Department of Biology and Chemistry

Mission

The Department of Biology and Chemistry (http://www.apu.edu/clas/biochem) at Azusa Pacific University provides an environment where undergraduate students can develop a Christian worldview and learn to integrate their faith into their lives as scientists. The department provides science courses that are consistent with the majors offered, that meet the goals of the General Education program (http://catalog.apu.edu/undergraduate/academic-programs/general-education-program), and that serve as support courses for students in other majors. The department also provides opportunities for students to prepare for graduate or professional studies and for success in their chosen careers.

Department Statement

The Department of Biology and Chemistry serves God through the integration of a Christian perspective into the disciplines of biology and chemistry, and the preparation of Christian men and women to serve in leadership or support roles in these sciences.

Goals

Upon completion of a bachelor’s degree from the Department of Biology and Chemistry, graduates will be able to:

1. Demonstrate a traditional knowledge base of the major subject and associated science cognate areas.
2. Relate theories, problem-solving techniques, laboratory applications, and instrumentation procedures to this field of study.
3. Integrate a Christian worldview within the science disciplines.
4. Matriculate into graduate programs appropriate to the specific discipline.

Department Overview

The Department of Biology and Chemistry offers Bachelor of Arts degrees in Allied Health (http://catalog.apu.edu/undergraduate/liberal-arts-sciences/biology-chemistry/allied-health-major) and Allied Health: Business Emphasis (http://catalog.apu.edu/undergraduate/liberal-arts-sciences/biology-chemistry/allied-health-business-emphasis), and Bachelor of Science degrees in Allied Health (http://catalog.apu.edu/undergraduate/liberal-arts-sciences/biology-chemistry/allied-health-major), Biology (http://catalog.apu.edu/undergraduate/liberal-arts-sciences/biology-chemistry/biology-major), Chemistry (http://catalog.apu.edu/undergraduate/liberal-arts-sciences/biology-chemistry/chemistry-major), and Biochemistry (http://catalog.apu.edu/undergraduate/liberal-arts-sciences/biology-chemistry/biochemistry-major).

Teaching Science at the Secondary Level

Students planning a career in teaching science at the secondary level should prepare for the CSET examination. Students should major in biology, chemistry, or physics to obtain subject-matter proficiency in one of these areas for the specialization test. In addition, to prepare for the breadth part of the test, students should take:

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Units</th>
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<tbody>
<tr>
<td>BIOL 151</td>
<td>General Biology I</td>
<td>4</td>
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<tr>
<td>BIOL 152</td>
<td>General Biology II</td>
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<tr>
<td>CHEM 151</td>
<td>General Chemistry I</td>
<td>4</td>
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<tr>
<td>CHEM 152</td>
<td>General Chemistry II</td>
<td>4</td>
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<tr>
<td>PHYC 130</td>
<td>Earth Science</td>
<td>4</td>
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<tr>
<td>PHYC 140</td>
<td>Introduction to Astronomy</td>
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<tr>
<td>PHYC 151 &amp;</td>
<td>Physics for Life Sciences I</td>
<td>4</td>
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<tr>
<td>PHYC 152</td>
<td>and Physics for Life Sciences II</td>
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<tr>
<td>PHYC 161 &amp;</td>
<td>Physics for Science and Engineering I</td>
<td></td>
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<tr>
<td>PHYC 162</td>
<td>and Physics for Science and Engineering II</td>
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Select one of the following: 8-10

Biology and Chemistry Fellowships

Each year the Department of Biology and Chemistry offers a limited number of fellowships to selected undergraduates to participate in the Student-to-Scholar (S2S) Program (http://www.apu.edu/clas/biochem/scholarships) involving laboratory research with a faculty mentor.
Requirements for Allied Health, Biochemistry, Biology, and Chemistry majors

While the Department of Biology and Chemistry does not cap enrollment in these majors, students are expected to demonstrate certain levels of achievement (detailed below) to enter and remain in these majors.

Freshman Applicants

To qualify for a major in allied health, biology, biochemistry, or chemistry¹, freshman² applicants must submit documentation of the following (or their equivalents) and indicate their choice for one of those majors to the Office of Undergraduate Admissions (http://www.apu.edu/admissions/undergraduate) before the start of classes. After this date, the requirements in the section Matriculated APU Students (below) must be met.

