

# Chemistry

The Whitworth Chemistry Department strives to develop confident, well-prepared students who are able to contribute to the world community on issues relating to modern chemistry. Our students are expected to develop strong oral and written communication skills, to engage in critical thinking, to develop excellent laboratory skills, to work on independent research, and to prepare for vocations in industrial, academic and professional areas.



The learning outcomes of this major prepare students to...

- understand the development of chemical theory and apply current chemical content to solving problems.
- communicate scientific issues in writing.
- communicate scientific issues verbally.
- use and critically analyze the chemical literature.
- know and use standard lab techniques.
- apply independent research skills learned through research experiences and/or independent projects within courses.
- understand the connections between their faith and/or worldview and the theory and practice of chemistry, ethical decision-making and vocation.

## Requirements for a Chemistry Major, B.A. (46)

One of the following:		3
CH 161	General Chemistry I	
CH 161H	General Chemistry I Honors	
CH 161L	General Chemistry I Lab	1
CH 181	General Chemistry II	3
CH 181L	General Chemistry II Lab	1
CH 271	Organic Chemistry I	3
CH 271L	Organic Chemistry I Lab	1
CH 278	Organic Chemistry II	3
CH 278L	Organic Chemistry II Lab	1
CH 315	Chemical Literature	1
CH 381	Chemistry Seminar	0
CH 481	Chemistry Seminar	1
Approved upper-division chemistry electives *		12
*One writing-intensive course and at least 2 credits of lab required		
(No more than two credits of internship and two credits of teaching assistantship)		
MA 171	Calculus I	4
MA 172	Calculus II	4
PS 151	General Physics I	3

PS 151L	General Physics I Lab	1
PS 153	General Physics II	3
One of the following:		1
PS 153L	General Physics II Lab	
PS 154L	Near Space Research Project	
For teacher certification, the following courses are required:		
CH 331	Environmental Chemistry (3)	
CH 401	Biochemistry I (3)	
CH 401L	Biochemistry I Lab (1)	
CH 403	Biochemistry II (3)	
EN 121	Epic Fails in Engineering (3)	
MA 256	Elementary Probability and Statistics (3)	
EDU 455	Science in Secondary School (2)	

(All endorsements subject to change; see School of Education for updated requirements.)

## Chemistry Core for B.S. Requirements (36)

One of the following		3
CH 161	General Chemistry I	
CH 161H	General Chemistry I Honors	
CH 161L	General Chemistry I Lab	1
CH 181	General Chemistry II	3
CH 181L	General Chemistry II Lab	1
CH 271	Organic Chemistry I	3
CH 271L	Organic Chemistry I Lab	1
CH 278	Organic Chemistry II	3
CH 278L	Organic Chemistry II Lab	1
CH 315	Chemical Literature	1
CH 381	Chemistry Seminar	0
CH 481	Chemistry Seminar	1
CH 494L	Chemistry Research	1
or CH 488L	Chemistry Research	
CH 497	Dissemination of Chemistry Research	1
MA 171	Calculus I	4
MA 172	Calculus II	4
PS 151	General Physics I	3
PS 151L	General Physics I Lab	1
PS 153	General Physics II	3
One of the following:		1
PS 153L	General Physics II Lab	
PS 154L	Near Space Research Project	

Complete one writing-intensive course

For teacher certification, the following additional courses are required:

CH 331	Environmental Chemistry (3)	
CH 401	Biochemistry I (3)	
CH 401L	Biochemistry I Lab (1)	
CH 403	Biochemistry II (3)	
EN 121	Epic Fails in Engineering (3)	
MA 256	Elementary Probability and Statistics (3)	
EDU 455	Science in Secondary School (2)	

All endorsements subject to change; see School of Education for updated requirements.

