Bennett Department of Chemistry

Degrees Offered

- Bachelor of Arts
- Bachelor of Science

Nature of the Program

The Bennett Department of Chemistry offers the bachelor of science with a major in chemistry and the bachelor of arts with a major in chemistry. These programs are configured to meet the needs of all students who have an interest in the broad field of chemistry.

The Department of Chemistry is located in Clark Hall, a state-of-the-art teaching facility for chemistry. Clark Hall offers many new instruments, numerous safety features, excellent ventilation and ample hoods, and complete accessibility for the physically handicapped. The department also has modern research facilities in the adjacent Chemistry Research Laboratory building where advanced undergraduates may participate in research projects.

The bachelor of science with a major in chemistry is approved by the American Chemical Society. This program is for students who desire to qualify for professional positions in industrial and governmental laboratories as well as those who plan to do graduate work in chemistry or allied areas in preparation for research careers in industry or academia.

The bachelor of arts with a major in chemistry is for students who pursue careers requiring a good background in the basic principles of chemistry. Areas such as medicine, dentistry, or other health-related sciences; secondary school teaching; chemical laboratory technical work; law; or business may be pursued with a proper choice of electives.

The two programs are similar during the first two years. Students in the B.S. program should complete the calculus requirement as soon as possible as a prerequisite for both the physics and physical chemistry sequences. The two degree programs differ primarily in the chemistry requirements. The B.S. program requires more upper-level chemistry courses than the B.A. program.

Students who earn a degree in the Eberly College of Arts and Sciences must complete the University requirements, the College requirements for their specific degree program, and their major requirements.

Chemistry Scholarships

In addition to financial aid offered by the University, the department maintains seven scholarships specifically for chemistry majors. The John A. Moore Trust Scholarships, the Charles L. Lazzell Scholarship, the Carpenter Family Scholarship, the Robert L. and Patricia Miller Stultz Chemistry Scholarship, the Herbert and Hannah Seigel Chemistry Scholarship, the Willard W. Hodge Scholarship, the Morrissey-Ropp Chemistry Scholarships, the William R. and Phylis T. Moore Organic Chemistry Scholarship, the Joseph T. Green Memorial Scholarship, and the Bud and Patty Blizzard Scholarships are awarded to students in either the B.S. or B.A. programs with records of outstanding achievement and demonstrated financial need. Several of these scholarships are restricted to West Virginia residents. Scholarship recipients are expected to remain as chemistry majors and to maintain a 3.0 average in their degree programs in order to be eligible for continued support.

Minors

All students have the possibility of earning one or more minors; follow the link for a list of all available minors and their requirements (http://catalog.wvu.edu/undergraduate/minors/). Please note that students may not earn a minor in their major field.

Certificate of Global Engagement

Students in the Eberly College, regardless of their major, can earn a Certificate of Global Engagement. Completion of the Certificate demonstrates the student's knowledge of diverse cultures, as well as the ability to communicate and interact effectively with people of different cultural backgrounds. Students will be required to apply their knowledge of contemporary issues and global social contexts to their coursework and their broader citizenship. For details regarding Certificate requirements, please visit the Eberly College page (http://catalog.wvu.edu/undergraduate/eberlycollegeofartsandsciences/#otherdegreeextern).

FACULTY

CHAIR

- Gregory Dudley - Ph.D. (M.I.T.)
  Synthetic organic chemistry
PROFESSORS

• Terry Gullion - Ph.D. (College of William & Mary)  
  Physical chemistry, Solid State NMR, Biological Materials, Polymers
• Lisa Holland - Ph.D. (University of North Carolina-Chapel Hill)  
  Micro-separations, High throughput drug screening
• Glen Jackson - Ph.D. (West Virginia University)  
  Mass spectrometry, Forensic science
• Fred L. King - Ph.D. (University of Virginia)  
  Analytical chemistry, Mass spectrometry, Trace elements, Gas-phase chemistry
• Kenneth Showalter - Ph.D. (University of Colorado)  
  Bennett Distinguished Professor, Physical chemistry, Chemical kinetics, Multi-stability and oscillating systems
• Bjorn Soderberg - Ph.D. (Royal Institute of Technology, Sweden)  
  Organic synthesis using transition metals
• Kung Wang - Ph.D. (Purdue University)  
  Eberly Distinguished Professor of Chemistry, Organic chemistry, stereoselective synthesis

