

CHEMISTRY

Department of Chemistry

Website: <https://www.washburn.edu/academics/college-schools/arts-sciences/departments/chemistry/index.html> (<https://www.washburn.edu/academics/college-schools/arts-sciences/departments/chemistry/>)

Faculty

Professor Shaun Schmidt, Chair, PhD
 Professor Seid Adem, PhD
 Professor Sam Leung, PhD
 Associate Professor Holly O'Neill, MS
 Assistant Professor Hoang Long Nguyen, PhD

Vision

Washburn Chemistry Department strives to create a supportive, diverse, and inclusive environment to promote life-long learning, to develop analytical and critical thinking skills, and to grow the body of knowledge for our students, faculty, and community.

Mission

Consistent with the mission of the University and the College of Arts and Sciences, the Department of Chemistry is committed to:

- Provide a broad spectrum of undergraduate students with a supportive environment in which to develop the necessary understanding of chemical principles, and analytical and critical thinking skills,
- Engage in scientific research,
- Serve the scientific and local communities.

Student Learning Outcomes

Chemistry majors at Washburn University, upon graduation, will be proficient in:

- Applying fundamental chemical principles, models, and theories;
- Safely conducting empirical labs, implementing calculations and computational methods, and evaluating data;
- Evaluating and delivering oral and written scientific communications;
- Practicing inclusive collaboration, ethics, and professionalism.

Additional Requirements

Additional Requirements for all Chemistry Bachelor Degrees

Research (CH 390 Chemistry Research) must be initiated at least one semester prior to the semester of graduation. A written report of research or internship is required of all majors. An oral presentation of CH 390 Chemistry Research results is required of all BS majors.

Required Natural Science Concentration

All Bachelor of Science degrees include a required 30-hour natural science concentration, which includes courses chosen from departments in the Natural Sciences and Mathematics Division, other than the student's major department. At least 15 of these hours must be in one

department. The 30 hours must be approved by the student's major department chairperson.

Natural Sciences Concentration courses for BS degrees offered by the Department of Chemistry are limited to these courses:

- Biology: BI 192 General Cellular Biology and courses with BI 192 or higher as prerequisite;
- Computer Information Sciences: CM 111 Introduction to Structured Programming or courses with CM 111 or higher as a prerequisite;
- Mathematics: MA 116 College Algebra and courses with MA 116 or higher as a prerequisite;
- Physics: PS 281 General Physics I or above for the ACS certified major, or PS 261 College Physics I or PS 281 General Physics I and above for the non-certified major.

Departmental Honors

Students are eligible to receive departmental honor upon graduation if they fulfill the minimum requirements:

- A grade point average of 3.5 in the major, including a 3.5 in upper division work in the major.
- Successful completion of research with presentation or internship in Chemistry.
- Service to the Department, or to the community relevant to the Chemistry major.
- The recommendation of the Department.

Programs

- Applied Chemistry, BA (<https://catalog.washburn.edu/undergraduate/college-arts-sciences/chemistry/chemistry-ba/>)
- Applied Chemistry, BS (<https://catalog.washburn.edu/undergraduate/college-arts-sciences/chemistry/chemistry-bs-not-certified-american-chemical-society/>)
- Biochemistry, BA (<https://catalog.washburn.edu/undergraduate/college-arts-sciences/chemistry/biochemistry-ba/>)
- Biochemistry, BS (<https://catalog.washburn.edu/undergraduate/college-arts-sciences/chemistry/biochemistry-bs/>)
- Chemistry, BS - Certified by the American Chemical Society (<https://catalog.washburn.edu/undergraduate/college-arts-sciences/chemistry/chemistry-bs-certified-american-chemical-society/>)
- Chemistry Secondary Education, BEd (<https://catalog.washburn.edu/undergraduate/college-arts-sciences/chemistry/chemistry-secondary-ed/>)
- Chemistry, Minor (<https://catalog.washburn.edu/undergraduate/college-arts-sciences/chemistry/chemistry-minor/>)
- Forensic Chemistry, BS (<https://catalog.washburn.edu/undergraduate/college-arts-sciences/chemistry/forensic-chemistry-bs/>)
- Forensic Chemistry, Minor (<https://catalog.washburn.edu/undergraduate/college-arts-sciences/chemistry/forensic-chemistry-minor/>)
- Laboratory Science, AA (<https://catalog.washburn.edu/undergraduate/college-arts-sciences/chemistry/laboratory-science-aa/>)

Course Offerings

CH 103 Introduction to Forensic Chemistry (3)

This scientific reasoning and literacy general education course emphasizes the history, philosophy and major theories of chemistry as they apply to current forensic analytical techniques. Prerequisites: None.