• Math: Score of 45 on the ALEKS test (http://www.apu.edu/lec/placement/math/using-aleks) or any of criteria 1-10 for waiving the GE Quantitative Literacy requirement. Note: The B- in MATH 110 prerequisite for CHEM 151 (which is required of all students in these majors) is also satisfied by criteria 1-8, but not criteria 9-10.
• High School Prep: Grades of B or higher in one year each of high school biology AND chemistry¹.

¹ For the chemistry major, a score of 65 on a proctored ALEKS test or criteria 1-8 are required, and high school physics may be substituted for biology.
² Freshman transfer students can qualify for the majors under freshman applicant requirements only if all college math/science grades are B- or better.

Freshman applicants who do not qualify for direct admission to allied health, biology, biochemistry, or chemistry may be admitted to allied health/biochemistry/biology/chemistry interest upon submission of documentation of the following (or the equivalent) and indicating their interest to the Office of Undergraduate Admissions before the start of classes:

• Math: Minimum 500 math SAT, 21 math ACT, or 30 ALEKS

NOTE: There is a two-semester limit for remaining in allied health, biochemistry, biology, or chemistry interest. After two semesters, students must meet the requirements to declare a major in the section for Matriculated APU Students below, or select a major outside the Department of Biology and Chemistry.

Transfer Applicants

To qualify for a major in allied health, biology, biochemistry, or chemistry, transfer¹ applicants must submit evidence of all of the following to the Office of Undergraduate Admissions (http://www.apu.edu/admissions/undergraduate) before the start of classes. After this date, the requirements in the section Matriculated APU Students (below) must be met.

• Math: B- in MATH 110 College Algebra, 65 ALEKS score (http://www.apu.edu/lec/placement/math/using-aleks) or any of criteria 1-8 for waiving the GE Quantitative Literacy requirement.
• Science: B- or higher in college courses equivalent to BIOL 151 AND CHEM 151².

¹ Freshman transfer students can qualify for the major under freshman applicant requirements only if all college math/science grades are B- or better.
² For the chemistry major: college-level physics or a second semester of college-level chemistry may be substituted for biology.

Matriculated APU Students

To declare a major in allied health, biology, biochemistry, or chemistry, all current APU students (including current allied health/biochemistry/biology/chemistry interest and already-matriculated transfer students) must earn grades of B- or higher in biology, chemistry, math, and English courses taken at APU that meet graduation requirements in their intended major. The following are examples of courses that could be used to fulfill the requirement. These requirements cannot be met by transfer courses, high school courses, or test scores. (Exception: If all math courses or English courses required for graduation in the intended major have been successfully completed, no additional course in the respective category is required for admission to the major.)

¹ To declare a major in chemistry, current APU students must earn a grade of B- or higher in CHEM 151 or other chemistry lecture course taken at APU and required by the chemistry major.

<table>
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<tbody>
<tr>
<td>BIOL 151</td>
<td>General Biology I</td>
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<tr>
<td>CHEM 151</td>
<td>General Chemistry I</td>
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<tr>
<td>or other 4-unit APU BIOL or CHEM course required by the intended major</td>
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<table>
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<tr>
<th>Math</th>
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<tbody>
<tr>
<td>MATH 110</td>
<td>College Algebra²</td>
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or other APU MATH course required by the intended major such as
MATH 130  Introduction to Statistics  3
MATH 151  Applied Calculus I  3
MATH 161  Calculus I  5

2 A B- in MATH 110 or a 65 ALEKS score is a prerequisite for CHEM 151.

English
WRIT 110  Writing 1: The Art and Craft of Writing  3
ENGL 111  Studies in Literature  3

or other APU ENGL or WRIT course that meets a General Education requirement

Department Policies

The following are policies that apply to all students in courses offered by the department:

• A student must complete all prerequisites for a BIOC, BIOL, or CHEM course with a C- or better before taking the course (except as noted in the course description).
• Students with a total of three unsuccessful attempts (below C-) in any combination of BIOC, BIOL, and CHEM courses will be automatically dropped from subsequent enrollment in department courses.
• Any single BIOC, BIOL, or CHEM course may only be taken two times at APU.
• Students may not earn a chemistry minor if they are majoring in biochemistry, nor may they earn a biology minor if they are majoring in allied health or biochemistry.
• Students missing more than three labs in a course receive an automatic F in the course.
• Courses with labs in an online or correspondence format are not allowed to transfer as BIOC, BIOL, or CHEM courses.