ASSOCIATE PROFESSORS

• Erin Battin - Ph.D. (Clemson University)  
  Bioinorganic Chemistry
• Fabien Goulay - Ph.D. (Université de Rennes)  
  Physical chemistry, Laser spectroscopy
• Jessica Hoover - Ph.D. University of Washington  
  Organometallic chemistry, Catalysis
• Justin Legleiter - Ph.D. (Carnegie Mellon University)  
  Biophysical chemistry, Atomic force microscopy
• Brian Mertz - Ph.D. Iowa State University  
  Computational biophysics and chemistry
• Carsten Milsman - Ph. D. University of Bochum  
  Transition metal catalysis, organometallic chemistry
• Joshua Osbourn - Ph.D. (University of Pittsburgh)  
  Organic chemistry
• Brian Popp - Ph.D. University of wisconsin - Madison  
  Organic and organometallic chemistry, Catalysis
• Betsy Ratcliff - Ph.D. (University of Binghamton - SUNY)  
  Physical chemistry
• Michelle Richards-Babb - Ph.D. (Lehigh University)  
  Chemical education
• Stephen Valentine - Ph.D. (Indiana University)  
  Mass spectrometric analysis of biomolecules
• Mingming Xu - Ph.D. (Ohio University)  
  Analytical chemistry

ASSISTANT PROFESSORS

• Brian Dolinar - Ph.D. University of Wisconsin - Madison  
  Synthetic Inorganic Chemistry, Magnetoochemistry, Physical Inorganic Chemistry, Computational Chemistry
• Melissa Gayton Ely - Ph.D. (West Virginia University)  
  Analytical chemistry
• Margaret Hilton - Ph.D. University of Utah
• Peng Li - Ph.D. (Texas Technical University)  
  Analytical chemistry, microfluidic devices
• Trina Perrone - Ph.D. West Virginia University
• Mark Tinsley - Ph.D., Leeds University, England  
  Nonlinear dynamics, chemical oscillators, moving precipitation patterns.
TEACHING INSTRUCTOR

• Mark Schraf - M.S. (West Virginia University)
  Analytical chemistry

PROFESSORS EMERITI

• Harry Finklea - Ph.D. (California Institute of Technology)
  Analytical/Physical Chemistry, Electron transfer kinetics, Solid oxide fuel cells, Gas phase sensors
• Robert S. Nakon - Ph.D. (Texas A&M University)
  Inorganic chemistry
• John Penn - Ph.D. (University of Wisconsin - Madison)
  Chemical education, On-line instruction methods in organic chemistry
• Jeffrey Petersen - Ph.D. (University of Wisconsin-Madison)
  Physical inorganic chemistry, electrophilic transition metal complexes, X-ray crystallography
• Ronald Smart - Ph.D. (University of Michigan)
  Electrochemistry, environmental chemistry
• Anthony Winston - Ph.D. (Duke University)
  Polymer chemistry

Admissions

• First Time Freshmen are admitted to the major directly. For the timely completion of the degree, it is recommended that students have a minimum MATH ACT of 22, a MATH SAT of 540, or an ALEKS score of 45. Students must have a placement into a Math course to receive a complete schedule for their first semester. Students without placement may not be competitive to remain in the major.

• Students transferring from another major within WVU are admitted into the major if they have completed CHEM 115, CHEM 115L, CHEM 116, and CHEM 116L with a grade of C- or better in each and have earned a minimum overall GPA of 2.0.

• Students transferring from another institution are admitted into the major if they have completed CHEM 115, CHEM 115L, CHEM 116, and CHEM 116L with a grade of C- or better in each and have earned a minimum overall GPA of 2.0.

