

# Department of Biology and Chemistry

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## Courses

### BIOC 270, Biomolecular Chemistry, 4 Units

Students in this course undertake a systematic and theoretical study of the biochemical activities of living cells as they are introduced to the structure, properties, and metabolism of proteins, carbohydrates, lipids, and nucleic acids. Emphasis is on the practical application of biochemical techniques in academic, government, and industrial laboratories today. Lecture, 3 hours; lab, 4 hours.

**Prerequisite:** C- or better in BIOL 151 and CHEM 152; C- or better in CHEM 251 (may be taken concurrently)

### BIOC 360, Principles of Biochemistry, 4 Units

Students in this course gain a systematic and theoretical understanding of the biochemical activities of living cells, including an introduction to the structure, properties, and metabolism of proteins, carbohydrates, lipids, and nucleic acids. This course does not meet the requirements of the biochemistry major. Credit will not be given for both BIOC 270 and BIOC 360, nor for both BIOC 360 and BIOC 370. Lecture, 3 hours; lab, 4 hours.

**Prerequisite:** CHEM 252 (C- or higher)

### BIOC 370, Biomolecular Metabolism, 4 Units

Students in this course gain an in-depth understanding of biomolecule metabolism, with emphasis on the mechanisms of energy transfer and chemical communication in living systems. Laboratory recitations foster the practical application of biochemical techniques and thorough understanding of current literature in the field. Lecture, 3 hours; lab, 4 hours.

**Prerequisite:** C- or better in BIOC 270 and CHEM 252.

### BIOC 390, Physical Biochemistry, 3 Units

Physical biochemistry is the study of the physical properties that govern how proteins, DNA, RNA, and other biological polymers assemble into life.

These physical properties provide a description of their interactions, from the atomic level to large macromolecular assemblies. Methods for measuring interactions between biomolecules involving nuclear, electric, magnetic, and centrifugal fields illustrate the interrelatedness of physics and chemistry in our understanding of conventional biology.

**Prerequisite:** C- or better in BIOC 270 and CHEM 252.

### BIOL 90, Laboratory Safety, 0 Units

This course provides an introduction to federal, state, and local regulations, material safety data suggestions, chemical hygiene plan, labels, equipment, spill response, and proper handling and disposal of chemicals as related to an academic laboratory.

### BIOL 101, Biology and Society, 4 Units

This elementary course covers principles of cell structure and function, genetics, development, reproduction, and animal systems biology. Lecture, 3 hours; lab, 3 hours. Not intended for health or natural sciences majors. *Meets the General Education Requirement: Natural Science.*

Special Fee Applies

### BIOL 109, Introduction to Biological Sciences, 3 Units

Designed for high school students participating in the APU/Azusa USD Summer GATE Program, this course provides an introduction and overview of biology concentrating on cell biology, genetics, kingdoms, and ecology. The emphasis is on basic science principles, their application to real-world situations, and developing the basic skills needed in college.

**Prerequisite:** High School biology course

### BIOL 115, Anatomy and Physiology, 4 Units

Lecture, 3 hours; Lab, 3 hours: This is an introductory course in the principles of anatomy and physiology as they relate to the structure and function of the living human body. It is designed for physical education majors. Does not count toward biology major credit.

Special Fee Applies

**Prerequisite:** BIOL 101 or BIOL 151. (Nursing Majors: High School Biology and minimum SAT/ACT scores)

### BIOL 151, General Biology I, 4 Units

This foundational course for science majors is the first in a two-semester sequence covering principles of cell structure and function, genetics, development, reproduction, and animal systems biology. Lab emphasis is on the investigative approach and experimental techniques of biology. Lecture, 3 hours; lab, 4 hours. *Meets the General Education Requirement: Natural Science.*

**Prerequisite:** Completion or waiver of MATH 95 (for example, by a 45 ALEKS score). For allied health, biochemistry, biological sciences, chemistry, kinesiology, psychology, computer science, and physics majors only; all other majors by department consent.

## BIOL 152, General Biology II, 4 Units

Lecture, 3 hours; Lab, 4 hours: This second-semester course deals with behavior, evolution, plant and animal diversity of life, plant biology, and introduction to ecology. There is a laboratory emphasis on plant and animal biology.

Special Fee Applies

**Prerequisite:** C- in BIOL 151

## BIOL 200, Human Anatomy for Nursing, 4 Units

Students in this intensive course study human anatomy using the systemic approach, with lab exercises utilizing human cadaver prosections. Lecture, 3 hours; discussion, 1 hour; lab, 4 hours.

**Prerequisite:** Preadmitted nursing major status and a B in one year of high school biology or C- in BIOL 151.

## BIOL 210, Human Physiology for Nursing, 4 Units

Students in this course study how human organ systems function and maintain homeostasis. Laboratory exercises include biomedical instrumentation. Lecture, 3 hours; lab, 4 hours.

Special Fee Applies

**Prerequisite:** C- in BIOL 200 and C- in CHEM 123 (may be taken concurrently) or a B in one year of high school chemistry; for nursing majors only - all other majors by department consent.

## BIOL 220, General Microbiology, 4 Units

This course is for students majoring (or planning to major) in nursing or allied health (BA). The focus is on fundamental microbiological principles and laboratory techniques, with an emphasis on disease-causing microorganisms, new and old methods of disease treatment and prevention, and host immune responses. Lecture, 3 hours; lab, 4 hours.

