

CHEMISTRY

The Wabash College Chemistry Department believes in a challenging curriculum, which thoroughly investigates all areas of modern chemistry, and in a significant hands-on laboratory experience in which students become progressively more independent as they proceed through the curriculum. We believe that such an education prepares chemistry majors for a variety of career outcomes, including those in research, medicine, teaching, and industry. In recent years, three-fourths of our majors have gone to graduate school in chemistry/biochemistry or to medical school following graduation. Others have chosen to take jobs as chemists or high school teachers or to attend other professional schools (business, law, and physical therapy). We strive to provide chemistry minors and pre-medical students with the knowledge base they need to succeed in their chosen fields. We seek to involve all Wabash students in the study of chemistry through non-majors courses such as CHE-101 Survey of Chemistry and CHE-106 Survey of Biochemistry. We attempt to teach all chemistry students about the relationship between chemistry and the world around them.

Goals

The core goals of the Chemistry Major are:

- Students will acquire a broad-based knowledge of general, organic, physical, analytical, inorganic, and biochemistry, and understand how these areas are interconnected.
- Students will be able to connect theory with experimental work, including being able to design, execute, and analyze experiments, and to present their results effectively. Students will develop confidence and precision in their laboratory technique.
- Students will have the ability to identify, comprehend, evaluate, and discuss primary chemical literature.
- Students will be able to effectively communicate chemical concepts to chemists, scientists, and the general public.
- Students will develop as scientists through research experiences.
- Students will engage the chemical and biochemical communities at Wabash and beyond.

Faculty Advisors

Majors are strongly urged to select an advisor from the Chemistry Department when they declare their major.

ACS Certified Degree

To meet the certification requirements formulated by the American Chemical Society Committee on Professional Training (CPT) as a chemist and for adequate preparation for graduate school, additional classroom and laboratory work beyond the minimum nine-course major is required. The student should consult with the Chair of the Chemistry Department concerning ways in which the remaining requirements may be fulfilled.

Advanced Placement

Please refer to the Credit by Examination and Advanced Placement Credit guidelines under Academic Policies - Transfer Credit. Potential chemistry majors and minors who wish to claim advanced placement credit should discuss placement options with the Department Chair. A placement examination will determine if students are eligible to being coursework beyond CHE-111 General Chemistry.

Requirements for the Chemistry Major

Code	Title	Credits
Core		
CHE-111	General Chemistry	1
CHE-241	Inorganic Chemistry	1
CHE-221	Organic Chemistry I	1
CHE-321	Organic Chemistry II	1
CHE-331	Analytical Chemistry	1
CHE-351	Physical Chemistry	1
CHE-361	Biochemistry	1
Electives		2
Select two credits from the following:		
CHE-421	Advanced Topics in Organic Chemistry ¹	
CHE-431	Adv Laboratory	
CHE-441	Adv Inorganic Chem ¹	
CHE-451	Physical Chemistry II	
CHE-461	Advanced Biochemistry ¹	
CHE-462	Advanced Biochemistry	
CHE-471	Special Topics in Chem ¹	
CHE-487	Undergrad Research Experience ²	
CHE-488	Undergrad Research Experience ²	
Total Credits		9

Code	Title	Credits
Collateral Requirements		
MAT-110	Calc I With Pre-Calc Review	1
	or MAT-111 Calculus I	
MAT-112	Calculus II	1
PHY-111	Physics I - Calculus	1
	or PHY-109 Physics I - Algebra	
Select one course from the following: PHY-110, PHY-112, CSC-111, MAT-223		1
Total Credits		4

¹ May be repeated when the topics change

² No more than one-half course credit of independent study may be used to construct the minimum nine-course major.

CHE-101 Survey of Chemistry, CHE-102 Topics in Chemistry, and CHE-106 Survey of Biochemistry do not count toward the major or minor.

The mathematics courses are best taken in the freshman year (e.g. MAT-010 Pre-Calc With Intro to Calc and MAT-110 Calc I With Pre-Calc Review or MAT-111 Calculus I and MAT-112 Calculus II), and the physics sequence are best taken in the sophomore year. Chemistry majors who intend to pursue a graduate degree are **strongly encouraged** to take the collateral requirements: PHY-111 and PHY-112.

Suggested order of courses for the chemistry major

Course	Title	Credits
Freshman		
Fall Semester		
CHE-111	General Chemistry	1
MAT-111	Calculus I	1
Credits		2

Spring Semester

CHE-241	Inorganic Chemistry	1
MAT-112	Calculus II	1
Credits		2

Sophomore

Complete collateral requirement when offered: PHY-110, PHY-112, CSC-111, or MAT-223		1
Credits		1

Fall Semester

CHE-221	Organic Chemistry I	1
PHY-111	Physics I - Calculus or PHY-109 or Physics I - Algebra	1

We recommend that students pursuing a graduate degree take PHY-111 this semester.