Due to Covid-19 – Admission requirements may differ from what is listed on this page. Please review the most up-to-date program admission requirements for the Bachelor of Science and Bachelor of Arts in Chemistry (https://admissions.wvu.edu/academics/majors/chemistry/) major.

ADMISSION REQUIREMENTS 2023-2024

The Admission Requirements above will be the same for the 2023-2024 Academic Year.

Major Code: 1439

Degree Progress

• By the end of their second semester (excluding summer) in the major, at minimum, students must have completed MATH 126 with a minimum grade of C-.

• By the end of the second semester in the major or two semesters after completing CHEM 110, completion of CHEM 115, CHEM 115L, CHEM 116 and CHEM 116L with C- or better in each.

• By the end of the second year in the major, completion of CHEM 234 and CHEM 234L with C- or better and a 2.0 in the major.

• All majors must meet with a Chemistry adviser each semester.

Students who do not meet their benchmark expectations may be removed from the major.

Major Learning Outcomes

CHEMISTRY

1. Will have sufficient knowledge of the fundamental chemical principles and an understanding of the methods of chemistry to be able to formulate solutions to problems of chemical relevance.

2. Will have acquired sufficient training to perform accurate and precise quantitative analyses, to utilize modern instrumental methods of analysis, to analyze and report the results of chemical experimentation, to work safely with chemicals, and to work effectively both as an individual and in a small group.

3. Will understand how to retrieve information from the chemical literature and be able to organize and communicate chemical information effectively in written reports and oral presentations.

4. Will possess the basic laboratory skills and chemical knowledge to qualify for entry level industrial or government laboratory positions or to be able to apply and gain admission to competitive graduate and professional schools.
COURSES

CHEM 110. Introduction to Chemistry. 2 Hours.
PR: Satisfy the minimum ACT/SAT math score, or satisfactory performance on placement examination, or MATH 124 or higher with a minimum grade of C-. Required for students whose performance on ACT/SAT/placement examination indicates need for introductory work before enrolling in other chemistry courses. Elementary scientific terminology and concepts; simple chemical arithmetics; chemical symbols, formulae and equations; and mole concepts.

CHEM 111. Survey of Chemistry 1. 3 Hours.
PR or CONC: CHEM 111L, WVU sections require MATH 124 or MATH 126, with a minimum grade of C-, or PR or CONC: a higher Math class, or ALEKS Score of 45, or Math ACT Score of 22, or Math SAT Score of 540 or Math SAT of 510 (Pre-March 2016), WVUIT and PSC sections require MATH 122 with a minimum grade of C- or ML 10, or Math ACT Score of 19 or Math SAT Score of 460 or Math SAT (March 2016) Score of 500 or PR or CONC: MATH 124 or MATH 126, (including 126 A, B, or C) or MATH 129 or MATH 150 or MATH 153 or MATH 155. Designed primarily for students taking only one year of college chemistry. Atomic structure; chemical bonding; acids, bases, and salts; periodicity; properties of gases, liquids, and solids; stoichiometry; oxidation-reduction. (3 hr. lecture).

CHEM 111L. Survey of Chemistry 1 Laboratory. 1 Hour.
PR or CONC: CHEM 111. Survey of Chemistry 1 - CHEM 111 Laboratory.

CHEM 112. Survey of Chemistry 2. 3 Hours.
PR: WVU and WVUIT sections require CHEM 111 and CHEM 111L and PR or CONC: CHEM 112L, PSC sections require CHEM 111 and CHEM 111L and PR or CONC: CHEM 112L with a minimum grade of C- in all. Continuation of CHEM 111. Nuclear chemistry; air and water pollution; useful natural materials; consumer chemistry; introduction to organic and biochemistry.

