

# 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
- Understand the connections between their faith and/or worldview and the theory and practice of chemistry and ethical decision-making

B.S. students will also do the following:

- Demonstrate the ability to conduct research through the development and use of experiments to test a hypothesis

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

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
CH 278	Organic Chemistry II	3
CH 278L	Organic Chemistry II Lab	1
CH 320W	Scientific Literacy and Communication	3

Approved upper-division chemistry electives \* 11

\*At least two credits of lab required

No more than 2 credits of internships or independent study, no more than 2 credits of teaching assistantships, no more than 4 credits of Chemistry research (CH 488LH or CH 494LH), and no more than 4 total credits for any combination of the above will count towards chemistry electives.

MA 171	Calculus I	4
MA 172	Calculus II	4

One of the following year-long sequences: 8

PS 131 & 131L	College Physics for Life Sciences and College Physics for Life Sciences Laboratory I	
PS 133 & 133L	College Physics for Life Sciences II and College Physics for Life Sciences Lab II	
PS 151 & 151L	General Physics I and General Physics I Lab	
PS 153 & 153L	General Physics II and General Physics II Lab	

For teacher certification, the following course is required:

EDU 455W	Science in Secondary School (2)	
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For teacher certification, the following courses are strongly suggested:

CH 325L	Community Chemistry Outreach	
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CH 331	Environmental Chemistry	
CH 335	Modern Analytical Chemistry	
CH 335L	Modern Analytical Chemistry Lab	
CH 401	Biochemistry I	
CH 401L	Biochemistry I Lab	
SI for General Chemistry		
MA 256	Elementary Probability and Statistics (3)	

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

## Chemistry Major, B.A. (Pre-Pharmacy Track) (52)

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
CH 278	Organic Chemistry II	3
CH 278L	Organic Chemistry II Lab	1
CH 320W	Scientific Literacy and Communication	3
CH 401	Biochemistry I	3
CH 401L	Biochemistry I Lab	1
CH 403	Biochemistry II	3
Approved upper-division chemistry electives* at least one credit of lab required		7
HS 220	Anatomy and Physiology I	4
& 220L	and Lab: Anatomy and Physiology I	
or BI 350	Comparative Vertebrate Anatomy	
HS 221	Anatomy and Physiology II	4
& 221L	and Lab: Anatomy and Physiology II	
or BI 323	Animal Physiology	
BI 306	Medical Microbiology	4
BI 306L	Medical Microbiology Lab	0
MA 171	Calculus I	4
MA 256	Elementary Probability and Statistics	3
or MA 256H	Elementary Probability and Statistics	

Recommended:

BI 140	General Biology I: Genes, Cells and Evolution	
& 140L	and General Biology I: Genes, Cells and Evolution Lab	
BI 143	General Biology II: Ecology and Evolution	
& 143L	and Ecology and Evolution Lab	

One of the following year-long sequences

PS 131	College Physics for Life Sciences	
& 131L	and College Physics for Life Sciences Laboratory I	
PS 133	College Physics for Life Sciences II	
& 133L	and College Physics for Life Sciences Lab II	
or		
PS 151	General Physics I	
& 151L	and General Physics I Lab	
PS 153	General Physics II	
& 153L	and General Physics II Lab	

\* Up to 7 credits of upper division chemistry credit may be transferred from WSU Spokane School of Pharmacy.

## Chemistry Core for B.S. Requirements (36-37)

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 320W	Scientific Literacy and Communication	3

One of the following options: 1-2

CH 387 & 387L	Chemistry Experimental Design and Chemistry Experimental Design Lab	
or		
CH 494LH	Chemistry Research	
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
PS 153L	General Physics II Lab	1
or PS 154L	Near Space Research Project	

For teacher certification, the following course is required:

EDU 455W	Science in Secondary School	
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For teacher certification, the following additional courses are strongly suggested:

CH 325L	Community Chemistry Outreach	
CH 331	Environmental Chemistry	
CH 335	Modern Analytical Chemistry	
CH 335L	Modern Analytical Chemistry Lab	
CH 401	Biochemistry I	
CH 401L	Biochemistry I Lab	
SI for General Chemistry		
MA 256	Elementary Probability and Statistics (3)	

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

## General Track for Chemistry, B.S. (60)

Core requirements 36

Five of the following 20

CH 331	Environmental Chemistry (plus lab)	
CH 335	Modern Analytical Chemistry (plus lab)	
CH 336	Spectroscopic Analysis (plus lab)	
CH 351	Inorganic Chemistry (plus lab)	
CH 401	Biochemistry I (plus lab)	
CH 421	Thermochemistry (plus lab)	

CH 423	Quantum Chemistry (plus lab)	
Approved upper-division chemistry electives		4
No more than 2 credits of internships or independent study, no more than 2 credits of teaching assistantships, no more than 4 credits of Chemistry research (CH 488LH or CH 494LH), and no more than 4 total credits for any combination of the above will count towards chemistry electives.		

