# CHEMISTRY

Chemistry is an interdisciplinary subject which grew out of an ancient desire to isolate fundamental substances and systematize them, ultimately resulting in the Period Table of Elements. The main tasks of chemistry now involve creating new compounds and industrial processes and furthering our understanding of chemical reactions in the natural world. An understanding of the principles of chemistry is essential to the study of many fields of science and technology. The Chemistry Department emphasizes the fundamental principles of chemistry and the development of laboratory skills. We also desire to foster an ethical perspective of the role of science in the world and to develop well-rounded graduates who can provide service to our society and the church through their competence in science.

The chemistry program is approved by the American Chemical Society (http://www.acs.org/) to certify degrees in chemistry and biochemistry. The ACS certified degree requires additional course work beyond the basic major.

The major prepares students for graduate studies in chemistry, biochemistry, and related fields; for entry into health professions; for work in industry and government; and for teaching at the secondary level. A sound understanding of analytical and problem-solving skills provides the student with a foundation for engaging in a wide range of service, management, and leadership roles.

**The Chemistry Department Honors Program** for majors requires four hours of honors course work and four hours of research credit (CHEM 495 Independent Research) including a thesis. Plans should be established no later than the fall semester of the junior year.

## Faculty

**Chair, Professor,** Peter Walhout
**Professor,** Daniel Burden
**Associate Professors,** Lisa Burden, Benjamin Lovaasen, Francis Umesiri
**Instructor,** Melody David

## Programs

- Biochemistry and Molecular Biology Major, Bachelor of Science (https://catalog.wheaton.edu/undergraduate/arts-sciences/bhs/biochemistry-and-molecular-biology-major-bs/)
- Chemistry Major (https://catalog.wheaton.edu/undergraduate/arts-sciences/chemistry/chemistry-major/)
- Chemistry Major with a Biochemistry Concentration (https://catalog.wheaton.edu/undergraduate/arts-sciences/chemistry/chemistry-major-biochemistry-concentration/)
- Chemistry Major with an American Chemical Society Certification (https://catalog.wheaton.edu/undergraduate/arts-sciences/chemistry/chemistry-major-american-chemical-society-certification/)
- Chemistry Major with an American Chemical Society Certification and a Biochemistry Concentration (https://catalog.wheaton.edu/undergraduate/arts-sciences/chemistry/chemistry-major-american-chemical-society-certification-biochemistry-concentration/)
- Chemistry Major with Teaching (https://catalog.wheaton.edu/undergraduate/arts-sciences/chemistry/chemistry-major-with-teaching/)
- Chemistry Minor (https://catalog.wheaton.edu/undergraduate/arts-sciences/chemistry/chemistry-minor/)
- Departmental Honors Endorsement: Chemistry (https://catalog.wheaton.edu/undergraduate/arts-sciences/chemistry/departmental-honors-endorsement-chemistry/)
- Extended Studies in Major Endorsement: Chemistry (https://catalog.wheaton.edu/undergraduate/arts-sciences/chemistry/extended-studies-in-major-endorsement-chemistry/)
- General Studies Endorsement for Fourth-Year Majors in Chemistry (https://catalog.wheaton.edu/undergraduate/arts-sciences/chemistry/general-studies-endorsement-for-fourth-year-majors-in-chemistry/)

## Courses

See the Financial Information (https://catalog.wheaton.edu/financial-information/) section of this catalog for course fees.

## Chemistry Courses

**CHEM 201. Contemporary Topics in Life Science. (4 Credits)**
This course provides students with a study of concepts generally applicable to living systems, including cell structure and function, genetics, heredity, evolution, systems of the human body, and a survey of living organisms. The course is organized around recent advances in science and presents culturally relevant issues and topics for consideration and discussion. Students will be exposed to scientific vocabulary and principles while also examining the history and culture surrounding specific and recent scientific discoveries. Focus will be placed on drawing students into application and integration of science and developing the ability to engage with scientific topics in the popular culture. Three lectures and three hours laboratory. This is a course for non-science majors. Cross-listed with BIOL 201. Additional course fee required: $95.
**Tags:** SIP, SP

**CHEM 205. Frontiers in Nanoscale Science. (2 Credits)**
Big things happen in tiny spaces! Themes of nanoscience and nanotechnology span the news cycle, the natural sciences, and other applied areas of STEM, all to the glory of God! This course provides an interdisciplinary introduction to the field by engaging students in hands-on laboratory learning, while making specific connection to foundational ideas in biology, chemistry, and physics. Classroom learning sessions include, “What is Nanoscience and Nanotechnology?,” “Nanoscale Biology,” “Nanoscale Chemistry,” and “Nanoscale Physics,” as well as “Philosophical and Ethical Issues within Nanoscience.” Laboratory sessions will allow students to investigate the brilliant nanoscale features of butterfly wings, unveil size-dependent phenomena in Qdots, and participate in the latest government-sponsored research concerning biologically inspired nanovalves. Successful completion of a high school chemistry, biology, or physics course is recommended prior to taking this course. (Open to Wheaton College Summer Institute students only)