CHEM 112L. Survey of Chemistry 2 Laboratory. 1 Hour.
PR: WVU and WVUIT sections require CHEM 111 and CHEM 111L and PR or CONC: CHEM 112, PSC sections require CHEM 111 and CHEM 111L and PR or CONC: CHEM 112 with a minimum grade of C- in all. Survey of Chemistry 2 - CHEM 112 Laboratory.

CHEM 115. Fundamentals of Chemistry 1. 3 Hours.
PR: Satisfactory ACT/SAT or placement exam performance, or WVU sections require CHEM 110 with a minimum grade of C- or MATH 129 or higher with a minimum grade of C-, PSC sections require MATH 124 or MATH 126 or PR or CONC: MATH 129, and PR or CONC: CHEM 115L. For students who need more than one year of college chemistry and quantitative relationships on which subsequent chemistry courses are built. Pre-requisite(s) and/or co-requisite(s) may differ on regional campuses.

CHEM 115L. Fundamentals of Chemistry 1 Laboratory. 1 Hour.
PR or CONC: CHEM 115. Fundamentals of Chemistry 1 - CHEM 115 Laboratory.

CHEM 116. Fundamentals of Chemistry 2. 3 Hours.
PR: CHEM 115 and CHEM 115L and PR or CONC: CHEM 116L with a minimum grade of C- in all. Continuation of CHEM 115 and CHEM 115L.

CHEM 116L. Fundamentals of Chemistry 2 Laboratory. 1 Hour.
PR or CONC: CHEM 116. Fundamentals of Chemistry 2 - CHEM 116 Laboratory.

CHEM 117. Principles of Chemistry 1. 5 Hours.
PR: Satisfactory ACT/SAT and placement examination performance, or a score of four or five on AP Chemistry examination, and PR or CONC: CHEM 117L. A more advanced treatment of the principles and theories of chemistry than offered in CHEM 115 and CHEM 116. Primarily for students specializing in chemistry. (Students may not receive credit for CHEM 117 and for CHEM 111 or CHEM 115.).

CHEM 117L. Principles of Chemistry 1 - Laboratory. 0 Hours.
PR or CONC: CHEM 117. Principles of Chemistry 1 - CHEM 117 Laboratory.

CHEM 118. Principles of Chemistry 2. 5 Hours.
PR: CHEM 117 and CHEM 117L and PR or CONC: CHEM 118L. Continuation of CHEM 117. (3 hr. lec. plus recitation) (Students may not receive credit for CHEM 118 and for CHEM 112, CHEM 116 or CHEM 215.).

CHEM 118L. Principles of Chemistry 2 - Laboratory. 0 Hours.
PR or CONC: CHEM 118. Principles of Chemistry 2 - CHEM 118 Laboratory.

CHEM 191. First-Year Seminar. 1-3 Hours.
Engages students in active learning strategies that enable effective transition to college life at WVU. Students will explore school, college and university programs, policies and services relevant to academic success. Provides active learning activities that enable effective transition to the academic environment. Students examine school, college and university programs, policies and services.

CHEM 215. Introductory Analytical Chemistry. 3 Hours.
PR: CHEM 116 and CHEM 116L with a minimum grade of C- in each and PR or CONC: CHEM 215L. Volumetric analysis, gravimetric analysis, solution equilibria, spectrophotometry, separations, and electrochemical methods of analysis. (Students may not receive credit for CHEM 215 and for CHEM 117 and CHEM 118.).
CHEM 215L. Introductory Analytical Chemistry Laboratory. 1 Hour.
PR: CHEM 116 and CHEM 116L with a minimum grade of C- in each and PR or CONC: CHEM 215. Volumetric analysis, gravimetric analysis, solution equilibria, spectrophotometry, separations, and electrochemical methods of analysis.

CHEM 231. Organic Chemistry: Brief Course. 3 Hours.
PR: CHEM 116 and CHEM 116L and PR or CONC: CHEM 231L. Emphasis on biological applications for students in medical technology, agriculture, and family resources. Nomenclature, structure, reactivity, and stereochemistry are stressed. (3 hr. lec., 3 hr. lab.) (Students may not receive credit for CHEM 231 and for CHEM 233 and CHEM 234.)