## 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
One of the following:		4
CH 331	Environmental Chemistry (plus lab)	
CH 335	Modern Analytical Chemistry (plus lab)	
CH 336	Spectroscopic Analysis (plus lab)	
CH 351	Inorganic Chemistry (plus lab)	
CH 423	Quantum Chemistry (plus lab)	
Approved upper-division chemistry electives		3-4
No more than 2 credits of internships or independent study, no more than 2 credits of teaching assistantships, no more than 4 credits of Chemistry research (CH 488LH or CH 494LH), and no more than 4 total credits for any combination of the above will count towards chemistry electives.		
BI 140	General Biology I: Genes, Cells and Evolution	4
BI 143	General Biology II: Ecology and Evolution	4
One of the following:		3-4
BI 399	Molecular Genetics	
CH 402	The Biochemistry of DNA and RNA	

## Physical Chemistry Track for Chemistry, B.S. (61-64)

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:		8
CH 331	Environmental Chemistry (plus lab)	
CH 335	Modern Analytical Chemistry (plus lab)	
CH 336	Spectroscopic Analysis (plus lab)	
CH 351	Inorganic Chemistry (plus lab)	
CH 401	Biochemistry I (plus lab)	
Approved upper-division chemistry electives		3-4
No more than 2 credits of internships or independent study, no more than 2 credits of teaching assistantships, no more than 4 credits of Chemistry research (CH 488LH or CH 494LH), and no more than 4 total credits for any combination of the above will count towards chemistry electives.		
Approved math or physics courses		6-8
MA 273	Calculus III	
MA 278	Discrete Mathematics	
MA 330	Linear Algebra	
PS 251W	Modern Physics	

## 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 course is required:

EDU 455W	Science in Secondary School (2)
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For teacher certification, the following courses are strongly suggested:

CH 278	Organic Chemistry II
CH 278L	Organic Chemistry II Lab
CH 325L	Community Chemistry Outreach
CH 335	Modern Analytical Chemistry
CH 335L	Modern Analytical Chemistry Lab
CH 331	Environmental Chemistry
CH 401	Biochemistry I
CH 401L	Biochemistry I Lab
SI for General Chemistry	
MA 256	Elementary Probability and Statistics
PS 131 & 131L	College Physics for Life Sciences and College Physics for Life Sciences Laboratory I
PS 133 & 133L	College Physics for Life Sciences II and College Physics for Life Sciences Lab II

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

## Interdisciplinary Courses

### STEM 126 Seminar for Health Professions

1

A seminar to introduce students to the pre-health fields. Visiting speakers will represent medical, dental, pharmacy, and veterinary fields. This course will cover the specifics of courses, majors, and other issues related to pre-health fields. Students will also reflect on the importance of the connections between academic disciplines as they consider future vocational options. Recommended for pre-health professional students interested in the fields listed above. This seminar fulfills the SC 126 Shared Curriculum requirement. 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 143, CH 161, CH 181, CH 271, CH 278, PS 151 & 153 or PS, 131 & 133.

## Courses

### CH 101 Introduction to Chemistry

3

Introduction to the fundamental concepts in chemistry for nursing majors, select allied health fields. Fall semester. Restricted to allied health majors.

<b>CH 101L Introduction to Chemistry Lab</b>	<b>1</b>
Basic laboratory practices, titration,,radioisotope measurement, simple synthesis.,Corequisite: concurrent enrollment in CH,101. Fall semester. Also offered summer semesters.,Lab fee.	
<b>CH 102 Bioorganic Chemistry</b>	<b>3</b>
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. Also offered,summer semesters online.	
<b>CH 102L Bioorganic Chemistry Lab</b>	<b>1</b>
Simple quantitative analysis, separation,techniques, enzyme studies. Corequisite:,concurrent enrollment in CH 102. Spring semester.,Also offered summer semesters. Lab fee.	
<b>CH 104 Prep Course for History of Chemistry and,Art Study Program in Europe</b>	<b>1</b>
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.	
<b>CH 105 Chemistry History and Art in Europe</b>	<b>3</b>
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.	
<b>CH 111 Green Chemistry</b>	<b>3</b>
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.	
<b>CH 112 Chemistry and Health</b>	<b>3</b>
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.	
<b>CH 114 Science of Cooking</b>	<b>3</b>
This non-majors course will be a scientific,exploration of the food we eat. Students will,learn chemistry and biology concepts applied to,food and cooking. The course will also explore the,scientific process through the optimization of,recipes. The course will require students to,complete cooking experiments at home.	
<b>CH 120H The Chemistry in Art</b>	<b>3</b>
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.	
<b>CH 122 Chemistry in Modern Living</b>	<b>3</b>
Overview of current chemical issues for the,non-science student. Topics may include air,pollution, climate change, ozone layer, acid rain,,nuclear energy, alternative energy, plastics,,nutrition, nutrition, and/or pharmaceutical drugs.,Basic math and algebra skills will be used. For,non-majors. Also listed as ENS 122. Periodic,offering.	

