

# CHEMISTRY AND BIOCHEMISTRY

Robin McRae, Chair  
 department page (<https://www.ewu.edu/cstem/programs/chemistry>)  
 226 Science Bldg.  
 509.359.2798

---

## Faculty

Peter T. Bilous, Nicholas E. Burgis, Jeffrey A. Corkill, Yao A. Houndonougbo, Janelle E. Jenkins, Ashley Lamm, Daniel E. Love, Jamie L. Manson, Anthony Masiello, Amber McConnell, Robin P. McRae, Jeffrey A. Rahn, Kenneth W. Raymond, Wes E. Steiner.

---

## Undergraduate Degrees

### Bachelor of Arts (BA)

- Chemistry/Biochemistry Major with General Option (<http://catalog.ewu.edu/science-technology-engineering-mathematics/chemistry-biochemistry/chemistry-biochemistry-general-option-ba>)

### Bachelor of Arts in Education (BAE)

- Chemistry/Biochemistry/Secondary Major (<http://catalog.ewu.edu/science-technology-engineering-mathematics/chemistry-biochemistry/chemistry-biochemistry-secondary-bae>)

### Bachelor of Science (BS)

- Chemistry/Biochemistry Major with Biochemistry Option (<http://catalog.ewu.edu/science-technology-engineering-mathematics/chemistry-biochemistry/chemistry-biochemistry-option-bs>)
- Chemistry/Biochemistry Major with Forensic Science Option (<http://catalog.ewu.edu/science-technology-engineering-mathematics/chemistry-biochemistry/chemistry-biochemistry-forensic-science-option-bs>)
- Chemistry/Biochemistry Major with Pre-Med/Pre-Dent/Pre-Vet Option (<http://catalog.ewu.edu/science-technology-engineering-mathematics/chemistry-biochemistry/chemistry-biochemistry-premed-predent-prevet-option-bs>)
- Chemistry/Biochemistry Major with Professional Option (<http://catalog.ewu.edu/science-technology-engineering-mathematics/chemistry-biochemistry/chemistry-biochemistry-professional-option-bs>)
- Chemistry/Biochemistry Major with Standard Option (<http://catalog.ewu.edu/science-technology-engineering-mathematics/chemistry-biochemistry/chemistry-biochemistry-standard-option-bs>)

### Undergraduate Minors

- Chemistry/Biochemistry (<http://catalog.ewu.edu/science-technology-engineering-mathematics/chemistry-biochemistry/chemistry-biochemistry-minor>)
- Chemistry/Biochemistry Secondary (<http://catalog.ewu.edu/science-technology-engineering-mathematics/chemistry-biochemistry/chemistry-biochemistry-secondary-minor>)

- Environmental Chemistry (<http://catalog.ewu.edu/science-technology-engineering-mathematics/chemistry-biochemistry/environmental-chemistry-minor>)

### Teacher Certification/Add-on Endorsements

- General Science/Add-on Endorsement (<http://catalog.ewu.edu/science-technology-engineering-mathematics/chemistry-biochemistry/general-science-add-on-endorsement>)

### Pre-Professional Program Requirements

- Pre-Dentistry and Pre-Medicine (<http://catalog.ewu.edu/science-technology-engineering-mathematics/pre-dentistry-pre-medicine>)
- Pre-Pharmacy (<http://catalog.ewu.edu/science-technology-engineering-mathematics/pre-pharmacy>)
- Pre-Veterinary Medicine (<http://catalog.ewu.edu/science-technology-engineering-mathematics/pre-veterinary-medicine>)

---

## Undergraduate Programs

Chemistry occupies a unique position within the modern sciences. Ultimately, most of the phenomena in the biological, geological, physical, environmental and medical sciences can be expressed in terms of the chemical and physical behavior of atoms and molecules. Because of chemistry's key role, majors in chemistry and biochemistry are well prepared to pursue careers in a wide variety of disciplines.

The department offers programs leading to the Bachelor of Science and the Bachelor of Arts. These programs prepare students for careers in chemistry, biochemistry, biotechnology, medicine and related fields, forensic science, environmental science and education. The department's professional BS option is approved by the American Chemical Society. BS degrees are recommended for students planning professional careers in chemistry or related areas, while BA degrees are recommended for students with other career goals.