Special Fee Applies

**Prerequisite:** C- in BIOL 151 or BIOL 230, and C- in CHEM 151 (may be taken concurrently) or CHEM 123. Nursing majors: C- in CHEM 123.

Department consent required for non-nursing majors.

## BIOL 226, Intro to Neurobiology, 4 Units

Students in this course explore how scientists study the biological basis of human behavior, focusing on the specific aspects of neuroscience that are directly related to various behavioral and cognitive functions. This course takes a case-study and research-based approach, relying on textbook but also group discussion of current behavioral neuroscience research and techniques. Students develop the skills to interpret, critically analyze, and apply relevant research and theories in the field of behavioral neuroscience and its biological basis in psychopharmacology. Lecture, 3 hours; lab, 4 hours.

Special Fee Applies

**Prerequisite:** C- in BIOL 151

## BIOL 230, Human Anatomy and Physiology I, 4 Units

This is the first semester of a two-semester course that examines the anatomy and physiology of the human body from an integrated perspective. Topics include basic biological and chemical concepts, tissue types, integumentary, musculoskeletal and nervous systems, and special senses. The laboratory component includes model-based anatomical studies and the examination of physiological processes via the scientific method.

Special Fee Applies

**Prerequisite:** Kinesiology students only

## BIOL 231, Human Anatomy and Physiology II, 4 Units

This is a continuation of the Human Anatomy and Physiology I course. Topics include metabolism and the autonomic nervous, endocrine, cardiovascular, lymphatic, respiratory, urinary and reproductive systems. The laboratory component includes model-based anatomical studies and the examination of physiological processes via the scientific method. *Meets the General Education Requirement: Natural Science.*

Special Fee Applies

**Prerequisite:** C- or higher in BIOL 230. Kinesiology students only.

## BIOL 240, Biology of Microorganisms, 4 Units

This course covers the fundamental principles and techniques of microbiology, with emphasis on the role of microorganisms in disease, immunity, and food production. Lecture, 3 hours; lab, 4 hours.

Special Fee Applies

**Prerequisite:** C- in BIOL 151; and C- in BIOL 152, C- in BIOL 230, or C- in BIOL 250, as well as C- in CHEM 151 (may be taken concurrently).

Department consent required for all majors outside of the Department of Biology and Chemistry.

## BIOL 250, Human Anatomy, 4 Units

This intensive course in human anatomy uses the systemic approach, with lab exercises utilizing human cadaver prosections. Lecture, 3 hours; discussion, 1 hour; lab, 4 hours.

Special Fee Applies

**Prerequisite:** C- in BIOL 151; for allied health and kinesiology (health professions concentration) majors only-all other majors by department consent.

## BIOL 251, Human Physiology, 4 Units

Students in this course study how human organ systems function and maintain homeostasis. Laboratory exercises include biomedical instrumentation. Lecture, 3 hours; lab, 4 hours.

Special Fee Applies

**Prerequisite:** C- in BIOL 151 and C- in BIOL 250; and C- in CHEM 151 or C- in CHEM 123; for allied health and kinesiology (health professions concentration) majors only-all other majors by department consent

## BIOL 280, Cell Biology, 4 Units

This course covers a theoretical approach to cellular and molecular biology, including ultrastructure, cytology, metabolism, and molecular genetics. Laboratory emphasis is given to electron microscopy, centrifugation, and DNA and protein electrophoresis. Lecture, 3 hours; lab, 4 hours; discussion/quiz, 1 hour.

Special Fee Applies

**Prerequisite:** Allied health and biological sciences majors: C- in BIOL 240 and C- in CHEM 151; biochemistry majors: C- in BIOC 270.

## BIOL 300, Genetics, 4 Units

This course covers the principles of heredity, including Mendelism, cytogenetics, population theory, human medical genetics and gene regulation, classical laboratory experimentation, and modern molecular biology techniques. Lecture, 3 hours; Lab, 4 hours. *Meets the General Education Requirement: Integrative and Applied Learning.*

Special Fee Applies

**Prerequisite:** C- in BIOL 280

## BIOL 311, Teaching and Learning in STEM, 2 Units

Students in this course learn about the fundamentals of effective STEM teaching, including common challenges for STEM learners, active engagement strategies, assessment techniques, supporting diverse learners, designing assignments, and planning courses and lessons.

**Prerequisite:** BIOL 151, CHEM 151, CS 120, MATH 165, PHYC 151, PHYC 161, or equivalent

## BIOL 312, STEM Education Research Seminar, 1 Unit

Students identify challenges for effective STEM education that they observe during their experiences as STEM students and in STEM teaching support roles. Using readings drawn from the STEM education research literature, students identify and evaluate solutions to these challenges.

**Prerequisite:** BIOL 151, CHEM 151, CS 120, MATH 165, PHYC 151, PHYC 161, or instructor permission

## BIOL 313, STEM Teaching Practicum, 1 Unit

This course is intended for students serving in teaching support roles for STEM courses, including Learning Assistants, Teaching Assistants, and tutors. Students observe and reflect on effective STEM teaching practices and assist learners in engaging with and understanding course content.