CHEM 231L. Organic Chemistry: Brief Course Laboratory. 1 Hour.
PR: CHEM 116 and CHEM 116L with a minimum grade of C- and PR or CONC: CHEM 231. Emphasis on biological applications for students in medical technology, agriculture, and family resources. Nomenclature, structure, reactivity, and stereochemistry are stressed.

CHEM 233. Organic Chemistry 1. 3 Hours.
PR: (CHEM 116 and CHEM 116L) or (CHEM 118 and CHEM 118L) and PR or CONC: (CHEM 233L or CHEM 235) with a minimum grade of C- in all. Basic principles of organic chemistry. Modern structural concepts, the effect of structure on physical and chemical properties, reactions and their mechanisms and application to syntheses.

CHEM 233L. Organic Chemistry 1 Laboratory. 1 Hour.
PR: CHEM 116 and CHEM 116L with a minimum grade of C- in each and PR or CONC: CHEM 233. Fundamental organic reactions and the preparation of organic compounds.

CHEM 234. Organic Chemistry 2. 3 Hours.
PR: CHEM 233 and (CHEM 233L or CHEM 235) and PR or CONC: (CHEM 234L or CHEM 236) with a minimum grade of C- in all. Continuation of CHEM 233 and 233L and the study of basic principles of organic chemistry. Modern structural concepts, the effect of structure on physical and chemical properties, reactions and their mechanisms and application to syntheses.

CHEM 234L. Organic Chemistry 2 Laboratory. 1 Hour.
PR: CHEM 233 and (CHEM 233L or CHEM 235) and PR or CONC: CHEM 234 with a minimum grade of C- in all. Continuation of CHEM 233L and its study of fundamental organic reactions and the preparation of organic compounds.

CHEM 293. Special Topics. 1-6 Hours.
PR: Consent. Investigation of topics not covered in regularly scheduled courses.

CHEM 310. Instrumental Analysis. 3 Hours.
PR: (CHEM 215 and CHEM 215L with a minimum grade of C-) and (CHEM 341 or CHEM 346) and PR or CONC: CHEM 310L. Lectures and demonstrations. Fundamentals of instrumental methods applied to chemical analyses: electrochemistry, spectroscopy, mass spectrometry, and chromatography.

CHEM 310L. Instrumental Analysis Laboratory. 1 Hour.
PR or CONC: CHEM 310. Practical application of modern instrumental methods to problems in chemical analysis.

CHEM 312. Environmental Chemistry. 3 Hours.
PR: CHEM 215 and CHEM 234 and physical chemistry. Study of the nature, reactions, transport, and fates of chemical species in the environment. (2 hr. lec., 1 hr. demonstration.)

CHEM 322. Inorganic Chemistry 1. 3 Hours.
PR: CHEM 116 and CHEM 233 with minimum grade of C- in each. This course provides an introduction to transition metal chemistry and provides a comprehensive overview of the chemistry of main group elements and compounds. Students learn to apply a qualitative treatment of quantum mechanics to explain periodic trends learned in introductory courses and to classify compounds according to concepts of point group molecular symmetry.

CHEM 335. Methods of Structure Determination. 4 Hours.
PR: CHEM 234 and (CHEM 234L or CHEM 236) and Coreq: CHEM 335L. Use of chemical methods and UV, IR, NMR, and mass spectroscopy to elucidate structures of organic compounds. For students in chemistry and related fields who may need these methods in research and applied science.

CHEM 335L. Methods of Structure Determination Laboratory. 0 Hours.
PR: Corequisite of CHEM 335. Methods of Structure Determination - CHEM 335 Laboratory.

CHEM 339L. Organic Syntheses Laboratory. 3 Hours.
PR: CHEM 234 and (CHEM 234L or CHEM 236) with a minimum grade of C- in each. Modern synthetic methods of organic chemistry.