Additional Requirements for Allied Health, Biology, Biochemistry, and Chemistry Majors

All of the following requirements must be met to continue as an allied health, biology, biochemistry, or chemistry major. Failure to maintain these requirements will result in a student being dropped from the major. Re-entry to the major is by petition only.

• A minimum cumulative GPA of 2.0 in all biology, chemistry, biochemistry, math, and physics courses required for the major must be maintained.
• A student must complete each BIOC, BIOL, or CHEM course with a C- or higher for the course to meet a degree requirement in the Department of Biology or Chemistry.
• Any single class within the major can only be taken two times at APU; students must change to a major outside the department after two unsuccessful attempts in a single required course.
• Only two courses total within the major can be repeated; students must change to a major outside the department after unsuccessful attempts in any three required classes.
• All majors are required to take BIOL 496 to meet their General Education Senior Seminar or Writing 3 requirement.
• While courses required of the major may be taken at other accredited institutions, subject to approval via a transfer inquiry form, both lecture and laboratory components must be taken at the same institution in the same semester.
• It is strongly recommended that freshmen in all biology majors (including biochemistry) take General Chemistry I (CHEM 151) and General Biology I (BIOL 151) the first year, and that chemistry majors start with General Chemistry I (CHEM 151) and Calculus I (MATH 161) the first year. Should math placement assessment require algebra of the student, then that class should be taken the first year and a five-year program may be indicated.
• BIOL 151 should be taken by allied health, biochemistry, or biology majors who receive AP biology credit. Many medical schools and graduate programs will not accept AP biology to meet requirements for admission. AP credit for BIOL 151 will only be given with approval of the chair of the Department of Biology and Chemistry.
• Students may take a maximum of 3 units total from BIOL 390, BIOL 391, BIOL 490, BIOL 497 or BIOL 498 for elective credit toward the B.S. in Allied Health or the B.S. in Biology (molecular or organismal emphasis).

The following courses may not be taken to meet upper-division elective requirements in any major in the department.

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<tr>
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<td>Humans and the Environment</td>
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<td>Gender Differences</td>
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<tr>
<td>BIOL 400</td>
<td>Science and Children</td>
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General Education Note
Any health education requirement is waived for allied health, biochemistry, and biology majors.

Majors
- Allied Health (http://catalog.apu.edu/undergraduate/liberal-arts-sciences/biology-chemistry/allied-health-major)
- Biochemistry (http://catalog.apu.edu/undergraduate/liberal-arts-sciences/biology-chemistry/biochemistry-major)
- Biology (http://catalog.apu.edu/undergraduate/liberal-arts-sciences/biology-chemistry/biology-major)
- Chemistry (http://catalog.apu.edu/undergraduate/liberal-arts-sciences/biology-chemistry/chemistry-major)

Minors
- Biology (http://catalog.apu.edu/undergraduate/liberal-arts-sciences/biology-chemistry/biology-minor)
- Chemistry (http://catalog.apu.edu/undergraduate/liberal-arts-sciences/biology-chemistry/chemistry-minor)

BIOC 360, Principles of Biochemistry, 4 Units
Lecture, 3 Hours; Lab, 4 Hours: Students 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. The course does not meet the requirements of the biochemistry major. Credit will not be given for both BIOC 360 and BIOC 380, nor for both BIOC 360 and BIOC 381.
Special Fee Applies
Prerequisite: CHEM 252 (C- or higher)

BIOC 380, Biochemistry I, 4 Units
Lecture, 3 hours; Lab, 4 hours: Students gain a systematic and theoretical study of the biochemical activities of living cells in this course. It is an introduction to the structure, properties, and metabolism of proteins, carbohydrates, lipids, and nucleic acids.
Special Fee Applies
Prerequisite: C- in CHEM 252

