired protein into a cell with vectors, techniques for growing bacteria and yeast to produce a desired protein, cell transformation by electroporation, blue/white screening for selection of a colony with successful transformation with the desired vector, identification of a plasmid with PCR and DNA sequencing, use of enzyme assays to measure protein concentration in solutions, fed-batch yeast fermentation, mammalian cell culture techniques, and analysis of protein expression by Western blot. Lab fee.

Terms Typically Offered: Spring.

BIOL-404 Neuropharmacology 3 Credits

This course is designed to give students a fundamental understanding of the biochemical bases of behavior as well as the effects of drugs on the central nervous system and behavior. Topics covered include basic principles of neuropharmacology, pharmacokinetics, neurotransmitter systems, neural substrates of drug action, and neuropharmacology of neural disorders.

Prerequisite: BIOL-220

Terms Typically Offered: Fall, even years.

BIOL-405 Bioinformatics 3 Credits

Introduction to bioinformatic resources/methods for biologists. Topics include: biological databases, sequence alignment, gene and protein structure prediction, molecular phylogenetics, genomics and proteomics. Students will gain practical experience with bioinformatics tools and develop basic skills in the collection and presentation of bioinformatics data.

Co-Requisite: BIOL-405L

Terms Typically Offered: Spring.

BIOL-405L Bioinformatics Laboratory 1 Credit

Introduction to bioinformatic resources/methods for biologists. Topics include: biological databases, sequence alignment, gene and protein structure prediction, molecular phylogenetics, genomics and proteomics. Students will gain practical experience with bioinformatics tools and develop basic skills in the collection and presentation of bioinformatics data. This lab course must be taken concurrently with lecture BIOL-405.

Co-Requisite: BIOL-405

BIOL-406 Research Methods in Neurobiology 3 Credits

This course provides students with an empirically-based research experience in the area of behavioural neuroscience. Students will be using an animal model of addition to study the neural mechanisms behind learning and memory. Students will gain a basic understanding of proper research methodology, memory consolidation, reconsolidation, conditioned place preference paradigm, brain anatomy, and pharmacology. Students will have hands-on experience learning various techniques, including animal handling and injection, and behavioral analysis. Terms Typically offered: Spring, even years.

Prerequisite: BIOL-365

Terms Typically Offered: Spring, even years.

BIOL-432 Neuroscience 3 Credits

The study of the nervous system from the cellular physiology of the neuron to complex structure and function of the central nervous system. Emphasis will be given to the cellular neurophysiology and neuroanatomy. This course will give an excellent foundation for understanding the brain and the nervous system. Students will critically read and discuss the scientific literature and learn to critically evaluate experimental neuroscience. Lecture three hours.

Prerequisite: BIOL-220 and BIOL-204C, BIOL-304, or BIOL-305; or permission of instructor.

Co-Requisite: BIOL-432L

Terms Typically Offered: Spring, odd years.

BIOL-432L Neuroscience Lab 1 Credit

Laboratory three hours. Lab fee.

Prerequisite: BIOL-220L and BIOL-204CL, BIOL-304L or BIOL-305L; or permission of instructor.

Co-Requisite: BIOL-432

Terms Typically Offered: Spring, odd years.

BIOL-440 Molecular Biology 3 Credits

The study of the genome in prokaryotes and eukaryotes. Introduction to and an analysis of modern molecular biology techniques are presented including: replication, transcription, translation, genetic engineering, cloning, gene expression, sequencing and genetic analysis. Lecture three hours. Offered in alternate years.

Prerequisite: BIOL-220

Co-Requisite: BIOL-440L

Terms Typically Offered: Fall.

BIOL-440L Techniques in Molecular Biology 1 Credit

The study of the genome in prokaryotes and eukaryotes. Introduction to and an analysis of modern molecular biology techniques are presented including: genetic engineering, cloning, gene expression, sequencing and genetic analysis. This course prepares the student to develop the following critical skills: independent thinking, lab management, record keeping, and project development. Laboratory three hours. Lab fee. Offered in alternate years.

Prerequisite: BIOL-220

Co-Requisite: BIOL-440

Terms Typically Offered: Fall.



BIOL-450 UG Research or Internship Program 1-4 Credits

This course may be taken for a maximum of four (4) units in one semester. A maximum of six (6) combined units credit for BIOL-450 or BIOL-485 apply to graduation. This course is designed with the purpose of providing students the opportunity to conduct research off-campus at universities or STEM companies in the community. This course promotes early entry into the workplace for the student through part-time employment. This course requires actual work experience be sought in a biotech or STEM-focused business firm providing an opportunity to integrate classroom teaching in practical application under the direct supervision of the assigned instructor. Students are responsible for completing a project report and presenting their research results in BIOL-499C.