Course Attributes:

- KBOR Gen Ed: Scientific Reasoning and Literacy
- Pre-AY 2024-2025 Gen Ed: Natural Science
- USLO: Quantitative and Scientific Reasoning and Literacy

CH 111 Chemistry in Everyday Life (0-5)

An integrated lecture and laboratory course designed for students pursuing degrees outside the natural or health sciences and who are interested in understanding basic chemistry concepts and their applications in everyday life. Topics include composition, phases and structure of matter, chemical reactions, solution chemistry, electrochemistry, and chemical equilibrium and their effects on health, the environment, water quality, energy sources, food, and polymers. Lab exercises help students apply concepts and models. This course requires no previous science or mathematics background and does not count towards a major or minor in chemistry. Course consists of three hours of lecture and three hours of laboratory exercises per week. Prerequisites: None.

Course Attributes:

- KBOR Gen Ed: Natural and Physical Sciences
- KBOR Gen Ed: Scientific Reasoning and Literacy
- Pre-AY 2024-2025 Gen Ed: Natural Science
- USLO: Quantitative and Scientific Reasoning and Literacy

CH 121 General, Organic, and Biological Chemistry (5)

This one-semester survey lecture with lab course is ideal for students needing a one-semester survey of general, organic, and biological chemistry principles, including most nursing students. The lecture covers vocabulary, laws, and applications of chemistry concepts. In the laboratory portion, students engage in hands-on experiments that reinforce key concepts presented in the lecture portion, focusing on lab safety, quantitative techniques, and critical thinking. This course does not count toward a major or minor in chemistry. Course includes three hours of lecture, one hour of recitation, and three hours of laboratory each week. Prerequisites: Equivalent or higher of MA 112, MA 113, or MA 116 with a grade of C or better

Course Attributes:

- KBOR Gen Ed: Natural and Physical Sciences
- KBOR Gen Ed: Scientific Reasoning and Literacy
- Pre-AY 2024-2025 Gen Ed: Natural Science
- USLO: Quantitative and Scientific Reasoning and Literacy

CH 126 RN-BSN General, Organic, Bio Chemistry (3)

Designed to fulfill the degree requirement in chemistry for the Registered Nurse to Bachelor of Science in Nursing program, this course introduces measurements, atomic theory, compounds, solutions, and reactions. Prerequisite: The student must be a registered nurse and enrolled in or received a C or better in MA 116, its equivalent or higher.

CH 151 Fundamentals of Chemistry I (5)

This is the first lecture with lab course in a two-semester introductory sequence designed to provide a fundamental understanding of chemistry for chemistry and natural science majors. Lecture topics covered include chemical nomenclature, atomic structure, stoichiometry, thermodynamics, and the properties of gases, liquids, and solids. Students will develop their problem-solving skills by applying fundamental concepts to real-world scenarios. In the laboratory portion, students engage in hands-on experiments that reinforce key concepts presented in the lecture portion, focusing on lab safety, quantitative techniques, collaborative group work, and critical thinking. Course includes three hours of lecture, one hour of recitation, and three hours of laboratory each week. Prerequisite: MA 116 or concurrent enrollment.

Course Attributes:

- KBOR Gen Ed: Natural and Physical Sciences
- KBOR Gen Ed: Scientific Reasoning and Literacy
- Pre-AY 2024-2025 Gen Ed: Natural Science
- USLO: Quantitative and Scientific Reasoning and Literacy

CH 152 Fundamentals of Chemistry II (5)

This is the second lecture with lab course in a two-semester introductory sequence designed to provide a fundamental understanding of chemistry for chemistry and natural science majors. Lecture topics covered include molecular structure and bonding, kinetics, equilibrium, acid-base reactions, thermochemistry, and electrochemistry. Students continue to develop their problem-solving skills by applying fundamental concepts to real-world scenarios. In the laboratory portion, students engage in hands-on experiments that reinforce key concepts presented in the lecture portion, focusing on lab safety, the practical application of lecture material, collaborative group work, and critical thinking. Course includes three hours of lecture, one hour of recitation, and three hours of laboratory each week. Prerequisite: MA 116 or equivalent and CH 151 with a grade of C or better.

Course Attributes:

- KBOR Gen Ed: Natural and Physical Sciences
- KBOR Gen Ed: Scientific Reasoning and Literacy
- Pre-AY 2024-2025 Gen Ed: Natural Science
- USLO: Quantitative and Scientific Reasoning and Literacy

CH 291 Professionalism in Science (1)

This sophomore-level capstone seminar course introduces students to essential concepts and practices for a successful scientific career. Topics include general lab safety, scientific ethics, effective scientific communication, and career preparation. This course is a prerequisite for students planning to engage in research or internships in chemistry. Course includes two hours of seminar per week. Prerequisites: CH 152, CN 150 (or concurrent enrollment), and EN 101 with a grade of C or better.