**Prerequisite:** BIOL 151, CHEM 151, CS 120, MATH 165, PHYC 151, PHYC 161, or instructor permission

## BIOL 320, Ecology, 4 Units

This course provides an understanding of the relationship of plants and animals to their environment, with particular consideration given to distribution, communities, and population analysis. Lecture, 3 hours; Lab, 4 hours. *Meets the General Education Requirement: Civic Knowledge and Engagement.*

Special Fee Applies

**Prerequisite:** C- in BIOL 152 and BIOL 280; Upper-division status.

## BIOL 325, Humans and the Environment, 4 Units

Through lecture and lab experience students study the historical, biblical, and scientific aspects of the environment with particular emphasis on the impact of humans on God's world. Students explore a variety of environmental aspects related to economics, global studies, and missiology in individual studies/papers. Does not count toward biology major credit. *Meets the General Education Requirement: Natural Science.*

## BIOL 325H, Humans and the Environment - Honors, 4 Units

Through lecture and lab experience students study the historical, biblical, and scientific aspects of the environment with particular emphasis on the impact of humans on God's world. Students explore a variety of environmental aspects related to economics, global studies, and missiology in individual studies/papers. Does not apply for biology major credit. *Meets the General Education Requirement: Natural Science.*

**Prerequisite:** To enroll in the course, must be a student admitted to the Honors Program and be considered a member in "active" status.

## BIOL 326, Neurobiology, 4 Units

Students in this course undertake a detailed study of the structure and function of animal nervous systems. Special emphasis is given to the anatomy and neurophysiology of reflexes, motor pathways, senses, and neurological diagnosis. This course is designed for students oriented toward the health sciences. Lecture, 3 hours; lab, 4 hours. *Meets the General Education Requirement: Integrative and Applied Learning.*

Special Fee Applies

**Prerequisite:** C- or better in BIOL 280

## BIOL 330, Gender Differences, 3 Units

Lecture/Discussion, 3 hours: This course examines in detail differences in gender. Realizing gender differences are related to one's chronological age, these differences are studied from the biological, psychological, sociological, and theological perspectives and understood that each perspective influences the others. Does not count toward biology major credit.

## **BIOL 336, Vertebrate Biology, 4 Units**

Lecture, 3 hours; Lab, 4 hours: This course provides a comprehensive survey of the natural history, anatomy, and systematics of vertebrate animals - fish, amphibians, reptiles, birds, and mammals. Laboratory will include training in dissection skills and experience with a human cadaver.

Special Fee Applies

**Prerequisite:** C- in BIOL 152

## **BIOL 340, Invertebrate Biology, 4 Units**

Lecture, 3 hours; Lab, 4 hours: The classification, natural history, and functional morphology of invertebrate phyla are studied.

**Prerequisite:** C- in BIOL 152

## **BIOL 342, Medical Microbiology, 3 Units**

This lecture course emphasizes the importance of microbiology to medicine and applied areas of science. The spectrum of infectious agents, host response, current diagnostic methodologies, and recent advances/problems in diagnosis and treatment are covered.

**Prerequisite:** C- in BIOL 240 and BIOL 280

## **BIOL 346, Regional Human Anatomy, 4 Units**

This is a dissection-based course in human anatomy, utilizing cadavers and a regional approach to studying the human body. Upon completion, students are able to identify major skeletal, muscular, nervous, and vascular structures; organs; and the relationships of these structures to each other in each body area. Students also learn about the flow of blood from the heart through vascular structures to organs and limbs, as well as the structure and significance of the cervical, brachial, and lumbosacral plexuses, and are able to explain the actions of muscles based on origin and insertions. Students gain skills in dissection, collaborating with colleagues to perform dissections and present findings to the class. Finally, students gain an appreciation of the intricacy and detail of the human body, the importance of precision and accuracy in experimental work, and the value of collaborative learning.

Lecture, 3 hours; discussion, 1 hour; lab, 4 hours.

Special Fee Applies

**Prerequisite:** C- in BIOL 151 and BIOL 280; allied health (B.A.) majors: C- in BIOL 151 and BIOL 251.

## **BIOL 350, Mammalian Physiology, 4 Units**

Lecture, 3 hours; Discussion, 1 hour; Lab, 3 hours: This course offers an analysis of physiological mechanisms in animals with emphasis on the function at the organ systems level. This course is appropriate for those preparing for medical school and related graduate study. Introductory experiences applying physiological principles to clinical medicine are covered.

Special Fee Applies

**Prerequisite:** C- in BIOL 280

## **BIOL 365, Plant Biology, 4 Units**

Lecture, 3 hours; Lab, 4 hours: This course introduces botanical research topics, including plant classification, genetics, structure and function, growth and development, and evolution and ecology. It integrates themes and processes of the California State Science framework.

**Prerequisite:** C- in BIOL 280

## **BIOL 370, Prosection, 1 Unit**

Students are introduced to the human body through gross dissection and demonstration of selected portions of a human cadaver. This course requires 30 hours of laboratory.

## **BIOL 390, Pre-health Seminar, 1 Unit**

This course provides a background to the Biblical, historical and philosophical aspects of healthcare as well as an understanding of the reasons to pursue a career in the field. The course also covers the key principles required for success in applying for and matriculation into graduate programs in healthcare fields such as writing effective personal statements and interviewing well.

**Prerequisite:** Junior standing

## **BIOL 391, Medical Missions Practicum, 1 Unit**

Lecture/Discussion, 1 hour: This course offers a practicum experience for students preparing for a career in the medical/health-related sciences. Didactic medical-clinical instruction in first aid, assessment, and medical history is emphasized. Students gain practical field experience as Team Luke members with Mexico Outreach.