BIOC 381, Biochemistry II, 4 Units
Lecture, 3 hours; Lab, 4 hours: This course is a continuation of BIOC 380 Biochemistry I. Molecular lab techniques are emphasized.
Special Fee Applies
Prerequisite: C- in BIOC 380

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, Fundamentals of Biology, 4 Units
Lecture, 3 hours; Lab, 3 hours: This basic course covers the themes of cell biology, genetics, ecology, evolution, and human biology. It promotes an appreciation for the unification and interdependence of all life. Does not count toward biology major credit. Meets the General Education Requirement: Natural Science.
Special Fee Applies

BIOL 101H, Fundamentals of Biology - Honors, 4 Units
Lecture, 3 hours; Lab, 3 hours: This basic course covers the themes of cell biology, genetics, ecology, evolution, and human biology. It promotes an appreciation for the unification and interdependence of all life. This class must be taken concurrently with the corresponding lab. It is not applicable for biology majors. Meets the General Education Requirement: Natural Science.
Special Fee Applies
Prerequisite: To enroll in the course, must be a student admitted to the Honors Program and be considered a member in "active" status.

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
Lecture, 3 hours; Lab, 4 hours; Discussion/Quiz, 1 hour: Principles of cell structure and function, genetics, development, reproduction, and animal systems biology are covered in this introductory course. There is a laboratory emphasis on the investigative approach and experimental techniques of biology. Meets the General Education Requirement: Natural Science. Special Fee Applies
Prerequisite: B- in BIOL 101 or B in one year of high school biology along with completion or waiver of MATH 95 (for example by a 45 ALEKS)

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 220, General Microbiology, 4 Units
Lecture, 3 hours; Lab, 4 hours: This class is for students majoring in or planning to major in nursing. 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. Special Fee Applies
Prerequisite: C- in CHEM 112 or CHEM 123 and Department Consent

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
Lecture, 3 hours; Lab, 4 hours: This class is for students in applied health, biology, or biochemistry. It covers the fundamental principles and techniques of microbiology, with emphasis on the role of microorganisms in disease, immunity, and food production. Special Fee Applies
Prerequisite: Biology or Biochemistry major: C- in BIOL 152 and CHEM 151 (CHEM 151 may be taken concurrently with BIOL 240). Allied Health Major: C- in BIOL 151 and CHEM 151 (CHEM 151 may be taken concurrently with BIOL 240). All other majors: department permission.

BIOL 250, Human Anatomy, 4 Units
Lecture, 3 hours; Lab, 4 hours: This is an intensive course in human anatomy using the systemic approach. Lab exercises utilize human cadaver dissections. Special Fee Applies
Prerequisites: B- in BIOL 101, or C- in BIOL 151, or Pre-admitted Nursing status and B in one year of high school biology

BIOL 251, Human Physiology, 4 Units
Lecture, 3 hours; Lab, 4 hours: This course deals with how human organ systems function and maintain homeostasis. Laboratory exercises include biomedical instrumentation. Special Fee Applies
Prerequisite: C- in BIOL 250; and C- in CHEM 101, CHEM 123, or CHEM 151 or B in one year of high school chemistry

BIOL 280, Cell Biology, 4 Units
Lecture, 3 hours; Lab, 4 hours; Discussion/Quiz, 1 hour: This course covers a theoretical approach to cellular and molecular biology, including ultra structure, cytology, metabolism, and molecular genetics. Laboratory emphasis is given to electron microscopy, centrifugation, and DNA and protein electrophoresis. Special Fee Applies
Prerequisite: C- in BIOL 240 and CHEM 151
BIOL 300, Genetics, 4 Units
Lecture, 3 hours; Lab, 4 hours: Principles of heredity, including Mendelian, cytogenetics, population theory, human medical genetics and gene regulation, classical laboratory experimentation, and modern molecular biology techniques, are covered.
Special Fee Applies
Prerequisite: C- in BIOL 280

BIOL 320, Ecology, 4 Units
Lecture, 3 hours; Lab, 4 hours: 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. Meets the General Education Requirement: Writing 3: Writing in the Disciplines.
Special Fee Applies
Prerequisites: C- in BIOL 152 BIOL 280, and 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
Lecture, 3 hours; Lab, 4 hours: Students 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.
Special Fee Applies