## General Track for Chemistry, B.S. (64)

Core Requirements		36
CH 335	Analytical Chemistry	3
CH 335L	Analytical Chemistry Lab	1
CH 336	Spectroscopic Analysis	3
CH 336L	Spectroscopic Analysis Lab	1
CH 351	Inorganic Chemistry	3
CH 351L	Inorganic Chemistry Lab	1
CH 401	Biochemistry I	3
CH 401L	Biochemistry I Lab	1
CH 421	Thermochemistry	3
CH 421L	Thermochemistry Lab	1
CH 423	Quantum Chemistry	3
CH 423L	Quantum Chemistry Lab	1
One of the following:		4
MA 273	Calculus III	
PS 251W	Modern Physics	

## Biochemistry Track for Chemistry, B.S. (65-67)

Core Requirements		36
CH 401	Biochemistry I	3
CH 401L	Biochemistry I Lab	1
CH 403	Biochemistry II	3
CH 421	Thermochemistry	3
CH 421L	Thermochemistry Lab	1
Two of the following		7-8
CH 331	Environmental Chemistry	
CH 335	Analytical Chemistry (plus lab)	
CH 336	Spectroscopic Analysis (plus lab)	
CH 340	Forensic Chemistry	
CH 351	Inorganic Chemistry (plus lab)	
CH 423	Quantum Chemistry (plus lab)	

Note: CH-396 courses will apply toward this requirement. See advisor for details.

BI 140	General Biology I: Genes, Cells and Evolution	4
BI 141	General Biology II: Organismal Diversity	4
One of the following		3-4
BI 354	Developmental Biology	
BI 363	Genetics	
BI 399	Molecular Genetics	
BI 404	Neurophysiology	
BI 412	Cell Physiology	
BI 447	Microbial Physiology	

## Physical Chemistry Track for Chemistry, B.S. (65-68)

Core requirements		36
CH 421	Thermochemistry	3
CH 421L	Thermochemistry Lab	1
CH 423	Quantum Chemistry	3
CH 423L	Quantum Chemistry Lab	1
Two of the following		7-8

CH 331	Environmental Chemistry	
CH 335	Analytical Chemistry (plus lab)	
CH 336	Spectroscopic Analysis (plus lab)	
CH 340	Forensic Chemistry	
CH 351	Inorganic Chemistry (plus lab)	
Note: CH-396 courses will apply toward this requirement. See advisor for details.		
MA 273	Calculus III	4
PS 251W	Modern Physics	4
Approved upper-division math or physics courses		6-8

## Requirements for a Chemistry Minor (20)

CH 161	General Chemistry I	3
or CH 161H	General Chemistry I Honors	
CH 161L	General Chemistry I Lab	1
CH 181	General Chemistry II	3
CH 181L	General Chemistry II Lab	1
CH 271	Organic Chemistry I	3
CH 271L	Organic Chemistry I Lab	1
Approved chemistry electives		8

For teacher certification, the following courses are required:

CH 278	Organic Chemistry II (3)
CH 278L	Organic Chemistry II Lab (1)
CH 331	Environmental Chemistry (3)
CH 401	Biochemistry I (3)
CH 401L	Biochemistry I Lab (1)
CH 403	Biochemistry II (3)
EN 121	Epic Fails in Engineering (3)
MA 256	Elementary Probability and Statistics (3)
EDU 455	Science in Secondary School (2)
PS 151	General Physics I (3) *
PS 151L	General Physics I Lab (1)
PS 153	General Physics II (3) *
PS 153L	General Physics II Lab (1)
or PS 154L	Near Space Research Project

All endorsements subject to change; see School of Education for updated requirements.

\* Note: PS 151 has a prerequisite of MA 171 and PS 153 has a prerequisite of MA 172.

## Interdisciplinary Courses

### STEM 115 Preparing for a STEM Career 1

Students will learn about the type of scientific work they would enjoy, explore scientific careers, hear guest speakers, and understand the preparation necessary at the undergraduate level in order to succeed in their chosen career. Spring semesters. Recommended standing: Freshman.

### STEM 151 Seminar for Health Professions 1

A seminar to introduce students to the pre-health fields. Visiting speakers will represent medical, dental and veterinary fields. Course will also cover specifics of courses, majors, and other issues related to pre-health fields. Spring semester.

### STEM 351 Preparatory Seminar: Health Professions 1

A cross-disciplinary course focusing on synthesis of general biology, general chemistry, general physics, organic chemistry, physiology, NMR and IR spectroscopy. Strategic course for learning to apply introductory science/math knowledge to questions involving higher-order content. Intended for students planning to take the Medical College Admissions Test, Dental Aptitude Test, or veterinary-school entrance exams. Intended primarily for students in their junior or senior year. Students will prepare for health professions both in terms of the entrance exams and by researching each school's focus and prerequisites. Prerequisites: BI 140, BI 141, CH 161, CH 181, CH 271, CH 278, PS 151, and PS 153.