**Prerequisite:** BIOL 101, BIOL 151, or BIOL 250

## **BIOL 394, Directed Research Internship, 1-3 Units**

This course provides instruction in research design and technique, and gives students experience in the research process. The 1-unit expectation encompasses no fewer than 30 hours of work with accompanying reading, log writing, and seminar presentation within the department or in a university research symposium. May be repeated, subject to department policies.

**Prerequisite:** Department permission

## **BIOL 395, Biological Science Internship, 1-3 Units**

This course gives students an opportunity to apply classroom knowledge in real-world settings through paid or volunteer science-related internships with local businesses or organizations. Students gain a realistic view of their career goals, explore possible career choices, and gain valuable experience under the guidance of their job supervisor and academic supervisor. Internship committee approval is required for this course; applications must be submitted a minimum of three weeks prior to the start of the semester. Internship site requirements may vary; email [biologyandchemistry@apu.edu](mailto:biologyandchemistry@apu.edu) for details.

**Prerequisite:** 3.0 GPA, dept consent, and a C- or higher in the following: allied health BA: BIOL 251; allied health BA business emphasis, allied health BS, and biological sciences majors: BIOL 280; biochemistry majors: BIOC 270 and CHEM 252; chemistry majors: CHEM 300

## **BIOL 396, Topics in Biology and Christian Thought, 1 Unit**

This course covers the basic ideas behind the Creation/evolution and Creation care discussions. Students are exposed to, and are asked to critically evaluate, the scientific, philosophical, and theological foundations of these two debates.

**Prerequisite:** C- or higher in BIOL 151 and CHEM 152; UBBL 100 or UBBL 230; and junior standing. For biology minors only: C- or higher in BIOL 151, BIOL 240, and CHEM 151; UBBL 100 or UBBL 230; and junior standing.

## **BIOL 400, Science and Children, 4 Units**

This course is for liberal studies majors interested in obtaining a multiple subject teaching credential, helping them develop knowledge and skills in science content, including how to teach science concepts and processes emphasized in the Next Generation Science Standards and California State Framework - Science K-8. Lecture, 3 hours; lab, 3 hours. Does not count toward biology major credit. This is a core liberal studies course, and the 38 units of core liberal studies coursework must be completed with a grade of C or higher and an overall GPA of 3.0 or higher.

Special Fee Applies

**Prerequisite:** Junior or senior standing; completion of EDLS 200 or EDLS 202; and a C or better in two of the following courses: BIOL 101, PHYC 115, PHYC 125.

## **BIOL 410, Molecular Biology, 4 Units**

This course covers the traditional molecular biology curriculum, which includes transcription, translation, and gene expression in prokaryotes and eukaryotes. Lecture includes theory on key molecular techniques. Laboratory exercises emphasize current techniques in molecular biology such as molecular cloning, blotting, PCR, and assays of gene expression. Lecture, 3 hours; lab, 4 hours.

**Prerequisite:** C- or better in BIOL 280

## **BIOL 420, Cancer Biology, 3 Units**

This course covers a broad range of topics in cancer biology, including cancer statistics, cell cycle, oncogenes, tumor suppressor genes, DNA tumor viruses, stem cells, metastasis, etiology, and treatments.

**Prerequisite:** C- or higher in BIOL 280

## **BIOL 425, Immunology, 3 Units**

This course introduces students to the molecular and cellular basis, and the main mechanisms of, the mammalian immune system, including innate and acquired immunity. Emphasis is on reading and understanding scientific papers; applying course material to solve immunological problems; viewing the immune system as an interconnected, interdependent system; and studying mechanisms of immune dysfunction, microbial evasion of the immune system, and transplantation. Students also consider theological and ethical implications of our understanding of the immune system, research practices, and applications of immunity.

**Prerequisite:** C- or higher in BIOL 280; junior or senior standing

## **BIOL 430, Global Change Biology, 3 Units**

This course is an introduction to the emerging field of global change biology, with emphasis on the impacts of global change factors on humans, organisms, and ecosystems, with particular reference to past and present climate change, biodiversity loss, and environmental pollution. Avenues for adaptation and mitigation are also explored and discussed.

**Prerequisite:** C- or higher in BIOL 280, or instructor consent.

## **BIOL 435, Stewardship Ecology, 3 Units**

The history of humankind's view of nature and the resulting treatment of nature that arise from such views are examined. The biblical approach known as stewardship ecology is developed and supported as a foundation for the student's approach to this field.

**Prerequisite:** C- in BIOL 320

## **BIOL 440, Developmental Biology, 3 Units**

This is a study of the origin, morphology, and chemical control of developing germ layers, tissues, and systems of the body.

**Prerequisite:** BIOL 280 (C- or higher)

## **BIOL 450, Histology, 4 Units**

Lecture, 3 hours; Lab, 4 hours: This course teaches the structure and function of animal tissues. Emphasis is on preparation and recognition techniques of cell and tissue structure.

**Prerequisite:** C- in BIOL 280



## BIOL 454, Electron Microscopy for Biological Sciences, 2 Units

This lecture course deals with theory and principles of various microscopy methods, with emphasis given to electron optics, specimen preparation, and operation of transmission and scanning electron microscopes and ultrastructure analysis.

**Prerequisite:** PHYC 151, PHYC 152 or instructor consent

## BIOL 455, Laboratory in Electron Microscopy, 2 Units

This companion course to BIOL 454 covers biological and medical specimen preparation techniques and basic photographic protocol. Current laboratory instrumentation, dealing with both scanning and transmission electron microscopy, is emphasized.