Credits		2
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Spring Semester

CHE-321	Organic Chemistry II	1
We recommend that students pursuing a graduate degree take PHY-112 this semester.		

Credits		1
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Junior**Fall Semester**

CHE-351	Physical Chemistry	1
Credits		1

Spring Semester

CHE-331	Analytical Chemistry	1
CHE-361	Biochemistry	1
Credits		2

Senior

Plus two additional elective credits taken in the junior or senior year		2
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Credits		2
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Total Credits		13
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Strongly Recommended Supporting Coursework

Code	Title	Credits
BIO-111	General Biology I	1
BIO-112	General Biology II	1
More Mathematics, particularly:		
MAT-223	Elementary Linear Algebra	1
MAT-224	Elem Differential Equations	1
MAT-225	Multivariable Calculus	1
More Physics, particularly:		
PHY-210	Intro Quantum Theory & Apps	1
PHY-310	Classical Mechanics	1
CSC-111	Intro to Programming	1
Total Credits		8

Chemistry majors who wish to transfer chemistry credits from another institution as part of their major must have prior approval of the Department Chair to do so.

Comprehensive Exams

The written comprehensive examination for senior majors emphasizes both knowledge of basic chemical concepts and the ability to apply these concepts to new problems. The exam includes written questions over material from the seven core chemistry courses, a laboratory practical, and a primary literature component. Students that fail to complete their seven core chemistry courses by the time of the written examination must petition the Department Chair for a special exam no later than the fall prior to their comprehensive examination.

Requirements for the Chemistry Minor

The following courses are required for the chemistry minor:

Code	Title	Credits
CHE-111	General Chemistry	1
CHE-241	Inorganic Chemistry	1
CHE-221	Organic Chemistry I	1
Select one course from the following: CHE-321, CHE-331, CHE-351, CHE-361		1
Select one other course credit from the departmental offerings above CHE-221		1
Total Credits		5

No more than one-half course credit of independent study (CHE-487 Undergrad Research Experience, CHE-488 Undergrad Research Experience) may be used to construct the minimum five-course minor. Chemistry minors who wish to transfer a chemistry course credit from another institution as part of their minor must have prior approval of the Department Chair to do so; no more than one course credit of transfer credit from another institution may count as part of their minor.

CHE-101 Survey of Chemistry

A survey course designed for non-science concentrators, which considers the historical and philosophical developments in chemistry, as well as the application of chemical principles to physical phenomena and social issues. Topics include the development of the atomic theory of matter, atomic structure, chemical bonding, thermodynamics, the chemistry of life (organic and biochemistry), and nuclear energy. Some elementary mathematics will be used. Three lectures and one laboratory each week. Partially fulfills the College laboratory science requirement, but cannot be combined with CHE 111 to complete the laboratory science requirement. This course does not satisfy requirements for the chemistry major or minor. Only CHE 101 or CHE 111, not both, may be counted toward the total number of credits required for graduation.

Prerequisites: none

Corequisites: Co-Requisite: CHE-101L

Credit: 1

Distribution: Science Lab, Natural Science/Mathematics, Quantitative Literacy

CHE-102 Topics in Chemistry

A study of topics of current interest in chemistry. Topics and prerequisites will vary and will be announced prior to registration. Does not count towards the chemistry major or minor; however, it will count towards the 11-course maximum. Does not count towards the laboratory science distribution requirement.

Prerequisites: none

Credits: 0.5

Distribution: Natural Science/Mathematics

CHE-106 Survey of Biochemistry

Foods, medical treatments, and biotechnological applications are important aspects of daily life, both for the individual and society as a whole. This course will focus on the biochemistry of the fundamental building blocks of life: proteins, carbohydrates, lipids, and nucleic acids. It will include a broad overview of general and organic chemistry in the context of biomolecules. Emphases will include structure-function relationships, energy, human health, and societal issues. This course fulfills the lab science requirement, but does not count towards the chemistry, biochemistry, or biology majors or minors.

Prerequisites: none

Credit: 1

Distribution: Science Lab, Natural Science/Mathematics, Quantitative Literacy

CHE-111 General Chemistry

This is the introductory course for science concentrators. Topics include atomic theory, stoichiometry, thermo chemistry, equilibrium, gas laws, states of matter, solutions, atomic structure, and acid/base chemistry. The laboratory, which emphasizes the basic principles discussed in lecture, includes significant synthetic and analytical work. Three lectures and one laboratory each week. This course is offered in the fall semester.