Students majoring in chemistry have the opportunity to engage in research projects with department faculty and to gain experience with modern instrumental techniques including gas and liquid chromatography; ultra-violet, visible, infra-red, Raman, fluorescence, and atomic absorption spectrophotometry; nuclear magnetic resonance; and x-ray diffraction. Upon graduation, our students are knowledgeable, experienced and independent laboratory workers.

**General Admissions Requirements for Chemistry and Biochemistry:** students considering a major in Chemistry and Biochemistry should complete a high school chemistry course and mathematics courses through precalculus.

**General Admissions Requirements for Transfer Students:** students transferring from other institutions are urged to consult with the department chair to plan their Eastern program of study.

**Admissions Requirements for Chemistry Majors:** Chemistry courses must be taken in proper sequence and with certain prerequisites satisfied. To graduate within four years, chemistry majors must take CHEM 151, CHEM 152 and CHEM 153 during their freshman year. The physics and mathematics supporting courses must also be started without delay.

Students should complete the required calculus and physics courses prior to their junior year in order to have prerequisites for upper division chemistry courses. Completion of a computer programming course is recommended before taking CHEM 431.

**Academic Policy:** due to the cumulative nature of chemistry courses, the department strongly recommends that students receive a grade  $\geq 2.0$  in all prerequisite chemistry courses.

Information Regarding Pre-Pharmacy School Courses: students interested in this pre-professional program should contact a departmental advisor regarding the curriculum, application procedures and professional aptitude examinations.

### Graduate Program

The Department of Chemistry does not offer a graduate degree program but does offer graduate-level coursework.

**Required courses in the following programs of study may have prerequisites. Reference the course description section for clarification**

## Chemistry Courses

### CHEM 100. INTRODUCTION TO CHEMISTRY. 5 Credits.

This course prepares those who have not had a satisfactory background in high school chemistry to take CHEM 151 or CHEM 161. Topics include the scientific method, SI and metric systems, unit conversions, atomic structure, periodic table, bonding, and stoichiometry. Laboratory work is included.

### CHEM 121. CHEMISTRY AND ITS ROLE IN SOCIETY. 5 Credits.

**Satisfies:** GEGR for natural sciences, chemistry.

Basic chemical principles are used to examine some of the chemistry that most directly impacts individuals and society on a day-to-day basis. The course is designed to develop in students an appreciation for the chemical basis of their bodies and their environment. Emphasis is placed on the dynamic nature of the field of chemistry and efforts are made to dispel many of the common misconceptions that nonscientists often have about chemistry and other natural sciences. Laboratory work is included.

### CHEM 140. CRIMINALISTICS AND FORENSIC CHEMISTRY. 5 Credits.

**Pre-requisites:** two semesters of high school science or the equivalent are strongly recommended.

This course provides an overview of forensic science and criminalistics including history and the modern role of forensic science in the judicial system. Topics covered include DNA typing, trace evidence analysis, firearms and tool marks, and impression evidence. Laboratory work is included. Labs will focus on current forensic techniques.

### CHEM 151. GENERAL CHEMISTRY. 5 Credits.

**Pre-requisites:**  $\geq 2.0$  in MATH 141 or concurrent enrollment;  $\geq 2.0$  in CHEM 100 or  $\geq 2.0$  in CHEM 161 or one year of high school chemistry.

**Satisfies:** the completion of CHEM 151 satisfies a GEGR for natural sciences, chemistry.

Topics will include units, uncertainty in measurement, ionic nomenclature, structure of matter, chemical reactions and stoichiometry, thermochemistry, periodic table and chemical bonding. Quantitative and qualitative laboratory work is included.

### CHEM 152. GENERAL CHEMISTRY. 5 Credits.

**Pre-requisites:** CHEM 151;  $\geq 2.0$  in MATH 141.

**Satisfies:** the completion of CHEM 151 and CHEM 152 satisfies a second GEGR for natural sciences, chemistry.

Topics include properties of gases, liquids and solids; intermolecular forces; properties of solutions; chemical equilibrium and acid base equilibria. Laboratory work includes quantitative and qualitative analysis.