Prerequisite: BIOL-112

Terms Typically Offered: Spring.

BIOL-451 Immunology 3 Credits

The study of molecular and cell biology of specific and nonspecific immune responses in mammals, with special emphasis on human immune systems. Reviews experimental support for current immunological theories. Roles of immunology in human health and disease will be studied.

Prerequisite: BIOL-220 and BIOL-220L

Co-Requisite: BIOL-451L

Terms Typically Offered: Spring, odd years.

BIOL-451L Immunology Lab 1 Credit

A laboratory course designed to introduce students to current clinical and research procedures in immunology. Includes techniques, such as ELISA, Immunoprecipitation, cell culture techniques, T cell activation, Western blot, and blood cells recognition. These techniques are utilized in biological, biochemical research and clinical laboratories. Lab fee.

Prerequisite: Prerequisite: BIOL-220 and BIOL-220L

Co-Requisite: Concurrent: BIOL-451

Terms Typically Offered: Spring, odd years.

BIOL-455 Biology Teaching Internship 1-3 Credits

The student will meet for regular hours each week for classes and/or meetings that are established at the beginning of the semester with the supervising professor. The intern assists an instructor in planning and conducting lecture and/or laboratory sessions and with other assigned teaching related duties. This course may be taken for 1-3 units per semester. May be repeated for a maximum of six units.

Terms Typically Offered: Fall and Spring.

BIOL-456 Principles of Conservation Biology 3 Credits

Conservation biology is a developing and complex field. It draws upon the biological disciplines of population biology, taxonomy, ecology, genetics, and resource management as well as the fields of economics, ethics, and politics to document, understand, and protect the world's biodiversity. This course will give students an overview of this emerging discipline including the scientific methods employed, the biological principles behind conservation techniques and strategies, as well as the complexities involved in attempts to influence and implement conservation-oriented policies.

Prerequisite: BIOL-112 and BIOL-311

Terms Typically Offered: Fall.

BIOL-470 Special Topic in Biology 1-4 Credits

Study a special topic in Life Science. May be repeated for credit. May have lab and field trip fees in some cases.

Terms Typically Offered: On Demand.

BIOL-480 Individual Studies: 1-4 Credits

May be repeated for credit. May have lab fee and field trip fee in some cases.

Terms Typically Offered: On Demand.

BIOL-485 Undergrad Biological Research 1-4 Credits

This course provides the student with an empirically-based research experience in the biological sciences. Emphasis will be placed on project management, safety, instrumentation, solution preparation, and research documentation skills. This course is a variable credit course. Two units are recommended for all biology majors. It is expected that a research report be completed at the conclusion of the research project and an oral presentation of the results be given in BIOL-499C. This course may be repeated for credit. Lab fee.

Prerequisite: BIOL-112 and BIOL-112L

Terms Typically Offered: On Demand.

BIOL-488 Biology Senior Project 2 Credits

An advanced course providing the opportunity for a student to create a novel and independent intellectual work by comparing, contrasting and synthesizing recent research and his/her cumulative knowledge and understanding in the biological sciences. The precise nature, scope and format of the project must be developed and approved under the guidance of the instructor and in collaboration with the student's academic advisor. Senior projects are typically initiated in the Fall. The project results must also be presented in BIOL-499C. Lab fee.

Terms Typically Offered: Fall.

BIOL-499C Capstone Seminar in Biology 2 Credits

This course includes analysis and evaluation of current research in biology and the integration of faith and learning in the biological sciences. An oral presentation of BIOL-485 or BIOL-488 is required. In-class presentations by faculty and guests are a part of the course. This course fulfills the Core Curriculum Capstone requirement for Biology majors.

Prerequisite: BIOL-485 or BIOL-488

Terms Typically Offered: Spring.

BIOTECHNOLOGY

BIOT-200 Introduction to Biotechnology 3 Credits

An introductory course to the field of biotechnology and application of biotechnology methodologies in emerging areas. Topics of discussion will include microbial biotechnology, animal biotechnology, forensic biotechnology, agriculture biotechnology, bioremediation and medical biotechnology. Emphasis will be placed on ethical and social considerations and opportunities for improvements in the field.