Prerequisites: none

Corequisites: Co-Requisite: CHE-111L

Credit: 1

Distribution: Science Lab, Natural Science/Mathematics, Quantitative Literacy

CHE-171 Special Topics

Prerequisites: none

Credits: 0.5

Distribution: Natural Science/Mathematics

CHE-201 Survey of Chemistry II

Enrollment in this course is reserved solely for those students who took and passed CHE 101 and desire to prepare for further study in chemistry, such as organic chemistry. Topics include chemical bonding, thermodynamics and kinetics, chemical equilibrium, and electrochemistry. The laboratory will feature experiments and activities that reinforce and expand upon the fundamental principles explored in lecture. Three lectures and one laboratory each week. Partially fulfills the College laboratory science requirement. This course is offered in the spring semester.

Prerequisites: CHE-101 and permission of instructor

Corequisites: CHE-201L

Credit: 1

Distribution: Natural Science/Mathematics, Science Lab

CHE-221 Organic Chemistry I

A study of the structure and reactions of simple organic compounds. Included as topics are molecular conformations, stereochemistry, and a discussion of some types of modern spectroscopic techniques. The laboratory work emphasizes techniques frequently used by the organic chemist, including distillation, crystallization, sublimation, chromatography, and spectroscopy. Three lectures and one laboratory each week. This course is offered in the fall semester.

Prerequisites: Prerequisite: CHE-111

Corequisites: Co-Requisite: CHE-221L

Credit: 1

Distribution: Science Lab, Natural Science/Mathematics

CHE-241 Inorganic Chemistry

A study of the bonding and reaction chemistry of transition metal species, main group compounds, and solid state materials. Topics include coordination compounds, organometallic complexes, reaction kinetics and thermodynamics, molecular orbital theory, and a discussion of modern characterization techniques. Investigative work in the laboratory will feature a multi-week project involving the synthesis and characterization of a coordination compound, as well as experiments in descriptive inorganic chemistry, catalysis, and nanoscale structures. Three lectures and one laboratory each week. This course is offered in the spring semester.

Prerequisites: Take CHE-111.

Corequisites: Take CHE-241L.

Credit: 1

Distribution: Natural Science/Mathematics, Science Lab

CHE-302 Electron Microscopy

Electron microscopes employ a focused beam of highly energetic electrons to examine sample morphology and topography on a very fine scale. This information is essential to the characterization of a wide range of biological and inorganic specimens including microorganisms, cells, crystals, metals, microelectronics, and nanomaterials. The initial classroom portion of this course focuses on fundamental topics in instrument design, applications, limitations, and sample preparation methods. Subsequent laboratory work involves hands-on instrument training and a substantial microscopy project.

Prerequisites: none

Credits: 0.5

Distribution: Natural Science/Mathematics

Equated Courses: PHY-302

CHE-321 Organic Chemistry II

Characteristic reactions and syntheses of organic molecules will be covered in this course. Spectroscopic techniques not covered in CHE 221 will also be surveyed. Emphasis is placed on the utility of organic chemistry in today's world; class discussions and laboratory work will present many biologically interesting illustrations. Also included is an introduction to the use of the chemical literature. Three lectures and one laboratory each week. This course is offered in the spring semester.

Prerequisites: CHE-221

Corequisites: CHE-321L

Credit: 1

Distribution: Natural Science/Mathematics, Science Lab

CHE-331 Analytical Chemistry

An integrated survey of the application of instrumental methods (spectroscopy, mass spectrometry, chromatography) and modern data analysis methods to the analysis of chemical systems. Electronics and statistical methods of data analysis are also covered. The laboratory emphasizes basic analytical technique, instrument design and function, chemical characterization and separation, and data analysis. Three lectures and one laboratory each week. This course is offered in the spring semester.

Prerequisites: CHE-241

Corequisites: CHE-331L

Credit: 1

Distribution: Natural Science/Mathematics, Quantitative Literacy

CHE-351 Physical Chemistry

An introduction to quantum mechanics through the study of exactly soluble models of chemical significance is followed by a statistical mechanical development of chemical thermodynamics. Topics include the postulates of quantum mechanics, the Schrodinger equation, the Heisenberg uncertainty principle, equations of state, partition functions, laws of thermodynamics, and the thermodynamics of ideal and non-ideal solutions. The laboratory applies concepts studied in lecture and emphasizes laboratory report writing skills. Three lectures and one laboratory each week. This course is offered in the fall semester.

Prerequisites: Prerequisites: CHE-241 and MAT-112

Corequisites: Co-Requisite: CHE-351L

Credit: 1

Distribution: Natural Science/Mathematics, Science Lab, Quantitative Literacy

CHE-361 Biochemistry

Basic chemical concepts such as intermolecular forces, equilibria, energetics, and reaction mechanisms will be used to study biological systems. The class will be divided into three major foci: biomolecular structures, metabolism, and information transfer. The laboratory will familiarize students with common biochemical techniques and will integrate current areas of biochemical research. Three lectures and one laboratory each week. This course is offered in the spring semester.