**Prerequisite:** BIOL 280 or BIOL 454 (may be taken concurrently)

## BIOL 465, Practicum and Topics in Allied Health, 4 Units

This course deals with diagnosis strategies, prevention, and rehabilitation programs integral to the field of allied health. An emphasis on research literature facilitates students' development of knowledge, aptitudes, and skills within the allied health field. The clinical laboratory component emphasizes current instrumentation and practice. Lecture/discussion, 3 hours; lab, 4 hours. *Meets the General Education Requirement: Integrative and Applied Learning.*

Special Fee Applies

**Prerequisite:** C- or higher in the following: BIOL 280 or KIN 490; BIOL 250 or BIOL 336 or BIOL 230; BIOL 251 or BIOL 350 or BIOL 231 (may be taken concurrently). For allied health (B.A.) majors, the only prerequisite is a C- or higher in BIOL 251.

## BIOL 470, Science for the MCAT, 1 Unit

This course builds on lower-division courses in general and organic chemistry, biology, and physics to prepare students for the basic science content contained in the Medical College Admission Test (MCAT). Additional topics in genetics, biochemistry, physiology, and physics are presented, and integrated with practical mathematical skills in an interactive problem-solving setting. Fall semester includes practice items in biology and general and organic chemistry, and a practice test in biological sciences. May be repeated for 2 units of credit, and may not be taken to meet upper-division elective requirements in any major in the Department of Biology and Chemistry.

**Prerequisite:** Only for upper-division students admitted to the premedical track; department consent required.

## BIOL 490, Biology Seminar, 1 Unit

This course consists of review and discussion of current periodical literature. Written and verbal presentations are required.

**Prerequisite:** Junior or Senior Standing

## BIOL 494, Advanced Topics in Biology, 4 Units

This course presents advanced coverage of topics in physiology or other biological sciences. The course may be repeated for credit when different topics are offered. Lecture plus laboratory.

**Prerequisite:** C- or higher in BIOL 280; Jr or Sr Standing

## BIOL 495, Advanced Topics in Biology, 3 Units

This course presents advanced coverage of topics in physiology or other biological sciences. The course may be repeated for credit when different topics are offered. Lecture only.

**Prerequisite:** C- or higher in BIOL 280; Jr or Sr Standing

## BIOL 496, Writing 3: Ethics and the Sciences, 3 Units

This course covers the basics of worldviews, science, and ethics while delving deeper into the details of various ethical perspectives and their implications for science. Specific areas of science are explored from a Christian ethics viewpoint through lectures, writing instruction, a thesis, and oral presentations. *Meets the General Education Requirement: Writing 3: Writing in the Disciplines.*

**Prerequisite:** Writing 2 and a C- or higher in one of the following: BIOL 280, CHEM 252, CHEM 240, or BIOL 465 (Allied Health B.A. only). Department consent required.

## BIOL 497, Readings, 1-3 Units

This is a program of study concentrating on assigned readings, discussions, and writing arranged between and designed by, a university student of upper-division standing and a full-time professor. An independent study fee is assessed for each enrollment in this class. May be repeated subject to department policies.

## BIOL 498, Directed Research, 1-3 Units

This course provides instruction in research design and technique, and gives students experience in the research process. The 1-unit expectation encompasses no fewer than 30 hours of work with accompanying reading, log writing, and seminar presentation within the department or in a university research symposium. No more than 1 unit may be used to fulfill preparatory readings requirement. May be repeated subject to department policies.

**Prerequisite:** Junior or senior standing and department permission.

## **BIOT 500, Biotechnology Internship, 3 Units**

The biotechnology internship is a mandatory component of the Masters of Science in Biotechnology program, and is reserved for students enrolled in that program. The internship requirement is 320 hours, and generally takes 10-12 weeks to complete. Internships may be paid or unpaid, and are carried out at the business sites of biomedical product companies. Internship projects are presented at a biotechnology internship symposium in the fall semester after completion of the internship.

**Prerequisite:** BIOT 511, BIOT 512, and BIOT 515;

**Corequisites:** BIOT 516 and BIOT 600A

## **BIOT 510, Commercialization of Technology, 3 Units**

This course serves as an introduction to issues related to new product development, formulating strategies, acquiring resources, setting up and managing operations, and creating technology-focused businesses, with an emphasis on ethics in the high-tech workforce environment. Assignments and project emphasize learning how to manage and commercialize technology.

**Prerequisite:** Must be admitted into the M.S. in Biotechnology program;

**Corequisites:** BIOT 513 and BIOT 514

## **BIOT 511, Molecular Biology, Pharmacology, and Toxicology of Biopharmaceuticals, 3 Units**

This course is an overview of molecular biology, pharmacology, and toxicology concepts as applied to the development of biopharmaceutical products and biomedical devices. Students work collaboratively toward a final project to propose a new pharmaceutical product and/or biomedical device.

**Prerequisite:** BIOT 510, BIOT 513, and BIOT 514;

**Corequisites:** BIOT 512 and BIOT 515

## **BIOT 512, Bioinformatics, 3 Units**

This course introduces the strategies, approaches, and computer applications used in drug discovery, database design, and data mining. Case studies illustrate specific applications of the methods for measuring, visualizing, representing, inferring, clustering, classifying, and modeling biotechnological data. Class format involves didactic instruction and hands-on experience with various bioinformatics tools and databases.