## Courses

- CH 101 Introduction to Chemistry** 3  
Introduction to the fundamental concepts in Chemistry for nursing majors, select allied health fields, and those who have not previously taken a Chemistry course. Recommended for health majors whose chemistry background is not adequate for initial placement in CH 161. Fall semester.
- CH 101L Introduction to Chemistry Lab** 1  
Basic laboratory practices, titration, radioisotope measurement, simple synthesis. Corequisite: concurrent enrollment in CH 101. Fall semester. Lab fee.
- CH 102 Bioorganic Chemistry** 3  
Fundamentals of organic chemistry and biochemistry for nursing students. Organic structure, isomerism, nomenclature. Properties and reactions of lipids, carbohydrates, proteins. Prerequisite: CH 101 or CH 161. Spring semester.
- CH 102L Bioorganic Chemistry Lab** 1  
Simple quantitative analysis, separation techniques, enzyme studies. Corequisite: concurrent enrollment in CH 102. Spring semester. Lab fee.
- CH 104 Prep Course for History of Chemistry and Art Study Program in Europe** 1  
Preparatory course for students accepted to the History of Chemistry and Art Study Abroad course. Students will study chemical theory, learn about art history, and ties between chemistry and art. Students will also examine the culture of the European countries to be visited.
- CH 105 Chemistry History and Art in Europe** 3  
This course will examine how chemical ideas have developed over time, how social, cultural and historical factors have influenced the development of science and chemistry and conversely, how chemistry and science have contributed to society and human culture. The course traces the historical development of chemistry from ancient to modern times on site in London, Paris, and Munich. Students will "meet" the chemists, read from their original writings, and see where they lived and what they created. Periodic offering.
- CH 111 Green Chemistry** 3  
The focus will be on environmentally friendly chemistry (green chemistry) applied to the design, development, and implementation of chemical processes and products that are not harmful to humans or the environment. Basic math and algebra skills will be used. For non-majors. Also listed as ENS 112. Periodic Jan Term offering.
- CH 112 Chemistry and Health** 3  
Applications of chemical principles to concepts of health and disease. Overview of chemistry discoveries and their contributions to understanding current health issues. For non-majors. Also listed as ENS 113. Periodic Jan Term offering.
- CH 120H The Chemistry in Art** 3  
Chemistry applied to understanding art media, color, and form as well as art appreciation, history, analysis and conservation. Explore chemistry concepts through arts & crafts projects. Appropriate for non-science students. No pre-requisites. Meets honors course criteria. Periodic Jan term offering.

**CH 122 Chemistry in Modern Living** 3

Overview of current chemical issues, for the non-science student. Topics may include air pollution, global warming, ozone layer, acid rain, nuclear energy, solar energy, plastics, nutrition and/or pharmaceutical drugs. Basic math and algebra skills will be used. For non-majors. Also listed as ENS 122. Periodic Jan Term offering.

**CH 161 General Chemistry I** 3

Foundational course in chemistry. Treatment of measurement concepts, atomic and molecular theories, chemical reactions, chemical bonding, basic calculations. One year of high school chemistry recommended. Passing score on placement test and demonstrated mathematics proficiency required. Students without this prerequisite must take CH 101 before electing CH 161. Fall and spring semesters.

**CH 161H General Chemistry I Honors** 3

Foundational course in chemistry. CHEM 161H differs from the regular CHEM 161 offering in its small class size, its emphasis on active, collaborative, and problem-based learning, and a more rigorous, process-oriented approach. The dominant theme of the course is the connection between the molecular-level attributes of matter (elemental composition, atomic structure and electronic configurations, bonding, molecular structure and intermolecular forces) and the observable physical and chemical properties of individual substances as applied in the real world. One year of high school chemistry recommended and math proficiency required. Fall semester.

**CH 161L General Chemistry I Lab** 1

Basic laboratory techniques, simple synthesis, titration, qualitative analysis. Prerequisite: CH 161, CH 161H, or concurrent enrollment. Fall and spring semesters. Lab fee.