<b>CH 161 General Chemistry I</b>	<b>3</b>
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 the, Whitworth Mathematics Readiness Check or C- in MA, 130 College Algebra required. Students that do not, pass must complete MA 130 College Algebra with a, C- or better prior to enrolling in CH 161. Fall, and spring semesters.	
<b>CH 161H General Chemistry I Honors</b>	<b>3</b>
Foundational course in chemistry. CH 161H differs, from the regular CH 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. Passing score on the, Whitworth Mathematics Readiness Check or C- in MA, 130 College Algebra required. Students that do not, pass must complete MA 130 College Algebra with a, C- or better prior to enrolling in CH 161. Fall,, periodically.	
<b>CH 161L General Chemistry I Lab</b>	<b>1</b>
Basic laboratory techniques, simple synthesis,, titration, qualitative analysis. Prerequisite: CH, 161, CH 161H, or concurrent enrollment. Fall and, spring semesters. Lab fee.	
<b>CH 181 General Chemistry II</b>	<b>3</b>
Properties of solutions, introduction to kinetics,, acid-base concepts, equilibrium, nuclear, radioactivity, electrochemistry, and, thermochemistry. Prerequisite: CH 161 or CH 161H, with minimum grade of C-. Fall and spring, semesters.	
<b>CH 181L General Chemistry II Lab</b>	<b>1</b>
Titrations, equilibrium constant determination,, reaction kinetics, electrochemical studies,, Prerequisites: CH 161L and concurrent enrollment, in CH 181. Fall and spring semesters. Lab fee.	
<b>CH 271 Organic Chemistry I</b>	<b>3</b>
Detailed treatment of basic organic chemistry, concepts. Nomenclature, conformational and, structural analysis, basic reaction mechanisms,, Prerequisite: CH 181 with minimum grade of C-.	
<b>CH 271L Organic Chemistry I Lab</b>	<b>1</b>
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.	
<b>CH 278 Organic Chemistry II</b>	<b>3</b>
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.	
<b>CH 278L Organic Chemistry II Lab</b>	<b>1</b>
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.	
<b>CH 304 Prep Course for History of Chemistry and, Art Study Program in Europe</b>	<b>1</b>
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 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 320W Scientific Literacy and Communication** 3

This course is intended to equip each student with the skills needed to quickly and comfortably search, read, and utilize the chemical literature. Students will practice leading discussions of scientific topics and give an oral presentation on a research topic. This is a writing intensive course and students will learn to write in the style of a chemist through multiple assignments. Finally, chemistry encompasses many different paths and through exploring various topics, interacting with a variety of people, students will get the opportunity to expand their ideas about vocation.

**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 anthrosphere (humans). Offered Spring semesters, even years. Prerequisites: CH 271. Also listed as ENS 331 and CH 331W.

**CH 331L Environmental Chemistry Lab** 1

Explore the laboratory methods typical in environmental analysis. Includes sampling, techniques, use of certified protocol(s), and spectroscopic and instrumental analysis. Also listed as ENS-331L. Corequisite: concurrent enrollment in CH331, CH331W, or ENS331. Spring semester even years.

**CH 335 Modern Analytical Chemistry** 3

Overview of the science of analytical chemistry, including statistical treatment of collected data, and modern analytical methods of analysis, including titrations, electrochemistry, spectroscopy, chromatography, and mass spectrometry. Specific emphasis will be placed on core concepts of analysis and applied method, selection throughout the covered concepts. Prerequisites: CH 181. Spring semesters, odd years.

**CH 335L Modern Analytical Chemistry Lab** 1

Laboratory corequisite of CH335 (Analytical Chemistry) with focus on mastery of quantitative, analytical methods including titrations, electrochemistry, spectroscopy, chromatography, and mass spectrometry. Corequisite: concurrent enrollment in CH 335. Spring semester, odd 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 278. 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.