CH 293 Professional Forensic Science Seminar (1)

Students will be introduced to areas of forensic science not typically covered in traditional science coursework through seminars led by professionals in the field. These seminars will address topics relevant to many forensic disciplines, such as courtroom testimony, ethics and professionalism, and government and private forensic practices. Additional topics may include arson investigation, digital evidence, gunshot residue analysis, firearms and toolmark analysis, and fraud investigation. Course includes two hours of seminar per week. Prerequisites: None.

CH 300 Special Topics/Chemistry (1-3)

This course explores a topic in chemistry, with a format that may involve lectures, seminars, or lab work. Content, format, credit hours and prerequisites vary by section and will be announced before registration. This course may be repeated for credit. Prerequisites: Consent of instructor.

CH 320 Analytical Chemistry (3)

This foundation course in analytical chemistry provides students with both the theoretical background and practical application of classical analytical methods, with an emphasis on chemical equilibria, volumetric techniques, and statistical analysis of error in experimental data. The course also introduces basic instrumental methods, including spectrophotometry, electroanalytical techniques, and separation methods. Course includes three hours of lecture each week. Prerequisites: CH 152 with a C or better.

CH 321 Analytical Chemistry Lab (1)

In this laboratory course, students engage in hands-on experiments that reinforce key concepts presented in CH 320, focusing on lab safety, chemical analysis, proper scientific data recording, computer-aided data analysis, and written communication. Course includes three hours of laboratory each week. Prerequisites: CH 152 with a grade of C or better and concurrent enrollment in CH 320

CH 323 Advanced Forensic Chemistry (4)

This in-depth lecture and lab course familiarizes students with the most common equipment and techniques used in a professional forensic chemistry lab. Students will apply principles learned in the lecture to analyze mock evidence, interpret data accurately, and communicate results effectively. The course culminates in a simulated case, where students execute the entire process from sample preparation to final testimony in a courtroom setting. Course includes three hours of lecture and three hours of lab each week. Prerequisites: CH 340 with a C or better.

CH 326 Instrumental Methods In Forensic Analysis (3)

This in-depth lecture course explores the theoretical background and practical application of instrumental methods used in chemical analysis. Analytical techniques include spectrophotometric and electrochemical quantitation methods, and chromatographic separation. Course includes three hours of lecture each week. Prerequisites: CH 320 with a grade of C or better.

CH 327 Instrumental Methods in Forensic Analysis Lab (1)

In this laboratory course, students apply concepts from CH 326 to develop a practical understanding of chromatographic, spectrophotometric, and electrochemical instrumentation. Emphasis is placed on hands on strategies to safely generating, analyzing, and communicating data using analytical instrumentation, culminating in final self-directed project. Course includes three hours of lab each week. Prerequisites: CH 321 with a grade of C or better, and CH 326 with a C or better or concurrent enrollment.

CH 331 Inorganic Chemistry (3)

In this foundation course, students explore topics in inorganic chemistry, including atomic structure, molecular structure and bonding, symmetry and point groups, acid/base definitions, and oxidation/reduction concepts. These topics are applied to main group, coordination, and organometallic compounds, along with their respective reactions. Course includes three hours of lecture each week. Prerequisites: CH 340 with a grade of C or better.

CH 332 Inorganic Chemistry Lab (2)

In this laboratory course, students investigate the inorganic preparation of main group, organometallic, and coordination compounds, as well as meso-scale materials. The synthesized materials are characterized using appropriate analytical methods, with comparisons made to ab initio calculated properties in publication-style multi-draft reports. Course includes one hour lecture and one three-hour laboratory period per week. Prerequisites: CH 342 with a grade of C or better.

CH 340 Organic Chemistry I (3)

This foundation course in organic chemistry provides students with an understanding of the fundamental principles and concepts governing carbon-based compounds. Topics include chemical bonding, structures, nomenclature, stereochemistry, reactions and synthesis of several common classes of carbon-based compounds, and reaction mechanisms. Methods for determining chemical structures will also be covered, including mass spectrometry (MS), infrared (IR) spectroscopy, and nuclear magnetic resonance (NMR) spectroscopy. Course includes three hours of lecture each week. Prerequisites: CH 152 with a grade of C or better.