**CH 181 General Chemistry II** 3

Properties of solutions, introduction to kinetics, acid-base concepts, equilibrium, nuclear radioactivity, electrochemistry, and thermochemistry. Prerequisite: CH 161 or CH 161H. Fall and spring semesters.

**CH 181L General Chemistry II Lab** 1

Titration, equilibrium constant determination, reaction kinetics, electrochemical studies. Prerequisites: CH 161L and concurrent enrollment in CH 181. Fall and spring semesters. Lab fee.

**CH 271 Organic Chemistry I** 3

Detailed treatment of basic organic chemistry concepts. Nomenclature, conformational and structural analysis, basic reaction mechanisms. Prerequisite: CH 181. Fall and Spring semesters.

**CH 271L Organic Chemistry I Lab** 1

Preparation, purification and identification of organic compounds. An introduction to organic synthesis. Prerequisites: CH 181L and concurrent enrollment in CH 271. Fall and spring semesters. Lab fee.

**CH 278 Organic Chemistry II** 3

Reactions of organic molecules, mechanisms of reactions, and how such reactions may be employed in the synthesis of new compounds. Prerequisite: CH 271 with minimum grade of C-. Spring semester.

**CH 278L Organic Chemistry II Lab** 1

Synthetic techniques for organic compounds, design of multi-step synthesis, introduction to chemical literature, and spectroscopy. Prerequisites: CH 271L and concurrent enrollment in CH 278. Spring semester. Lab fee.

**CH 304 Prep Course for History of Chemistry and Art Study Program in Europe** 1

Preparatory course for students accepted to the History of Chemistry and Art Study Abroad course. Students will study chemical theory, learn about art history, and ties between chemistry and art, in addition to doing an in-depth literature research review of a historical chemist. Students will also examine the culture of the European countries to be visited.

- CH 305 Chemistry History and Art in Europe** 3  
 This course will examine how chemical ideas have developed over time, how social, cultural and historical factors have influenced the development of science and chemistry and conversely, how chemistry and science have contributed to society and human culture. The course traces the historical development of chemistry from ancient to modern times on site in London, Paris, and Munich. Students will "meet" the chemists, read from their original writings, and see where they lived and what they created. Periodic offering.
- CH 310 Chemical Entrepreneurs** 3  
 This class will examine in detail the role a chemist plays in bringing products to market, and how Chemistry interfaces with the many facets of modern companies. Be your own boss and explore your entrepreneurial instincts as you and your team "startup" your own company and design a "virtual" chemistry-based product, modelling it by computer. Actual synthesis/building of the product will not be required. Prerequisite: CH 271. Also listed as CH 310W. Periodic offering.
- CH 315 Chemical Literature** 1  
 An examination of current scientific literature and writing in chemistry. Students will gain skills in searching, reading and analysis of chemical literature. Students will practice writing using conventions found in chemistry. Prerequisite: CH 271. Fall and spring semesters.
- CH 325L Community Chemistry Outreach** 1  
 Promotion of science education through service-learning opportunities in the community, such as the presentation of fun chemistry experiments/demos as part of departmental outreach efforts to local K-12 students. Prerequisite: CH 101 or CH 161. Jan Term and periodic spring.
- CH 331 Environmental Chemistry** 3  
 Study of the environment from a systems approach. Includes study of the hydrosphere (water), atmosphere (air), and geosphere (earth) and interactions with the anthroposphere (humans). Prerequisites: CH 271. Also listed as ENS 331 and CH 331W.
- CH 331W Environmental Chemistry** 3
- CH 335 Analytical Chemistry** 3  
 Approaches to analyte separation and quantification including sampling, quality control, basic statistics, advanced treatment of equilibrium and electrochemistry, spectroscopic instrumentation, and chromatography. Prerequisites: CH 181 and CH 271 (CH 278 suggested). Also listed as CH 335W. Fall semesters, even years.
- CH 335L Analytical Chemistry Lab** 1  
 Statistical analysis of data, separation techniques, use of instrumentation in solving analytical problems. Corequisite: concurrent enrollment in CH 335 or 335W. Fall semesters, even years. Lab fee.
- CH 336 Spectroscopic Analysis** 3  
 Advanced treatment of the most common spectroscopic techniques including UV-Vis, IR, NMR, and GC-MS. Prerequisites: CH 181 and CH 278. Also listed as CH 336W. Fall semester, odd years.
- CH 336L Spectroscopic Analysis Lab** 1  
 Use of instrumentation in solving analytical problems. Prerequisite: concurrent enrollment in CH 336 or CH 336W. Fall semester, odd years. Lab fee.
- CH 340 Forensic Chemistry** 3  
 An examination of chemical theories and practices related to the analysis of chemical evidence in criminal investigations. This course will cover the major techniques and instruments used in the analysis of chemical and pattern evidence commonly used when analyzing forensic samples, including toxicology, explosive and firearms residues, drug classification, and ink and paint analysis. Periodic offering.
- CH 351 Inorganic Chemistry** 3