<b>CH 340 Forensic Chemistry</b>	<b>3</b>
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.	
<b>CH 342 Food Chemistry</b>	<b>3</b>
This course will cover chemistry concepts relating, to food science and cooking. Includes the study of, macromolecules and chemical reactions that occur, in the cooking process. The course will cover, applications of science in food industry as well, as cooking in the home.	
<b>CH 345 Supramolecular Chemistry</b>	<b>3</b>
This course will examine the fundamental basis for, molecular assembly and illustrate how, intermolecular interactions can be exploited to, form diverse supramolecular architectures ranging, from small molecules to biological systems. The, course will present an overview of the current, advances in supramolecular systems and provide, students with an awareness and appreciation of the, broader relevance of supramolecular chemistry as, applied to organic assemblies, coordination, building units and systems of higher complexity., Prerequisite: CH 271. Jan term, odd years.	
<b>CH 345W Supramolecular Chemistry</b>	<b>3</b>
This course will examine the fundamental basis for, molecular assembly and illustrate how, intermolecular interactions can be exploited to, form diverse supramolecular architectures ranging, from small molecules to biological systems. The, course will present an overview of the current, advances in supramolecular systems and provide, students with an awareness and appreciation of the, broader relevance of Supramolecular Chemistry as, applied to organic assemblies, coordination, building units and systems of higher complexity.	
<b>CH 351 Inorganic Chemistry</b>	<b>3</b>
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.	
<b>CH 351L Inorganic Chemistry Lab</b>	<b>1</b>
Approaches to synthesis of inorganic compounds., Corequisite: concurrent enrollment in CH 351 or, CH 351W. Fall semester, even years. Lab fee.	
<b>CH 381 Chemistry Seminar</b>	<b>0</b>
Discussion of current chemical topics. Listen to, and discuss student presentations, guest, lectures. Fall and spring semesters.	
<b>CH 387 Chemistry Experimental Design</b>	<b>1</b>
This course is designed for junior or senior, students completing a B.S. degree in chemistry who, may be interested in pursuing professional school, or an industrial position after graduating from, Whitworth. Students will be introduced to a, research area through reading, discussing, and, writing about primary literature. At the beginning, of the semester, students will practice skills and, techniques using prescribed protocols to hands-on, skills and learn about experimental design. For, the remainder of the semester, students will carry, out a research project in order to gain experience, with experimental design, troubleshooting, and the, complex nature of scientific inquiry., Prerequisite: CH 315. Spring semester.	
<b>CH 387L Chemistry Experimental Design Lab</b>	<b>1</b>
In this laboratory, students will engage in, critical thinking, will develop advanced, laboratory skills, and work on independent, research. Students will be introduced to a, research area through primary literature and, develop skills and techniques specific to the, research area and experimental design. Students, will then carry out a research project to gain, experience with experimental design,, troubleshooting, and the complex nature of, scientific inquiry.	

<b>CH 394L Chemistry Research</b>	<b>0</b>
Research in chemistry, first semester. By permission.	
<b>CH 401 Biochemistry I</b>	<b>3</b>
Structure and function of major classes of biomolecules. Overview of enzyme catalysis and kinetics. Prerequisites: CH 278. Also listed as CH 401W. Fall semester.	
<b>CH 401L Biochemistry I Lab</b>	<b>1</b>
Biochemical separations, assays and enzyme studies. Primary focus is on proteins and nucleic acids. Prerequisites: CH 271L and CH 401. Spring Semester. Lab fee.	
<b>CH 402 The Biochemistry of DNA and RNA</b>	<b>3</b>
In depth study of nucleic acid structure and function. Overview of replication, transcription, translation, and control of gene expression. The history and gender inequalities surrounding the discovery of DNA structure will also be examined. Prerequisites: CH 401. Jan Term, odd years.	
<b>CH 403 Biochemistry II</b>	<b>3</b>
Metabolic pathways and biochemical energy conversions. Overview of cellular signaling pathways and controls. Prerequisite: CH 401. Also listed as CH 403W. Spring semester.	
<b>CH 421 Thermochemistry</b>	<b>3</b>
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.	
<b>CH 421L Thermochemistry Lab</b>	<b>1</b>
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.	
<b>CH 423 Quantum Chemistry</b>	<b>3</b>
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.	
<b>CH 423L Quantum Chemistry Lab</b>	<b>1</b>
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.	
<b>CH 481 Chemistry Seminar</b>	<b>1</b>
Discussion of current chemical topics. Student presentations, guest lectures; attend local scientific meetings. Oral scientific presentation required. Fall and spring semesters.	
<b>CH 488LH Chemistry Research</b>	<b>1</b>
Student pursuit of a laboratory problem of fundamental interest to chemistry. By permission. Prerequisite: CH 315. Jan Term.	
<b>CH 490H Internship</b>	<b>1-12</b>
<b>CH 494LH Chemistry Research</b>	<b>1</b>
Research in chemistry, second semester, or for students completing research off campus at another university, an industry site or a national laboratory. By permission.	
<b>CH 497H Dissemination of Chemistry Research</b>	<b>1</b>
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.	