**Prerequisite:** BIOT 510, BIOT 513, and BIOT 514;

**Corequisites:** BIOT 511 and BIOT 515

## **BIOT 513, Regulatory Affairs for the Biotechnology Industry, 3 Units**

This course is a detailed examination of the terminology, timelines, and practices followed by regulatory affairs professionals employed in the biotechnology industry. Case studies from the industry are examined to supplement certain topics and to illustrate interpretation of regulations.

**Prerequisite:** Must be admitted into the M.S. in Biotechnology program;

**Corequisites:** BIOT 510 and BIOT 514

## **BIOT 514, Probability and Statistics for the Biotechnology Industry, 3 Units**

Students in this course examine the statistical methods and computer applications used in drug manufacturing processes. Topics covered include data presentation, probability, hypothesis testing, univariate and multivariate analysis, linear regression, and confidence interval estimation.

**Prerequisite:** Must be admitted into the M.S. in Biotechnology program;

**Corequisites:** BIOT 510 and BIOT 513

## **BIOT 515, Project Management for the Biotechnology Industry, 3 Units**

This course is designed to prepare students in business, engineering, and technology for the task of managing projects, such as information technology projects, business process improvement projects, and product development projects.

**Prerequisite:** BIOT 510, BIOT 513, and BIOT 514;

**Corequisites:** BIOT 511 and BIOT 512

## **BIOT 516, Ethics for Biomedical Products Industries, 3 Units**

Biotechnology exists at a critical intersection of science and ethics, and the power and potential of biotechnology demands caution to ensure ethical progress. Students in this course examine the ethical roles and responsibilities of key participants in the biomedical development process, including industry, government, and healthcare authorities. 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.

**Prerequisite:** BIOT 511, BIOT 512, and BIOT 515;

**Corequisites:** BIOT 500 and BIOT 600A

## **BIOT 517, Clinical Trials, 3 Units**

This course examines governmental laws, practices, and regulations associated with human clinical trials, and includes development and evaluation of a series of in-class assignments with class discussion and a capstone project for small student groups culminating with in-class presentations.

**Prerequisite:** BIOT 500, BIOT 516, and BIOT 600A;

**Corequisite:** BIOT 600B

## BIOT 530, Environmental Toxicology and Bioremediation, 3 Units

Students in this course survey pollutants released from various natural as well as anthropogenic sources and their toxicological effects on environments, humans, animals, and plants. Students also examine, evaluate, and present various bioremediation approaches for pollutant neutralization. Lecture and colloquium.

**Prerequisite:** Admission to the Master of Science in Biotechnology program, or instructor permission.

## BIOT 600A, Master's Degree Project I, 3 Units

This course comprises the first part of the capstone master's degree project (MDP) for the M.S. in Biotechnology program, and is to be taken in the fall semester of students' second year. In this course, students identify and begin work on their MDP, for which they must complete a minimum of 480 hours of in-person work at a project site approved by the program director-120 hours in BIOT 600A, and the balance of the hours in the 9-unit BIOT 600B in the spring semester of their second year.

**Prerequisite:** BIOT 511, BIOT 512, and BIOT 515, and good second-year standing in the M.S. in Biotechnology program;

**Corequisites:** BIOT 500 and BIOT 516

## BIOT 600B, Master's Degree Project II, 9 Units

This course comprises the second part of the capstone master's degree project (MDP) for the M.S. in Biotechnology program, and is to be taken in the spring semester of students' second year. In this course, students must complete the remaining 360 hours of in-person work at a project site approved by the program director, and must also give an oral presentation (defense) and a written report of the project to fulfill the degree requirement.

**Prerequisite:** BIOT 500, BIOT 516, and BIOT 600A, and good standing in the M.S. in Biotechnology program;

**Corequisite:** BIOT 517

## CHEM 90, Laboratory Safety, 0 Units

Students are introduced to federal, state, and local regulations, material safety data suggestions, chemical hygiene plans, labels, equipment, spill response, proper handling, and disposal of chemicals as related to an academic laboratory.

## CHEM 101, Chemistry and Society, 4 Units

This elementary course surveys contemporary and relevant topics in our society, and explores the basic laws and concepts of modern chemistry behind these topics. Lecture, 3 hours; Lab, 3 hours. *Meets the General Education Requirement: Natural Science. Not intended for health or natural science majors.*

Special Fee Applies

## CHEM 105, Citizen Chemistry, 4 Units

Lecture, 3 hours; Lab, 3 hours: This course is designed for nonscience majors and presents chemistry in its broad cultural, social, and economic context. The lectures and laboratories cover experiences that are of concern to students' everyday lives.

## CHEM 123, General, Organic, and Biological Chemistry for the Health Sciences, 4 Units

This course comprises an overview of general, organic, and biological chemistry topics, with an emphasis on health science applications. Topics include radioactivity, intermolecular forces, solution behavior, acids and bases, nomenclature, physical characteristics of organic compounds, and selected reactions, with focus on the simple organic functional groups and carbonyl chemistry. Biochemistry topics cover chemical reactions and physiological significance of cellular macromolecules including proteins, enzymes, and nucleic acids, as well as metabolism. Lecture, 3 hours; lab, 3 hours. *Meets the General Education Requirement: Natural Science.*

**Prerequisite:** Completion or waiver of MATH 95 (for example, by a 45 ALEKS score) and pre-admitted nursing status or department consent.