**CHEM 212. Everyday Chemistry. (4 Credits)**
The course covers basic concepts of chemistry as encountered in our everyday lives - food & metabolic energy, drugs & medicines, soaps & detergents, polymers - and allows students to explore the process of scientific investigation using familiar products and materials. Includes evaluation of scientific claims (e.g., recognizing pseudoscience in commercial chemical products) and the development of a scientific argument based on experimental evidence. The laboratory includes the preparation and analysis of common chemical materials. Three hours lecture, two hours laboratory.
**Tags:** SP

**CHEM 231. General Chemistry I. (4 Credits)**
Stoichiometry, introduction to reaction types, gases, thermochemistry, atomic and molecular structures, bonding, condensed phases. Three lectures, three hours laboratory. Prerequisite: high school algebra

**CHEM 232. General Chemistry II. (4 Credits)**
Solutions, kinetics, chemical equilibrium, acid/base chemistry, free energy, electrochemistry, inorganic chemistry, radiochemistry, introduction to organic. Three lectures, three hours laboratory. Prerequisite: CHEM 231.

**CHEM 241. Principles of Organic Chemistry. (4 Credits)**
A one-semester survey course in organic chemistry. Topics include common classes of organic compounds—especially those of biological interest - nomenclature, structure-reactivity, principles, reactions, and mechanisms. The laboratory stresses investigation of principles discussed in lecture. This course does not meet the requirements for medical, dental, or veterinary schools. Three lectures, three hours laboratory. Prerequisite: CHEM 232 or consent of the instructor.

**CHEM 294. Chemistry Colloquium. (0 or 1 Credits)**
Features a variety of presentations by students, faculty, and outside speakers on topics including current research, current events in chemistry, and history of chemistry. Also includes 'faith and learning' discussions of various books and articles. Intended for sophomore chemistry majors, though majors from other years are also welcome. Taught each semester.

**CHEM 321. Pseudoscience & Faith. (4 Credits)**
This course will explore scientific issues and practice by examining several notable examples of pseudoscience, which is the attempt to justify a claim about the world with dubious data and misguided scientific arguments created and analyzed outside the mainstream of traditional scientific communities. In-depth case studies related to Christian faith will include the Bible Code, the Shroud of Turin, among others. The normal practice of science will be studied through scholarly writings as well as scientific autobiographies.
**Tags:** SIP

**CHEM 336. Inorganic Chemistry. (4 Credits)**
Atomic structure (nuclear and electronic), molecular orbital theory, molecular symmetry, bonding models, solid state, acid-base theory, coordination compounds, organometallic chemistry. Three lectures, three hours laboratory. Pre or Corequisite: CHEM 342.

**CHEM 341. Organic Chemistry I. (4 Credits)**
A two-semester study of organic chemistry. Topics include nomenclature, principles of reactivity, reaction mechanisms, synthesis, and spectroscopy. The laboratory stresses the synthesis and characterization of organic compounds. (Not open to students who have taken CHEM 241.) Three lectures, three hours laboratory. Prerequisite: CHEM 232

**CHEM 342. Organic Chemistry II. (4 Credits)**
A two-semester study of organic chemistry. Topics include nomenclature, principles of reactivity, reaction mechanisms, synthesis, and spectroscopy. The laboratory stresses the synthesis and characterization of organic compounds. (Not open to students who have taken CHEM 241.) Three lectures, three hours laboratory. Prerequisites: CHEM 232 and CHEM 341.

**CHEM 355. Introduction to Analytical Chemistry. (2 Credits)**
Statistical treatment of scientific data sets (regression analysis, confidence intervals, ANOVA, principle component analysis). Solution activities. Introduction to instrumentation theory and methods for ultraviolet, visible, and atomic spectroscopy. Potentiometric and chromatographic theory. One lecture, three hours laboratory. Prerequisite: CHEM 241 or 341, or consent of instructor. (lin)

**CHEM 371. Physical Chemistry I. (4 Credits)**
A study of the laws of classical thermodynamics and their application to physical and chemical systems, followed by an introduction to kinetics, kinetic theory, and reaction dynamics. Prerequisite: MATH 235 or MATH 236 and either PHYS 222, 229 or 232.

**CHEM 372. Physical Chemistry II. (2 Credits)**
An introduction to quantum mechanics and statistical mechanics. Includes atomic theory, bonding theory, and computational chemistry. Prerequisite: CHEM 371 (lin)

**CHEM 436. Physical Inorganic Chemistry. (2 Credits)**
This course focuses on the bonding, electronic structure, and geometry of inorganic compounds. Topics include: molecular orbital theory, molecular symmetry, group theory, vibrational spectroscopy, electronic spectroscopy of transition metal complexes and solid state chemistry. Prerequisite: CHEM 336. Pre or Corequisite: CHEM 371.