A study of the elements (especially metals) and their compounds. Bonding, crystal-field theory, coordination compounds, organometallics, symmetry, group theory and descriptive inorganic chemistry. Prerequisites: CH 181 and MA 171. Also listed as CH 351W. Fall semester, even years.

**CH 351L Inorganic Chemistry Lab** **1**

Approaches to synthesis of inorganic compounds. Corequisite: concurrent enrollment in CH 351 or CH 351W. Fall semester, even years. Lab fee.

**CH 381 Chemistry Seminar** **0**

Discussion of current chemical topics. Listen to and discuss student presentations, guest lectures; attend local scientific meetings. Fall and spring semesters.

**CH 394L Chemistry Research** **0**

Research in chemistry, first semester. By permission.

**CH 401 Biochemistry I** **3**

Structure and function of major classes of biomolecules. Overview of enzyme catalysis and kinetics. Prerequisites: CH 271 and CH 278. Also listed as CH 401W. Fall semester.

**CH 401L Biochemistry I Lab** **1**

Separations, assays and kinetic studies in biochemical systems. Primary focus is on amino acids, peptides, and protein enzymes. Prerequisites: CH 271L and CH 401. Spring semester. Lab fee.

**CH 403 Biochemistry II** **3**

Metabolic pathways and biochemical energy conversions. Overview of gene transcription, translation, and cellular controls. Prerequisite: CH 401. Also listed as CH 403W. Spring semester.

**CH 421 Thermochemistry** **3**

Kinetics, thermodynamics, liquids and solids, changes of state, phase diagrams. Prerequisites: CH 181, PS 153, and MA 172. Also listed as CH 421W. Spring semester.

**CH 421L Thermochemistry Lab** **1**

Energetic, kinetic and thermodynamic studies. Primary focus is on phase transitions, mixtures, and gases. Corequisite: concurrent enrollment in CH 421 or CH 421W. Spring semester. Lab fee.

**CH 423 Quantum Chemistry** **3**

Basic quantum mechanical theories, and its application to lasers, magnetism, molecular structure, and vibrational and electronic spectroscopy. Prerequisites: CH 181, PS 153 and MA 172. Also listed as CH 423W. Fall semester, odd years.

**CH 423L Quantum Chemistry Lab** **1**

Infrared and electronic spectroscopy, laser spectroscopy and computer modeling of quantum chemistry problems. Corequisite: concurrent enrollment in CH 423 or CH 423W. Fall semesters, odd years. Lab fee.

**CH 481 Chemistry Seminar** **1**

Discussion of current chemical topics. Student presentations, guest lectures; attend local scientific meetings. Oral scientific presentation required. Fall and spring semesters.

**CH 488L Chemistry Research** **1**

Student pursuit of a laboratory problem of fundamental interest to chemistry. By permission. Prerequisite: CH 315. Jan Term.

**CH 490H Internship** **1-12**

**CH 494L Chemistry Research** **1**

Research in chemistry, second semester, or for students completing research off campus at another university, an industry site or a national laboratory. By permission.



**CH 497 Dissemination of Chemistry Research****1**

Research performed on campus or off-campus will be shared with others. Students are expected to complete a research paper and give a presentation to a conference audience. The course should be taken in the Spring semester after completion of chemistry research. By permission. Prerequisite: CH 494L or CH 488L. Spring semester.

# Font Notice

This document should contain certain fonts with restrictive licenses. For this draft, substitutions were made using less legally restrictive fonts. Specifically:

Times was used instead of Adobe Garamond Pro.

The editor may contact Leepfrog for a draft with the correct fonts in place.