## CHEM 151, General Chemistry I, 4 Units

This foundational course for science majors is the first in a two-semester sequence covering the basic laws and concepts of modern chemistry. Topics include atomic structure, chemical bonding, thermochemistry, stoichiometry, chemical reactions, solution chemistry, nuclear chemistry, and the behavior of gases. Lecture, 3 hours; lab, 3 hours. *Meets the General Education Requirement: Natural Science.*

Special Fee Applies

**Prerequisite:** B- or higher in MATH 110 or equivalent (for example, an ALEKS score of 65). For allied health, biochemistry, biological sciences, chemistry, kinesiology, physics, engineering, and computer science majors only; all other majors by department consent.

## CHEM 152, General Chemistry II, 4 Units

This is a foundational course for science majors and the second part of a two-semester sequence covering the basic laws and concepts of modern chemistry. Topics covered include solution chemistry, chemical kinetics, equilibrium, acid-base theory, thermodynamics, and electrochemistry. Lecture, 3 hours; lab, 4 hours.

Special Fee Applies

**Prerequisite:** C- in CHEM 151

## CHEM 240, Introduction to Organic and Biochemistry, 4 Units

Lecture, 3 hours; Lab, 3 hours: Students are introduced to the names, properties, and reactions of organic functional groups with applications to biochemical monomers and macromolecules.

Special Fee Applies

**Prerequisite:** C- in CHEM 152



## CHEM 251, Organic Chemistry: Theory I, 3 Units

This general course covers bonding theory, structure analysis, isomers, nomenclature, physical properties, functional groups, fundamental reaction mechanisms, stereochemistry, spectroscopy, and synthesis of hydrocarbons.

**Prerequisite:** C or better in CHEM 152;

**Corequisite:** CHEM 261

## CHEM 252, Organic Chemistry: Theory II, 3 Units

This general course covers spectroscopy, physical properties, reaction mechanisms, thermodynamics, kinetics, aromaticity, and fundamental reaction mechanisms of hydrocarbons, carbonyl compounds, and biological macromolecules.

**Prerequisite:** C- in CHEM 251;

**Corequisite:** CHEM 262

## CHEM 261, Organic Chemistry - Lab, 1 Unit

Techniques of determining chemical and physical properties and synthesis of organic compounds are the focus of laboratory study. Must be taken concurrently with CHEM 251.

Special Fee Applies

**Corequisite:** CHEM 251

## CHEM 262, Organic Chemistry - Lab, 1 Unit

Students in this lab focus on techniques for determining chemical and physical properties and synthesis of organic compounds.

**Prerequisite:** C- in CHEM 261.

**Corequisite:** CHEM 252

## CHEM 300, Quantitative Chemical Analysis - Theory, 2 Units

The theoretical basis of gravimetric and volumetric analyses are covered in this course. Topics include multiequilibria, acid-base equilibria, and redox reactions as applied to quantitative analysis.

**Prerequisite:** C- in CHEM 152

## CHEM 310, Quantitative Chemical Analysis - Laboratory, 2 Units

This is a laboratory course in the analysis of materials by the methods studied in CHEM 300.

**Corequisite:** CHEM 300

## CHEM 311, Teaching and Learning in STEM, 2 Units

Students in this course learn about the fundamentals of effective STEM teaching, including common challenges for STEM learners, active engagement strategies, assessment techniques, supporting diverse learners, designing assignments, and planning courses and lessons.

**Prerequisite:** BIOL 151, CHEM 151, CS 120, MATH 165, PHYC 151, PHYC 161, or equivalent

## CHEM 312, STEM Education Research Seminar, 1 Unit

Students identify challenges for effective STEM education that they observe during their experiences as STEM students and in STEM teaching support roles. Using readings drawn from the STEM education research literature, students identify and evaluate solutions to these challenges.

**Prerequisite:** BIOL 151, CHEM 151, CS 120, MATH 165, PHYC 151, PHYC 161, or instructor permission

## CHEM 313, STEM Teaching Practicum, 1 Unit

This course is intended for students serving in teaching support roles for STEM courses, including Learning Assistants, Teaching Assistants, and tutors. Students observe and reflect on effective STEM teaching practices and assist learners in engaging with and understanding course content.

**Prerequisite:** BIOL 151, CHEM 151, CS 120, MATH 165, PHYC 151, PHYC 161, or instructor permission

## CHEM 320, Instrumental Analysis: Theory, 3 Units

This course covers the theory and operation of modern analytical equipment, including electrochemical methods; UV-visible, infrared, and flame emission spectrophotometry; chromatographic methods; and others. *Meets the General Education Requirement: Integrative and Applied Learning.*

**Prerequisite:** C- or better in CHEM 300, C- or better in CHEM 310

## CHEM 330, Instrumental Analysis - Lab, 1 Unit

In this laboratory course, students analyze materials by the methods studied in CHEM 320.

**Prerequisite:** CHEM 320

## CHEM 394, Directed Research Internship, 1-3 Units

This course provides instruction in research design and technique, and gives students experience in the research process. The 1-unit expectation encompasses no fewer than 30 hours of work with accompanying reading, log writing, and seminar presentation within the department or in a university research symposium. May be repeated, subject to department policies.

**Prerequisite:** Department permission

## CHEM 395, Chemical Science Internship, 1-3 Units

This course gives students an opportunity to apply classroom knowledge in real-world settings through paid or volunteer science-related internships with local businesses or organizations. Students gain a realistic view of their career goals, explore possible career choices, and gain valuable experience under the guidance of their job supervisor and academic supervisor. Internship Committee approval is required for this course; applications must be submitted a minimum of three weeks prior to the start of the semester. Internship site requirements may vary; email [biologyandchemistry@apu.edu](mailto:biologyandchemistry@apu.edu) for details.