CHEM 341. Physical Chemistry: Brief Course. 3 Hours.
PR: MATH 156 and (CHEM 116 with a minimum grade of C- and CHEM 215) or CHEM 116) and (PHYS 102 or PHYS 112) and PR or CONC: CHEM 341L or CHEM 342. Beginning physical chemistry covering the subjects of chemical thermodynamics, chemical dynamics, and the structure of matter. (Students may not receive credit for CHEM 346 and 348 and for CHEM 341.)

CHEM 341L. Physical Chemistry: Brief Course Laboratory. 1 Hour.
PR or CONC: CHEM 341. Laboratory work in physical chemistry designed to accompany CHEM 341.
<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
<th>Credits</th>
<th>Prerequisites</th>
</tr>
</thead>
<tbody>
<tr>
<td>CHEM 346</td>
<td>Physical Chemistry 1</td>
<td>3</td>
<td>(CHEM 234 and CHEM 234L) with a minimum grade of C- and MATH 156 and (PHYS 112 and PHYS 112L) and PR or CONC: (CHEM 346L or CHEM 347) with a minimum grade of C-. Topics include a study of thermodynamics and chemical equilibria.</td>
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<tr>
<td>CHEM 346L</td>
<td>Physical Chemistry 1 Laboratory</td>
<td>1</td>
<td>PR: CHEM 118 or (CHEM 215 and CHEM 215L) and PR or CONC: CHEM 346 with a minimum grade of C- in all. Experimentation illustrating the principles of physical chemistry and offering experience with chemical instrumentation.</td>
</tr>
<tr>
<td>CHEM 348</td>
<td>Physical Chemistry 2</td>
<td>3</td>
<td>PR: CHEM 346 and MATH 251 and PR or CONC: (CHEM 348L or CHEM 349) with a minimum grade of C- in all. Chemical dynamics and the structure of matter.</td>
</tr>
<tr>
<td>CHEM 348L</td>
<td>Physical Chemistry 2 Laboratory</td>
<td>2</td>
<td>PR: CHEM 346 and (CHEM 346L or CHEM 347) and PR or CONC: CHEM 348. Continuation of CHEM 347.</td>
</tr>
<tr>
<td>CHEM 376L</td>
<td>Research Methods Laboratory</td>
<td>3</td>
<td>PR: (CHEM 118 or CHEM 215) and PR or CONC: ARSC 220. An introduction to the tools and mathematics that scientists use to solve scientific problems. Mathematical modeling, experimental design, hypothesis formulation, data collection, use of statistics, reading and evaluating the scientific literature, writing and reviewing scientific papers, and oral presentation of scientific research.</td>
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<tr>
<td>CHEM 393</td>
<td>Special Topics</td>
<td>1-6</td>
<td>PR: Consent. Investigation of topics not covered in regularly scheduled courses.</td>
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<tr>
<td>CHEM 401</td>
<td>Chemical Literature</td>
<td>1</td>
<td>PR: CHEM 234 and (CHEM 341 or CHEM 346). Study of techniques for locating, utilizing, and compiling information needed by the research worker in chemistry. (1 hr. lec.).</td>
</tr>
<tr>
<td>CHEM 403</td>
<td>Undergraduate Seminar</td>
<td>1</td>
<td>PR: CHEM 401. Instruction in design and presentation of topics of current chemical interest. (1 hour individual instruction and/or lecture.).</td>
</tr>
<tr>
<td>CHEM 422</td>
<td>Inorganic Chemistry 2</td>
<td>3</td>
<td>PR: CHEM 341 or (CHEM 346 and CHEM 348) with a minimum grade of C- in all. Structure, bonding, and reactivity of compounds of main-group and transition metal elements. Molecular structure and symmetry, solid state chemistry, ligand field theory, and coordination chemistry.</td>
</tr>
<tr>
<td>CHEM 422L</td>
<td>Inorganic Chemistry 2 Laboratory</td>
<td>2</td>
<td>PR or CONC: CHEM 422 with a minimum grade of C-. Application of modern synthetic and spectroscopic methods of analysis to the preparation and characterization of main group, solid-state, transition metal, and organometallic compounds.</td>