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 study the human body. Upon completion, students will be able to identify major skeletal, muscular, nervous, and vascular structures, organs, and the relationships of these structures to each other in each body area. They will learn the flow of blood from the heart through vascular structures to organs and limbs, understand the structure and significance of the cervical, brachial, and lumbosacral plexuses, and be able to explain the actions of muscles based on origin and insertions. Students will gain skills in dissection and in collaboration with colleagues to dissect and present findings to the class. Finally, students will 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.
Special Fee Applies
Prerequisite: BIOL 151 and BIOL 280
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: BIOL 280 (C- or higher)

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.
Prerequisites: BIOL 101, BIOL 151, or BIOL 250

BIOL 395, Science Internship, 1-3 Units
This course gives students an opportunity to apply knowledge gained in the academic setting to the real world by allowing them to establish either paid or volunteer science-related internships with local business, organizations, etc. 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.
Prerequisite: C- or higher in BIOL 280 and CHEM 240 or CHEM 251; Jr. standing and Instructor's consent

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: BIOL 151, CHEM 152, UBBL 100 or UBBL 230, Junior Level Standing

BIOL 400, Science and Children, 4 Units
Lecture, 3 hours; Lab, 3 hours: This course is designed for liberal studies majors interested in obtaining a Multiple-Subject Teaching Credential. It assists the student in developing knowledge and skills in science content for teaching science concepts and processes emphasized in the California State Science Framework, K-6. Does not count toward biology major credit.
Special Fee Applies

BIOL 410, Molecular Biology, 4 Units
Lecture, 3 hours; Lab, 4 hours: This course covers the traditional molecular biology curriculum which includes transcription, translation, and gene expression in both 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.
Prerequisite: C- in BIOL 280

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
Lecture/Lab/Discussion, 3 hours: 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 445, Environmental Internship, 2 Units
Lab/Discussion, 6 hours: Senior students are given the opportunity to apply academic knowledge to real-world situations through time spent working with various environmentally oriented organizations and businesses. This class must be taken concurrently with the corresponding lab.
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's 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 or corequisite: BIOL 280 or BIOL 454

BIOL 465, Practicum and Topics in Allied Health, 4 Units
Lecture/Discussion, 3 hours; Lab, 4 hours: This course deals with diagnosis strategies, prevention, and rehabilitation programs integral to the field of physical therapy and sports physiology. Study of research literature is emphasized to facilitate the student's development of knowledge, aptitudes, and skills within the allied health field. The clinical laboratory component emphasizes current instrumentation and practice. Meets the General Education Requirement: Writing 3: Writing in the Disciplines.
Special Fee Applies
Prerequisite: C- in BIOL 280; C- in BIOL 250 or BIOL 336; BIOL 251 or BIOL 350 (may be taken concurrently); and PHYC 151 or PHYC 161 (may be taken concurrently).

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. The course is intended for students with upper-division standing and acceptance to a premedical program. This course may be repeated for 2 units of credit.

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, 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, or CHEM 240

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 one unit may be used to fulfill preparatory readings requirement. An independent study fee is assessed for each enrollment. May be repeated subject to department policies.
Prerequisite: Junior or Senior Standing
**BIOL 498H, Directed Research- Honors, 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 one unit may be used to fulfill preparatory readings requirement. An independent study fee is assessed for each enrollment. May be repeated subject to department policies.

**Prerequisite:** Honors program, Junior or Senior Standing

**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, Introduction to Chemistry, 4 Units**

Lecture, 3 hours; Lab, 3 hours: This elementary course is designed for the student with no previous high school or college chemistry. Prepares the student for CHEM 123 or CHEM 151. *Meets the General Education Requirement: Natural Science.*

**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 covers an overview of general, organic, and biological chemistry topics with a particular 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. The biochemistry topics cover chemical reactions and physiological significance of cellular macromolecules including proteins, enzymes, nucleic acids, and metabolism. *Meets the General Education Requirement: Natural Science.*

**Prerequisite:** C- in CHEM 101 or Pre-admitted Nursing status and B in one year of high school chemistry

**CHEM 151, General Chemistry I, 4 Units**

Lecture, 3 hours; Lab, 4 hours. This is a foundational course for science majors and the first of 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. *Meets the General Education Requirement: Natural Science.*

**Special Fee Applies**

**Prerequisite:** B- or higher in CHEM 101 or B or higher in one year of high school chemistry. B- or higher in MATH 110 or equivalent.