**Prerequisite:** 3.0 GPA, dept consent, and a C- or higher in the following: allied health (BA) majors: BIOL 251; allied health (BA business emphasis and BS) and biological sciences majors: BIOL 280; biochemistry majors: BIOC 270 and CHEM 252; chemistry majors: CHEM 300

## CHEM 401, Physical Chemistry I, 3 Units

This is an advanced course covering the theoretical basis of thermodynamics, including the laws of thermodynamics and their applications. Topics include energy, enthalpy, entropy, gas laws, kinetic model of gases, phases, chemical potential, and the kinetics of chemical reactions.

**Prerequisite:** C in CHEM 152 and C- in MATH 165

## CHEM 402, Physical Chemistry II, 3 Units

This is an advanced course covering the Schrodinger equation and its applications to the particle in a box, the rigid rotor, and the harmonic oscillator. Once a firm foundation has been established in the underlying theories of quantum mechanics, they are applied to atomic and molecular structure, vibrational and electronic spectroscopy, and computational chemistry.

**Prerequisite:** C- or higher in CHEM 401 and C- or higher in MATH 268; recommended: PHYC 152 or PHYC 162.

## CHEM 411, Physical Chemistry I Lab, 1 Unit

This is an upper-level laboratory over one semester on thermodynamics and kinetics and their applications. Laboratories include experiments, theoretical calculations, and mathematical methods recitations on the topics of partial molar volume, calorimetry, phase diagrams, electrochemistry, kinetics, colligative properties, molecular dynamics, and partial derivatives.

Special Fee Applies

**Corequisite:** CHEM 401

## CHEM 412, Physical Chemistry II Lab, 1 Unit

This is an upper-level laboratory over one semester on quantum mechanics and its applications. Laboratories include experiments, theoretical calculations, and mathematical methods recitations on the topics of linear algebra, multivariable calculus, symmetry, probability, Planck temperature distribution, photoelectric effect, quantum dots, spectroscopy, particle in a box, and molecular orbitals.

Special Fee Applies

**Corequisite:** CHEM 402

## CHEM 451, Advanced Organic Chemistry, 4 Units

This course covers advanced physical organic chemistry, modern organic synthesis strategies, reaction mechanisms, and bonding theories.

**Prerequisite:** CHEM 252

## CHEM 461, Inorganic Chemistry, 3 Units

This course lays a foundation in the subjects of atomic structure, bonding theory, symmetry theory, and acid-base chemistry, which is then used to explore advanced topics involving crystalline compounds, coordination compounds, and organometallic compounds. Topics include bonding, spectroscopy, and kinetics.

**Prerequisite:** C- in CHEM 252

## CHEM 490, Chemistry Seminar, 1 Unit

The seminar consists of reviews, reports, and discussions on current scientific literature.

**Prerequisite:** Senior Standing

## CHEM 495, Advanced Topics in Chemistry, 3-4 Units

This course presents advance coverage of topics in chemistry. Course credit is 4 units when a laboratory component is included. The course may be repeated for credit when different topics are offered.

**Prerequisite:** Junior Standing

## CHEM 497, Readings, 1-4 Units

This is a program of study concentrating on assigned readings, discussions, and writing arranged between and designed by a university student of upper-division standing and a full-time professor. An independent study fee is assessed for each enrollment in this class. May be repeated subject to department policies.

## CHEM 498, Directed Research, 1-3 Units

This course provides instruction in research design and technique, and gives students experience in the research process. The 1-unit expectation encompasses no fewer than 30 hours of work with accompanying reading, log writing, and seminar presentation within the department or in a university research symposium. No more than 1 unit may be used to fulfill preparatory readings requirement. May be repeated subject to department policies.

**Prerequisite:** Junior or senior standing and department permission.

### **PRBI 101, Biology and Society, 4 Units**

This introductory course covers principles of cell structure and function, genetics, development, reproduction, and animal systems biology. Lecture, 3 hours; lab, 3 hours. Not intended for health or natural sciences majors. *Meets the General Education Requirement: Natural Science.*

Special Fee Applies

### **PRCH 101, Chemistry and Society, 4 Units**

This elementary course surveys contemporary and relevant topics in our society, and explores the basic laws and concepts of modern chemistry behind these topics. Lecture, 3 hours; Lab, 3 hours. *Meets the General Education Requirement: Natural Science. Not intended for health or natural science majors.*

Special Fee Applies

### **PRCH 123, General, Organic, and Biological Chemistry for the Health Sciences, 4 Units**

This course comprises an overview of general, organic, and biological chemistry topics, with an emphasis on health science applications. Topics include radioactivity, intermolecular forces, solution behavior, acids and bases, nomenclature, physical characteristics of organic compounds, and selected reactions, with focus on the simple organic functional groups and carbonyl chemistry. Biochemistry topics cover chemical reactions and physiological significance of cellular macromolecules including proteins, enzymes, and nucleic acids, as well as metabolism. Lecture, 3 hours; lab, 3 hours. *Meets the General Education Requirement: Natural Science.*

**Prerequisite:** Completion or waiver of MATH 95 (for example, by a 45 ALEKS score) and pre-admitted nursing status or department consent.