CH 341 Organic Chemistry II (3)

This in-depth lecture is a continuation of CH 340 in which students will expand their knowledge in designing syntheses of organic compounds. Topics include the structures, nomenclature, properties, and reactions of additional nitrogen, and oxygen containing major functional groups. This course also covers aromaticity and the reactions of aromatic compounds. Course includes three hours of lecture each week. Prerequisites: CH 340 with a grade of C or better.

CH 342 Organic Chemistry Lab I (2)

In this laboratory course, students are introduced to the skills and techniques commonly used in an organic chemistry lab. Exercises include the synthesis, isolation, purification, and identification of organic compounds which utilizes instrumental methods such as gas chromatography (GC), infrared (IR) spectroscopy, and nuclear magnetic resonance (NMR) spectroscopy. Course includes one hour of lecture and three hours of lab each week. Prerequisites: CH 152 and CH 340 with a grade of C or better or concurrent enrollment.

CH 343 Organic Chemistry Lab II (2)

This laboratory course is a continuation of CH 342 emphasizing the common methodologies for the synthesis of organic compounds. Infrared (IR) spectroscopy and nuclear magnetic resonance (NMR) spectroscopy are the primary methods for structure identification. Course includes one hour of lecture and three hours of lab each week. Prerequisites: CH 342 and CH 341 (or concurrent enrollment) with a grade of C or better.

CH 344 Organic Spectroscopy (2)

This in-depth lecture course will discuss four common spectroscopic methods used in organic chemistry: ultraviolet-visible (UV-Vis) spectroscopy, infrared (IR) spectroscopy, nuclear magnetic resonance (NMR) spectroscopy, and mass spectrometry (MS). The emphasis will be on the interpretation of the spectra produced by these methods in the identification of organic compounds. Course includes two hours of lecture each week. Prerequisites: CH 343 with a grade of C or better.

CH 350 Biochemistry I (3)

This foundation course in biochemistry focuses on understanding the structure and function of proteins, carbohydrates, lipids, and nucleic acids. Emphasis on chemical basis of molecular interactions, bioenergetics, enzyme catalysis, and an introduction to cellular metabolism of carbohydrates will be covered. Course includes three hours of lecture each week. Prerequisites: CH 340 with a grade of C or better.

CH 351 Biochemistry Lab I (2)

In this laboratory course, students are introduced to the skills and techniques commonly used in a biochemistry lab such as spectrophotometry, bioinformatics, enzyme purification and assays, liquid chromatography, and electrophoresis. Experiments are designed to reinforce concepts from CH 350 including molecular interactions, and enzyme catalysis. Emphasis is placed on developing practical lab skills, data collection & analysis, and scientific communication. A pertinent research question is developed using a Course-Based Undergraduate Research Experience (CURE) approach which may be investigated in CH 353. Course includes one hour of lecture and three hours of lab each week. Prerequisites: CH 342 and CH 350 (or concurrent) with a grade of C or better.

CH 352 Biochemistry II (3)

This in-depth lecture is a continuation of CH 350 exploring advanced concepts in the structural and biochemical basis of cellular function. Topics include bioenergetics, advanced metabolic pathways of carbohydrates, proteins, and lipids, and molecular basis of information storage, and transfer. Emphasis is placed on understanding the integration of metabolic networks, and their roles in physiological conditions and diseases states. Course includes three hours of lecture each week. Prerequisites: CH 350 with a grade of C or better.

CH 353 Biochemistry Lab II (2)

This laboratory course is a continuation of CH 351 which features a Course-Based Undergraduate Research Experience (CURE) that engages students in an original research project. Topics may include bioinformatics, growing and isolating proteins in cellular systems, chromatography, electrophoresis, and protein pull-down assays. Students use a hypothesis which may have been developed in CH351 to design and perform experiments which address the hypothesis. Findings are reported in oral and written form. Course includes one hour of lecture and three hours of lab each week. Prerequisites: CH 350 and CH 351 with a grade of C or better.

CH 355 Medicinal Chemistry (2)

This in-depth lecture course introduces students to the process and chemistry of drug discovery and development. Major topics covered include lead compound discovery, structure-activity relationships, mechanisms of drug action, pharmacokinetics, drug metabolism, and drug synthesis. Course includes two hours of lecture each week. Prerequisites: CH 341 with a grade of C or better.