### CHEM 153. GENERAL CHEMISTRY. 5 Credits.

**Pre-requisites:** CHEM 152.

Topics include kinetics, thermodynamics, electrochemistry, nuclear and/or chemistry of nonmetals, and transition metals and coordination chemistry. Laboratory work includes quantitative and qualitative analysis.

### CHEM 161. GENERAL CHEMISTRY FOR THE HEALTH SCIENCES. 5 Credits.

**Credits.**

**Pre-requisites:** Concurrent enrollment in or completion of MTHD 104 or MATH 107 or MATH 141 or equivalent. A high school chemistry course or CHEM 100 is highly recommended.

**Satisfies:** a GEGR for natural sciences, chemistry.

Course includes a survey of inorganic chemistry for pre-nursing, pre-dental hygiene and allied health science students. Topics include atomic structure, the periodic table, stoichiometry, solutions, equilibrium, acids and bases. Laboratory work is included. A placement exam will be given during the first week of classes.

### CHEM 162. ORGANIC CHEMISTRY FOR THE HEALTH SCIENCES. 5 Credits.

**Credits.**

**Pre-requisites:** CHEM 161.

**Satisfies:** a GEGR for natural sciences, chemistry.

The course is a survey of organic chemistry for pre-nursing, pre-dental hygiene and allied health science students. Topics include naming, properties and reactions of hydrocarbons, alcohols, ethers, amines and carbonyl compounds. Laboratory work is included.

### CHEM 163. BIOCHEMISTRY FOR THE HEALTH SCIENCES. 5 Credits.

**Pre-requisites:** CHEM 162.

This course is a survey of biochemistry for pre-nursing, pre-dental hygiene, and allied health science students. Topics include amino acids, proteins, enzymes, lipids, carbohydrates, nucleic acids, biotechnology, and metabolic pathways. Laboratory work is included.

### CHEM 196. EXPERIMENTAL COURSE. 1-5 Credits.

### CHEM 199. DIRECTED STUDY. 1-5 Credits.

### CHEM 297. WORKSHOP, SHORT COURSE, CONFERENCE, SEMINAR. 1-10 Credits.

### CHEM 304. QUANTITATIVE ANALYSIS. 6 Credits.

**Pre-requisites:** CHEM 153.

Theory and practice of gravimetric and volumetric analysis with an introduction to some elements of instrumental analysis.

### CHEM 316. ENVIRONMENTAL CHEMISTRY. 5 Credits.

**Pre-requisites:** CHEM 151, CHEM 152, CHEM 153 or CHEM 161, CHEM 162, CHEM 163.

The course is an introduction to environmental chemistry covering both fundamental chemical principles and societal implications. Emphasis will be placed on local issues such as Hanford Nuclear Reservation and the environmental impact of mining. Laboratory work is included.

### CHEM 319. MODERN INORGANIC CHEMISTRY. 4 Credits.

**Pre-requisites:** CHEM 153.

This course covers periodicity, group trends, structure-reactivity relationships of the elements and chemical reactions.

### CHEM 338. DISCOVERING WOMEN IN SCIENCE. 1 Credit.

**Cross-listed:** BIOL 338, GEOL 338, HIST 338, PHYS 338, PSYC 338, WMST 338.

The course uses several scientific themes to rediscover from the past and find in contemporary research, the women who have made significant contributions to science.

**CHEM 350. PRINCIPLES OF PHARMACOLOGY. 2 Credits.****Pre-requisites:** CHEM 163, BIOL 233 or equivalent.

The course is primarily intended for the athletic training or other allied health science students. The course presents a review of the actions of over-the-counter drugs and an introduction to the principles of pharmacological action from the integrated foundations of physiology, organic chemistry, and biochemistry.

**CHEM 351. ORGANIC CHEMISTRY. 4 Credits.****Pre-requisites:** CHEM 153.

An integrated study of fundamental organic chemistry for Chemistry majors and students planning on careers in medicine, dentistry, pharmacology, engineering, or related fields. Emphasizes nomenclature, bonding, reactivity, stereochemistry, synthetic methods, reaction mechanisms, physical properties, and spectrometric identification of the principal classes of organic compounds, including biochemical examples.