Pre- or Co-Requisite: BIOL-111/BIOL-111L and BIOT-200L

BIOT-200L Introduction to Biotechnology Laboratory 1 Credit

An introductory laboratory course to the field of biotechnology and application of biotechnology methodologies in emerging areas. Laboratories include aseptic technique, pipetting and measurement, NNA extraction and restriction digestion, gel electrophoresis nad PCR. Lab fee required.

Prerequisite: BIOL-111/BIOL-111L

Pre- or Co-Requisite: BIOT-200



BIOT-403 Adv. Research Methods in Biotechnology 3 Credits

Methodology and application in biotechnology. The following topics will be covered: genetic engineering techniques for introducing a gene for a desired protein into a cell with vectors, techniques for growing bacteria and yeast to produce a desired protein, cell transformation by electroporation, blue/white screening for selection of a colony with successful transformation with the desired vector, identification of a plasmid with PCR and DNA sequencing, use of enzyme assays to measure protein concentration in solutions, fed-batch yeast fermentation, mammalian cell culture techniques, and analysis of protein expression by Western blot. Lab fee.

Prerequisite: BIOT-200

BIOT-405 Bioinformatics 3 Credits

Introduction to bioinformatic resources/methods for biologists. Topics include: biological databases, sequence alignment, gene and protein structure prediction, molecular phylogenetics, genomics and proteomics. Students will gain practical experience with bioinformatics tools and develop basic skills in the collection and presentation of bioinformatics data.

Prerequisite: DSCI-100C, DSCI-100CL

Co-Requisite: BIOT-405L

BIOT-405L Bioinformatics Laboratory 1 Credit

Introduction to bioinformatic resources/methods for biologists. Topics include: biological databases, sequence alignment, gene and protein structure prediction, molecular phylogenetics, genomics and proteomics. Students will gain practical experience with bioinformatics tools and develop basic skills in the collection and presentation of bioinformatics data. This lab course must be taken concurrently with lecture BIOL-405.

Prerequisite: DSCI-100C, DSCI-100CL

Co-Requisite: BIOT-405

BIOT-413 Cell Culture Techniques 3 Credits

This course is primarily lab based and will focus on teaching the techniques necessary to maintain mammalian cells in culture and manipulating stem cells. Exercises will include hands-on training isolating, maintaining, characterizing, cryopreserving, and manipulating in vitro cells in addition to independent research experience. Additional skills will include Basic Aseptic Technique; Media Preparation; Cell counting; Survival assays, Live Cell Identification and Transfection. These skills are crucial for individuals seeking career opportunities in the biotechnology field.

Prerequisite: BIOL-309, BIOL-309L

BIOT-500 Career Prep/Biosci Industry Engagement 1 Credit

Preparation for PSM Program and Bioscience Industry Engagement. Career preparation for successful entry and development in biotechnology. Community and interactive discussion topics including the business of science, career opportunities, industry and workforce trends, and overview of the biotechnology industry. Intended to help students identify career values and goals and get them on track for being successful in finding a meaningful project for their capstone experience. Students will research potential internship sites and develop a plan for securing a project. In addition to writing a resume and cover letter, students will develop interviewing and networking skills, set goals and learning objectives, and learn skills that will ensure their success in their internships or research projects.

BIOT-503 Advanced Research Methods in Biotech 3 Credits

Methodology and application in biotechnology. This course is primarily lab based and will prepare students for independent research project. The following topics will be covered: genetic engineering techniques for introducing a gene for a desired protein into a cell with vectors, techniques for growing bacteria and yeast to produce a desired protein, cell transformation by electroporation, blue/white screening for selection of a colony with successful transformation with the desired vector, identification of a plasmid with PCR and DNA sequencing, use of enzyme assays to measure protein concentration in solutions, fed-batch yeast fermentation, mammalian cell culture techniques, and analysis of protein expression by Western blot. Lab fee.

BIOT-505 Bioinformatics 3 Credits

Introduction to bioinformatic resources/methods for biologists. Topics include: biological databases, sequence alignment, gene and protein structure prediction, molecular phylogenetics, genomics and proteomics. Students will gain practical experience with bioinformatics tools and develop basic skills in the collection and presentation of bioinformatics data.

BIOT-505L Bioinformatics Laboratory 1 Credit

Introduction to bioinformatic resources/methods for biologists. Topics include: biological databases, sequence alignment, gene and protein structure prediction, molecular phylogenetics, genomics and proteomics. Students will gain practical experience with bioinformatics tools and develop basic skills in the collection and presentation of bioinformatics data. This lab course must be taken concurrently with lecture BIOT-505.