CH 371 Topics in Materials Chemistry (1)

This in-depth lecture course explores a topic in materials chemistry such as synthetic polymers, meso or nanoscale materials, or supramolecular aggregates. It emphasizes significant discussion of primary sources focusing on preparation, characterization, and physical properties of the materials. The specific course content will depend on the instructor and will be announced before registration. This course may be repeated for credit. Course includes one hour of lecture each week. Prerequisites: CH 340 with a C or better and either CH 320 , CH 331 , or CH 380 with a C or better

CH 372 Environmental Chemistry (3)

This in-depth lecture course applies chemistry to key environmental topics like the ozone layer, air pollution, climate change, and water pollution. Students will cultivate an ethical understanding of issues through an unbiased, data-driven, scientific approach. The course will focus on chemical descriptions and explanations of current environmental challenges, examine human impacts, and explore potential solutions for the future. Course includes three hours of lecture each week. Prerequisites: CH 320 with a C or better or CH 340 with a C or better or instructor consent.

CH 380 Fundamentals of Physical Chemistry (3)

This course provides students with a non-calculus-based survey of physical chemistry principles to explain various macroscale chemical observations. Topics covered include properties of gases, thermodynamics, state changes, equilibrium, and kinetic principles. Course includes three hours of lecture each week. Prerequisites: CH 152 with a grade of C or better, PS 262 or PS 282 (recommended or concurrent enrollment).

CH 381 Physical Chemistry I (3)

This calculus-based foundation course in physical chemistry provides students with the physical principles to explain various macroscale chemical observations. Topics covered include properties of gases, thermodynamics, state changes, equilibrium, properties of solution, and kinetic principles. Course includes three hours of lecture each week. Prerequisites: CH 152 and MA 151 with a grade of C or better, PS 262 or PS 282 (recommended or concurrent enrollment), and MA 152 (recommended).

CH 382 Physical Chemistry II (3)

This in-depth lecture is a continuation of CH 381 which focuses on understanding and using quantum mechanical principles to model and explain different physical and chemical systems. Topics covered include quantum mechanics, statistical mechanics, statistical thermodynamics, and kinetic theory of gases. Course includes three hours of lecture each week. Prerequisites: CH 381 with a grade of C or better and MA 152 or concurrent enrollment.

CH 383 Physical Chemistry III (3)

This in-depth lecture is a continuation of CH 382 which focuses on applying quantum mechanical principles in spectroscopy. Topics covered include nuclear magnetic resonance, molecular orbitals, molecular reaction dynamics, surface chemistry, and electrochemistry. Course includes three hours of lecture each week. Prerequisites: CH 382 with a grade of C or better.

CH 384 Physical Chemistry Concepts Lab (1)

In this non-calculus-based laboratory course, students are introduced to the tools and techniques commonly used in a physical chemistry lab. Students will carry out experiments focused on the physical measurements and calculations for chemical systems. Course includes three hours of laboratory each week. Prerequisites: CH 380 with a grade of C or better or concurrent enrollment.

CH 385 Physical Chemistry Lab (1)

In this calculus-based laboratory course, students are introduced to the tools and techniques commonly used in a physical chemistry lab. Students will carry out experiments focused on the physical measurements and data analysis for chemical systems. Course includes three hours of laboratory each week. Prerequisites: CH 381 with a grade of C or better or concurrent enrollment.

CH 390 Chemistry Research (1-5)

This capstone laboratory course provides student researchers with hands-on, computational, or theoretical research experience in chemistry. Working closely with a faculty mentor, students will prepare a written research proposal, design experiments, analyze data, and interpret results. The full scope of this project will be presented in CH 491. This course may be repeated for credit. No more than five credit hours may be applied toward meeting departmental or graduation requirements. Course includes 45 hours of laboratory work per semester for each credit enrolled. Prerequisites: EN 200, CH 291 with a grade of C or better, and departmental permission.

CH 393 Chemistry Internship (1-5)

This capstone laboratory course provides students with experiential training in a professional laboratory setting. Working with an internship coordinator, students will prepare a written proposal which outlines the expectations for the internship. The full scope of this project will be presented in CH 491. This course may be repeated for credit. No more than five credit hours may be applied toward meeting departmental or graduation requirements. Course includes 45 hours of laboratory work per semester for each credit enrolled. Prerequisites: EN 200, CH 291 with a grade of C or better, and departmental permission. Recommended CH 293 for Forensic Chemistry Internship.

CH 491 Chemistry Seminar (1)

This senior-level capstone seminar course is designed for students to synthesize concepts and practices for a successful scientific career. Topics include general lab safety, scientific ethics, effective scientific communication, and career preparation. Students will give public oral and written presentations on their research work in CH 390 or internship experiences from CH 393. Course includes two hours of seminar per week. Prerequisites: Either CH 390, or CH 393 with a grade of C or better; and either EN 300, EN 308, or EN312 with a grade of C or better; and departmental permission.