**CHEM 352. ORGANIC CHEMISTRY. 4 Credits.****Pre-requisites:** CHEM 351.

An integrated study of fundamental organic chemistry for Chemistry majors and students planning on careers in medicine, dentistry, pharmacology, engineering, or related fields. Emphasizes nomenclature, bonding, reactivity, stereochemistry, synthetic methods, reaction mechanisms, physical properties, and spectrometric identification of the principal classes of organic compounds, including biochemical examples.

**CHEM 353. ORGANIC CHEMISTRY. 3 Credits.****Pre-requisites:** CHEM 352.

A comprehensive study of the chemistry of polyfunctional carbon compounds.

**CHEM 357. NEUROPHARMACOLOGY. 2 Credits.****Pre-requisites:** CHEM 163 and BIOL 233 or equivalent, or permission of the instructor.

The course is primarily intended for pre-medical, pre-dental, pre-pharmacy or other science students. Topics covered include CNS neurotransmitters and their pharmacology, various biochemical hypotheses for neurological disorders, and the pharmacology of a variety of psychoactive drug classes of use or abuse.

**CHEM 371. PRE-MEDICAL, DENTAL, VETERINARY AND PHARMACY PREPARATION. 1-2 Credits.****Pre-requisites:** CHEM 352.

Prepare students for their application to medical, dental, veterinary or pharmacy school and for professional activities.

**CHEM 372. ORGANIC CHEM LABORATORY I. 3 Credits.****Pre-requisites:** CHEM 351.

This course is an introduction to the elementary techniques of the organic laboratory; including synthesis, application of chromatography, and spectrometry. This is a laboratory course.

**CHEM 373. ORGANIC CHEM LABORATORY II. 3 Credits.****Pre-requisites:** CHEM 352 and CHEM 372.

This course emphasizes spectrometry, synthesis, structure determination and advanced techniques in isolation, purification and analysis. This is a laboratory course.

**CHEM 390. CHEMICAL METHODS IN SECONDARY SCHOOL. 2 Credits.****Pre-requisites:** CHEM 153 and concurrent enrollment in SCED 390, or permission of the instructor.

This course is for chemistry majors planning to teach in the secondary schools. It includes organization of lesson materials and techniques, and evaluation methods.

**CHEM 395. INTERNSHIP. 1-10 Credits.****Pre-requisites:** permission of the instructor, department chair and college dean.**CHEM 396. EXPERIMENTAL COURSE. 1-6 Credits.****CHEM 397. WORKSHOP, SHORT COURSE, CONFERENCE, SEMINAR. 1-10 Credits.****CHEM 399. DIRECTED STUDY. 1-10 Credits.****Pre-requisites:** permission of the instructor, department chair and college dean.

Library or laboratory study of a chemical problem.

**CHEM 416. ADVANCED ENVIRONMENTAL CHEMISTRY. 3 Credits.****Pre-requisites:** CHEM 304, CHEM 316 and CHEM 352 (or concurrent), or permission of the instructor.

This course includes a detailed study of atmospheric, soil, water, and waste water chemistry. Aspects of environmental/analytical chemistry will be introduced. Laboratory work will cover aspects of sampling, instrumental and automated analysis, and regulatory requirements. Students will concentrate in the area of their particular interest, leading to a comprehensive written research report and presentation. Laboratory work is included.

**CHEM 418. MODERN ANALYTICAL CHEMISTRY. 5 Credits.****Pre-requisites:** CHEM 304.

Principles of recently developed methods of analytical chemistry.

**CHEM 419. ADVANCED INORGANIC CHEMISTRY. 5 Credits.****Cross-listed:** CHEM 490.**Pre-requisites:** CHEM 319 and CHEM 422.**Satisfies:** senior capstone university graduation requirement.

The course covers ionic, covalent and metallic bonding, complexes, symmetry, acids and bases, molecular structure, and thermodynamics of inorganic reactions. It also introduces mechanisms and organometallic chemistry of selected groups of elements.