BIOT-508 Legal and Social Ethics in Science 3 Credits

A seminar course that examines the ethical implications of decisions made in biotechnology as well as the responsibilities of life scientists in the biomedical development process, including industry, government, and healthcare authorities and in their communities. Course discussions include stewardship and environmental impacts of biomanufacturing as well as ethical use of laboratory animals. Students examine ethical issues related to biomedical product advancement and use, and specific areas of science are also explored from a Christian ethics viewpoint through lectures, student oral presentations, team debate, and final written projects.

BIOT-511 Regulations and Quality Management 2 Credits

A course designed for science professionals to develop and apply skills and knowledge for managing business operations. Real-world business cases are used to develop students' management capacity and capability. Areas of focus include the process view of organizations, performance measures, products and product attributes, production processes, process competencies, procurement and supply chain management and regulatory requirements. The laws and regulations enforced by the Food and Drug Administration and other regulatory agencies related to the biotechnology, pharmaceutical, and medical device industries are surveyed. Included is the U.S. legal regulatory system, Food, Drug, and Cosmetic Act and related laws, Freedom of Information Act, regulation affecting foods, drugs, biologics, veterinary products, diagnostics, and devices, FDA enforcement, product liability, and import/export requirements. Reviews the impact of quality systems and the functions, roles, and responsibilities on Quality Assurance and Quality Control.



BIOT-513 Cell Culture Techniques 3 Credits

This course is primarily lab based and will focus on teaching the techniques necessary to maintain mammalian cells in culture and manipulating stem cells. Exercises will include hands-on training isolating, maintaining, characterizing, cryopreserving, and manipulating in vitro cells in addition to independent research experience. Additional skills will include Basic Aseptic Technique; Media Preparation; Cell counting; Survival assays, Live Cell Identification and Transfection. These skills are crucial for individuals seeking career opportunities in the biotechnology field.

BIOT-515 Experimental Design and Statistical Analysis 3 Credits

Introduces advanced statistical concepts and analytical methods for the experimental needs and data encountered in biotechnology and biomedical sciences. Experimental design/conduct, quantitative analysis of data, and statistical inferences and interpretations are studied for scientific hypothesis testing, as well as clinical trials. Explores methodological approaches to bioassay development/testing and provides a foundation for critically evaluating information to support research findings, product claims, and technology opportunities. Students are recommended to be familiar with Python programming. Terms Typically Offered: Fall.

BIOT-550 Internship Program 1-4 Credits

This course may be taken for a maximum of four (4) units in one term. A maximum of eight (8) combined credit units apply to graduation. This course is designed with the purpose of providing students the opportunity to conduct research off-campus at STEM companies in the community. This course promotes early entry into the workplace for the student through part-time employment. This course requires actual work experience be sought in a biotech or STEM-focused business firm providing an opportunity to integrate classroom teaching in practical application under the direct supervision of the assigned instructor. Students are responsible for completing a project report and presenting their research results in BIOT-699.

BIOT-600 Bioinnovation/Entrepreneurship/Biotech 2 Credits

A seminar course that develops skills in managing bioentrepreneurship projects in the bioscience and biomedical device fields. Students learn how to be responsive team members as well as communicative team leaders. This course also investigates issues and decisions that inventor / scientists, investors, founders, business people, lawyers, and others might typically encounter when they are considering the application and commercialization of early stage scientific discoveries. And how to sustain innovation in organizations and team dynamics.

BIOT-603 Bus Analytics and Professional Comm 3 Credits

A course that focuses on oral and written communication for both scientific and nonscientific audiences for a variety of sources in biotechnology, including journals, investor relations, and regulatory documentation. Topics include uses and management of information; decision tools and concepts; quality control.

BIOT-685 Independent Advanced Research 4-6 Credits

Students conduct supervised, independent research in Biotechnology. The student and faculty supervisor together develop a course outline, with a proposal for original research and the method of evaluation, including a formal research paper. Outline must be approved by the department before the student is permitted to register. Students will present their work in oral and written format. A maximum of eight (8) combined units apply to graduation.

BIOT-699 Graduate Seminar 1 Credit

Seminar series with invited biology speakers including many prominent scientists and leaders working at biotechnology companies. Students will be expected to present their research at these Seminars. Graduate students are to take this course every Spring. This course is repeatable to a maximum of 3 units.

Prerequisite: BIOT-550 or BIOT-685