**CHEM 151H, General Chemistry I - Honors, 4 Units**

Lecture, 3 hours; Lab, 4 hours. This is a foundational course for science majors and the first of 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. *Meets the General Education Requirement: Natural Science.*

**Special Fee Applies**

**Prerequisites:** One year of high school chemistry or CHEM 101; MATH 110 or equivalent. Must also be a student admitted to the Honors Program and be considered a member in "active" status.

**CHEM 152, General Chemistry II, 4 Units**

Lecture, 3 hours; Lab, 4 hours. This is a foundational course for science majors and the first 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.

**Special Fee Applies**

**Prerequisite:** C- in CHEM 151

**CHEM 152H, General Chemistry II - Honors, 4 Units**

Lecture, 3 hours; Lab, 3 hours; Discussion, 2 hours: This is a continuation of CHEM 151 General Chemistry begun in the fall. Topics covered include solution chemistry, chemical kinetics, equilibrium, acid-base theory, thermodynamics, and electrochemistry. This class must be taken concurrently with the corresponding lab.

**Special Fee Applies**

**Prerequisite:** CHEM 151. Must also be a student admitted to the Honors Program and be considered a member in "active" status.

**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, 4 Units  
This is a general course in bonding theory, structure analysis, isomers, nomenclature, physical properties, functional groups, fundamental reaction mechanisms, stereochemistry, spectroscopy, and synthesis of hydrocarbons. The laboratory course CHEM 261 must be taken concurrently with CHEM 251.  
Prerequisite: C or better in CHEM 152; Must be taken concurrently with CHEM 261.

CHEM 252, Organic Chemistry - Theory II, 4 Units  
This is a general course in the spectroscopy, physical properties, reaction mechanisms, thermodynamics, kinetics, aromaticity, and fundamental reaction mechanisms of hydrocarbons, carbonyl compounds, and biological macromolecules. The laboratory course CHEM 262 must be taken concurrently with CHEM 252.  
Prerequisites: 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  
Techniques of determining chemical and physical properties and synthesis of organic compounds are the focus of laboratory study.  
Special Fee Applies  
Corequisite: CHEM252

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 320, Instrumental Analysis - Theory, 3 Units  
The theory and operation of modern analytical equipment are covered in this course, including electrochemical methods; UV-visible, infrared, and flame emission spectrophotometry; chromatographic methods; and others. Meets the General Education Requirement: Writing 3 if taken with CHEM 330.  
Prerequisite: C- in CHEM 152

CHEM 330, Instrumental Analysis - Lab, 1 Unit  
In this laboratory course, students analyze materials by the methods studied in CHEM 320. Meets the General Education Requirement: Writing 3: Writing in the Disciplines.  
Prerequisite: CHEM 320

CHEM 390, Physical Biochemistry, 3 Units  
The physical and chemical theories of thermodynamics, equilibria, kinetics, and spectroscopy are examined in the context of the chemical and physical properties of a living cell.  
Prerequisite: C- in BIOC 360 or BIOC 380

CHEM 401, Physical Chemistry I, 3 Units  
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 or higher in CHEM 152 and C- or higher in MATH 161

CHEM 402, Physical Chemistry II, 3 Units  
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.  
Prerequisites: C- in CHEM 401 and C- in MATH 162; 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. This foundation is then used to explore advance topics involving crystalline compounds, coordination compounds, and organometallic compounds. Topics include bonding, spectroscopy, and kinetics.
Prerequisite: C- in CHEM 152

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: upper-level class 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, 1-4 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 one unit may be used to fulfill preparatory readings requirement. An independent study fee is assessed for each enrollment in this class. May be repeated subject to department policies listed above.
Prerequisite: Junior or Senior Standing

CHEM 498H, Directed Research- Honors, 1-4 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 one unit may be used to fulfill preparatory readings requirement. An independent study fee is assessed for each enrollment in this class. May be repeated subject to department policies.
Prerequisite: To enroll in the course, must be a student admitted to the Honors Program and be considered a member in "active" status.

Faculty

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