**CHEM 420. INSTRUMENTAL ANALYSIS. 5 Credits.****Pre-requisites:** CHEM 422 or permission of the instructor.

This course introduces instrumental methods of analysis. This is a laboratory course.

**CHEM 421. PHYSICAL CHEMISTRY. 4 Credits.****Notes:** for CHEM 421, completion of a computer programming course is strongly recommended.**Pre-requisites:** CHEM 304, PHYS 133 or PHYS 153, MATH 162.

Classical and statistical thermodynamics, electrochemistry, quantum theory, kinetics, symmetry, spectroscopic, and diffraction methods of structure determination.

**CHEM 422. PHYSICAL CHEMISTRY. 3 Credits.****Pre-requisites:** CHEM 421.

Classical and statistical thermodynamics, electrochemistry, quantum theory, kinetics, symmetry, spectroscopic, and diffraction methods of structure determination.

**CHEM 423. PHYSICAL CHEMISTRY. 3 Credits.****Pre-requisites:** CHEM 422.

Classical and statistical thermodynamics, electrochemistry, quantum theory, kinetics, symmetry, spectroscopic, and diffraction methods of structure determination.

**CHEM 431. PHYSICAL CHEMISTRY LABORATORY. 1 Credit.**

**Notes:** for CHEM 421, completion of a computer programming course is strongly recommended.

**Pre-requisites:** concurrent enrollment in CHEM 421.

(See your Chemistry/Biochemistry advisor.) These courses cover data treatment, current physicochemical techniques, computer applications to chemical systems. These are laboratory courses

**CHEM 432. PHYSICAL CHEMISTRY LABORATORY. 2 Credits.**

**Pre-requisites:** concurrent enrollment in CHEM 422.

These courses cover data treatment, current physicochemical techniques, computer applications to chemical systems. These are laboratory courses

**CHEM 433. PHYSICAL CHEMISTRY LABORATORY. 2 Credits.**

**Pre-requisites:** concurrent enrollment in CHEM 423.

These courses cover data treatment, current physicochemical techniques, computer applications to chemical systems. These are laboratory courses

**CHEM 440. ADVANCED PHYSICAL CHEMISTRY. 4 Credits.**

**Pre-requisites:** concurrent enrollment or completion of CHEM 423.

Further development of principles underlying molecular symmetry, group theory and quantum chemistry, with applications to molecular orbitals and molecular spectroscopy. Introduction to semi-empirical calculations of electronic properties of molecules and analysis of spectroscopic data.

**CHEM 445. TOPICS IN FORENSIC CHEMISTRY. 5 Credits.**

**Pre-requisites:** acceptance into BS forensic option.

This course includes a detailed investigation of current topics in forensic chemistry and forensic science. Topics will include courtroom testimony, laboratory accreditation, and analyst certification. Laboratory work is included.

**CHEM 450. ADVANCED FORENSIC CHEMISTRY. 5 Credits.**

**Pre-requisites:** acceptance into BS forensic option.

This course includes a detailed examination of the techniques of forensic chemistry including organic, inorganic, and instrumental analysis. Topics include gunshot residue, drugs and toxicology, paint, arson and explosives, and biochemical methods such as electrophoresis. Advanced topics in crime scene procedures, chain-of-custody, and quality assurance, will be discussed. Laboratory work is included.

**CHEM 454. CLINICAL CHEMISTRY. 4 Credits.**

**Pre-requisites:** CHEM 304 and CHEM 352.

This course is an introduction to both the methodologies involved in the analyses of diagnostically important compounds in clinical chemistry, (i.e., spectroscopy, ion-selective electrodes, enzymology, immunoassays and liquid chromatography), and the biochemical and physiological correlations of normal and disease states. This is intended for medical technology and chemistry majors and students with interests in medical sciences.

**CHEM 465. ADVANCED ORGANIC CHEMISTRY. 2 Credits.**

**Pre-requisites:** CHEM 353 and CHEM 421 or permission of the instructor.

This course is an in-depth study of the mechanisms of organic reactions in vitro and in vivo, coupled to a detailed investigation of current techniques in structural analysis of organic compounds.