</tr>
<tr>
<td>CHEM 440</td>
<td>Quantum Chemistry</td>
<td>3</td>
<td>PR: CHEM 348. Introduction to the principles of quantum mechanics and its application to atoms, molecules, solids, spectroscopy, and computational chemistry.</td>
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<tr>
<td>CHEM 444</td>
<td>Colloid and Surface Chemistry</td>
<td>3</td>
<td>PR: Physical chemistry. Selected topics in the properties and physical chemistry of systems involving macromolecules, lyophobic colloids, and surfaces. (3 hr. lec.).</td>
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<tr>
<td>CHEM 460</td>
<td>Forensic Chemistry</td>
<td>3</td>
<td>PR: CHEM 215 and CHEM 215L and CHEM 234 and (CHEM 234L or CHEM 236) and PR or CONC: (CHEM 460L or CHEM 463) with a minimum grade of C- in all. Analytical chemistry as applied in forensic science. Drug analysis, toxicology, arson, paints, polymers, fibers, inks, and gunshot residue.</td>
</tr>
<tr>
<td>CHEM 460L</td>
<td>Forensic Chemistry Laboratory</td>
<td>1</td>
<td>PR: CHEM 215 and CHEM 215L and CHEM 234 and CHEM 234L and PR or CONC: CHEM 460 with a minimum grade of C- in all. Analytical chemistry as applied in forensic science. Drug analysis, toxicology, arson, paints, polymers, fibers, inks, and gunshot residue.</td>
</tr>
<tr>
<td>CHEM 462</td>
<td>Biochemistry 2</td>
<td>3</td>
<td>PR: AGBI 410 and PR or CONC: (CHEM 462L or CHEM 464) with a minimum grade of C- in all. Second semester of undergraduate biochemistry with a focus on the molecular level processes that enable life and the integration of multiple hierarchies of mechanistic regulation.</td>
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<tr>
<td>CHEM 462L</td>
<td>Biochemistry 2 Laboratory</td>
<td>1</td>
<td>PR: AGBI 410 and AGBI 410L and PR or CONC: CHEM 462 with a minimum grade of C- in all. Second semester of undergraduate biochemistry lab, familiarizes students with biochemical techniques used in the analysis of biological species/processes.</td>
</tr>
<tr>
<td>CHEM 490</td>
<td>Teaching Practicum: Peer-Led Team Learning</td>
<td>1-3</td>
<td>PR: Consent. Teaching practice as a tutor or assistant.</td>
</tr>
<tr>
<td>CHEM 490A</td>
<td>Teaching Practicum-CLC</td>
<td>1-3</td>
<td>PR: Consent. Teaching practice as a tutor or assistant.</td>
</tr>
<tr>
<td>CHEM 490B</td>
<td>Teaching Practicum - TA</td>
<td>1-3</td>
<td>PR: Consent. Teaching practice as a tutor or assistant.</td>
</tr>
</tbody>
</table>
CHEM 491. Professional Field Experience. 1-18 Hours.
PR: Consent. (May be repeated up to a maximum of 18 hours.) Prearranged experiential learning program, to be planned, supervised, and evaluated for credit by faculty and field supervisors. Involves temporary placement with public or private enterprise for professional competence development.

CHEM 492. Directed Study. 1-3 Hours.
Directed study, reading, and/or research.

CHEM 493. Special Topics. 6 Hours.
PR: Consent. Investigation of topics not covered in regularly scheduled courses.

CHEM 494. Seminar. 1-3 Hours.
PR: Consent. Presentation and discussion of topics of mutual concern to students and faculty.

CHEM 496. Senior Thesis. 1-3 Hours.
PR: Consent.

CHEM 497. Research. 1-6 Hours.
Independent research projects.

CHEM 498. Honors. 1-3 Hours.
PR: Students in Honors Program and consent by the honors director. Independent reading, study, or research.