**CHEM 437. Organometallic Chemistry. (2 Credits)**
A course in the structure, reactivity and applications of organometallic compounds with a focus on transition metal organometallic compounds. Topics will include: electronic structure; reactivity and mechanisms of coordination compounds; ligands, descriptive chemistry, reaction mechanisms, characterization of organometallic compounds; catalysis. Prerequisite: CHEM 336.

**CHEM 441. Medicinal Chemistry. (4 Credits)**
This advanced course introduces students to the basics of medicinal chemistry. Students will utilize knowledge gained in chemistry, organic chemistry, and biochemistry in an integrated fashion as applied to modern medicinal chemistry. Topics include descriptions of receptor structure, dynamics, and interactions; different strategies of drug development and design; pharmacodynamics and pharmacokinetics. Extensive discussion of current limitations of the field and real-life case studies will be included. Prerequisite: CHEM 341, CHEM 342. Pre or Corequisite: CHEM 461.

**CHEM 455. Advanced Analytical Chemistry I. (2 Credits)**
Instrumental methods used in analysis and research. Scientific instrumentation electronics, computer interfacing, and signal processing. Cyclic voltammetry and fluorescence techniques. One lecture, three hours laboratory. Prerequisite: CHEM 355. (lin)

**CHEM 457. Advanced Analytical Chemistry II. (2 Credits)**
Instrumental methods used in analysis and research. High performance liquid chromatography, capillary electrophoresis, atomic and mass spectrometry. Tools for nanoscale/single-molecule investigations. One lecture, three hours laboratory. (lin) Prerequisite: CHEM 355.

**CHEM 461. General Biochemistry. (4 Credits)**
The chemical reaction mechanisms of life processes. The structure and function of biomolecules. Protein purification and characterization. Enzyme kinetics. Bioenergetics and the role of metabolic interconversions in energy production. Membrane transport, regulation, and compartmentation. Prerequisites: CHEM 342 or 241.

**CHEM 462. Advanced Biochemistry. (2 Credits)**
Advanced topics in biochemistry, including biosynthesis and action of phospholipids and nitrogen-containing biomolecules. DNA and RNA metabolism. Protein synthesis. Student presentations from the biochemical literature are given. Prerequisite: CHEM 461.

**CHEM 463. Biochemistry Analysis. (4 Credits)**
Laboratory course introducing common biochemistry techniques for experimentation, such as biological sample preparation and handling, preparing biological buffers, protein quantification, activity assays, enzyme kinetics analysis, gel electrophoresis, western blotting, expression and purification of proteins, and biomolecular separations. Each experiment is accompanied by lectures on the theoretical aspects of the topic and requires use of the biochemical literature. One lecture, six hours laboratory. CHEM 355 recommended. Prerequisite: CHEM 342. Pre or Corequisite: CHEM 461. Additional course fee required: $95.

**CHEM 475. Methods in Physical Chemistry. (2 Credits)**
A laboratory-oriented course to give experience in physical chemistry measurements. Experiments on molecular spectroscopy, crystal structure, laser spectroscopy, macromolecules, and kinetics will be included. Each experiment is accompanied by lectures on theoretical aspects of the topic. One lecture, three hours laboratory. Prerequisite: CHEM 371. (lin)

**CHEM 485. Synthesis And Analysis. (2 Credits)**
Laboratory course involving special techniques in the synthesis of organic and inorganic compounds and the spectroscopic methods of their characterization. Six hours laboratory. Alternate years. (lin)

**CHEM 486. Advanced Topics In Chemistry. (2 Credits)**
Special topics of current interest chosen from the areas of inorganic, organic, polymer, industrial, physical, biological, or analytical chemistry. Prerequisite will depend upon the subject. May be taught as a tutorial.

**CHEM 494. Chemistry In Context. (2 Credits)**
Capstone Course: A discussion of chemistry in historical, philosophical, and theological perspective. Includes vocation issues. Prerequisite: CHEM major with senior standing.
**General Education:** SHAR

**CHEM 495. Independent Research. (2 or 4 Credits)**
A research project carried out under the supervision of a chemistry department faculty member. Includes opportunities for collaborative programs with academic, government, and industrial institutions as approved by the department. Prerequisite: consent of instructor.

**CHEM 496. Internship. (1 to 4 Credits)**
Practical experience and training at an academic, government, or industrial laboratory as approved by the department. Graded pass/fail. Prerequisite: junior or senior standing with Chemistry major.

**CHEM 499. Honors Thesis. (4 Credits)**
An independent project requiring original laboratory research developed in a scholarly paper and culminating in an oral examination. Fulfills partial requirement for an honors chemistry degree. Requirements are available in the Chemistry Office or the department web site www.wheaton.edu/chemistry.