**CHEM 466. STRUCTURAL ANALYTICAL TECHNIQUES IN ORGANIC CHEMISTRY. 2 Credits.**

**Pre-requisites:** CHEM 353 and CHEM 421, or permission of the instructor.

This course is an in-depth study of modern analytical techniques used in the structural analysis of organic compounds. This course will comprise both theory and practical experience with the instruments. Topics covered include UV, IR, NMR, mass spectrometry, and chromatography. This is a laboratory course with lecture included.

**CHEM 480. BIOCHEMISTRY. 5 Credits.**

**Notes:** For the Biochemistry Option only. See your Chemistry/Biochemistry advisor.

**Pre-requisites:** CHEM 352, concurrent enrollment or completion of BIOL 310 is suggested, CHEM 483 should be taken concurrently.

This course covers elements of biochemistry, including the structure and function of the major classes of proteins, nucleic acids, carbohydrates and lipids.

**CHEM 481. INTERMEDIARY METABOLISM. 5 Credits.**

**Pre-requisites:** CHEM 480.

Biosynthesis and metabolism of nucleotides, carbohydrates, lipids, amino acids, and steroids; regulation and integration of biochemical pathways.

**CHEM 482. INTEGRATED TOPICS IN BIOCHEMISTRY AND BIOPHYSICS. 3 Credits.**

**Pre-requisites:** CHEM 480.

Explores energy pathways, signal transduction pathways and genetic information pathways in living organisms. Provides a chemical perspective of the key principles of bioenergetics and membrane transport. Specific topics, discussed at a molecular level, are selected from, but not limited to, the following: electron transport, proton pumping, and ATP production in mitochondria and chloroplasts; hormone induced signal transduction; RNA synthesis and processing, and protein synthesis and processing.

**CHEM 483. BIOCHEMISTRY LABORATORY. 2 Credits.**

**Pre-requisites:** concurrent enrollment or completion of CHEM 480.

Experiments include basic analytical and separatory techniques applied to problems in nucleotide identification, lipid turnover, photosynthesis, enzyme kinetics and cell fractionation.

**CHEM 484. BIOCHEMISTRY LABORATORY. 2 Credits.**

**Pre-requisites:** concurrent enrollment or completion of CHEM 480.

Experiments include basic analytical and separatory techniques applied to problems in nucleotide identification, lipid turnover, photosynthesis, enzyme kinetics, and cell fractionation.

**CHEM 490. SENIOR CAPSTONE. 5 Credits.**

**Cross-listed:** CHEM 419.

**Pre-requisites:** CHEM 319 and CHEM 422.

**Satisfies:** senior capstone university graduation requirement.

The course covers ionic, covalent and metallic bonding, complexes, symmetry, acids and bases, molecular structure, and thermodynamics of inorganic reactions. It also introduces mechanisms and organometallic chemistry of selected groups of elements.

**CHEM 491. SENIOR THESIS. 4-6 Credits.**

**Pre-requisites:** senior standing.

**Satisfies:** senior capstone university graduation requirement.

Directed research in your area of chemistry leading to an oral presentation and written report. See your advisor for further information.

**CHEM 495. INTERNSHIP. 1-10 Credits.**

**Pre-requisites:** permission of the instructor, department chair and college dean.

Supervised chemistry-related experiences with a professional or business organization.

**CHEM 496. EXPERIMENTAL COURSE. 1-15 Credits.**

**CHEM 497. WORKSHOP, SHORT COURSE, CONFERENCE, SEMINAR. 1-10 Credits.**

**CHEM 498. SEMINAR. 1-2 Credits.**

**Pre-requisites:** permission of the instructor.

Oral presentation of a chemical topic.

**CHEM 499. DIRECTED STUDY. 1-10 Credits.**

**Pre-requisites:** permission of the instructor, department chair and college dean.

Research on a chemical problem.

**CHEM 539. SPECIAL STUDIES. 2-6 Credits.**

**CHEM 597. WORKSHOP, SHORT COURSE, CONFERENCE, SEMINAR. 1-15 Credits.**

**CHEM 599. INDEPENDENT STUDY. 2-6 Credits.**

**Pre-requisites:** permission of the instructor, department chair and college dean.