Prerequisites: CHE-211, 241, or 321 or Permission of Instructor.

Corequisites: CHE-361L

Credit: 1

Distribution: Natural Science/Mathematics, Quantitative Literacy

CHE-371 Special Topics

Prerequisites: none

Credits: 0.5-1

Distribution: Natural Science/Mathematics

CHE-421 Advanced Topics in Organic Chemistry

Topics covered vary from year to year. Examples of recent topics include advanced synthesis, medicinal chemistry, and physical organic chemistry. Refer to the Course Descriptions document on the Registrar's webpage for topics and descriptions of current offerings. This course is offered either in the fall or spring semester.

Prerequisites: CHE-321

Credits: 0.5

Distribution: Natural Science/Mathematics

CHE-431 Adv Laboratory

A laboratory-based, research-focused exploration of advanced topics in chemistry and biochemistry. Experiments dealing with basic analog and digital electronics will stress measurement techniques and the construction and testing of simple, yet useful, instruments and techniques. The use of laboratory computers and programming will be considered, with emphasis on data collection (interfacing) and manipulation. These topics will be integrated into discussion and experiments dealing with instrumental analysis. Individual research projects will involve the construction/characterization of instruments and techniques. This course is offered on an occasional basis.

Prerequisites: CHE-331

Corequisites: CHE-431L

Credits: 0.5

Distribution: Natural Science/Mathematics, Science Lab

CHE-441 Adv Inorganic Chem

A survey of the periodic table emphasizing the applications of modern structural principles, kinetics, and thermodynamics to inorganic systems. Descriptive treatment of selected elements and families included. The laboratory experiments emphasize the synthesis and characterization of air-sensitive compounds. Three lectures and one laboratory each week. This course is offered in the fall semester.

Prerequisites: Prerequisites: CHE-241

Credits: 0.5

Distribution: Natural Science/Mathematics, Science Lab

CHE-451 Physical Chemistry II

An advanced study of quantum mechanics beyond 351, including molecular structure, group theory, molecular spectroscopy, and advanced concepts in chemical bonding. It is very important that students who are interested in attending graduate school in chemistry or biochemistry take this course. Laboratory experiments reflect topics discussed in lecture.

This course is offered in the spring semester.

Prerequisites: CHE-351

Credits: 0.5

Distribution: Natural Science/Mathematics, Quantitative Literacy

CHE-461 Advanced Biochemistry

Topics vary from year to year. Examples of recent topics include the chemistry of cancer, determining structures of biomolecules, the RNA world, fermentation and brewing, and the mechanisms of enzyme action. Refer to the Course Descriptions document on the Registrar's webpage for Topics and Descriptions of current offerings.

Prerequisites: Prerequisites: CHE-361

Credits: 0.5

Distribution: Natural Science/Mathematics

CHE-462 Advanced Biochemistry

This capstone course for the biochemistry major will use primary literature to examine DNA replication, transcription, and translation on a molecular level, and will include a primary literature research project. This course is offered in the fall semester.

Prerequisites: Prerequisite: CHE-361

Credits: 0.5

Distribution: Natural Science/Mathematics

CHE-471 Special Topics in Chem

Focused study of topics of current chemical interest for advanced students; topics vary from year to year and are announced prior to registration for each semester. Refer to the Course Descriptions document on the Registrar's webpage for Topics and Descriptions of current offerings.

Prerequisites: none

Credits: 0.5

Distribution: Natural Science/Mathematics

CHE-487 Undergrad Research Experience

Individual laboratory or library research projects under the supervision of individual faculty on selected problems for qualified students.

Prerequisites: none

Credits: 0.5-1

Distribution: Natural Science/Mathematics, Science Lab

CHE-488 Undergrad Research Experience

Individual laboratory or library research projects under the supervision of individual faculty on selected problems for qualified students.

Prerequisites: none

Credits: 0.5-1

Distribution: Natural Science/Mathematics, Science Lab

CHE-491 Integrative Topic in Chemistry

The study of chemistry builds upon a progressive investigation of the field's traditional subdisciplines. While a strong preparation in these areas is established through rigorous foundation level coursework, many of the most significant and innovative topics in modern research emerge through meaningful integration of several subdisciplines. This half-semester course focuses on an advanced research field that challenges students to apply knowledge from a combination of foundational courses within the major. While topics may vary each offering, critical engagement with the primary literature, small- group discussion, guided inquiry, and diverse modes of oral and written presentation will be emphasized. This course is required of all majors and is offered during the first half of the fall semester.

Prerequisites: none

Credits: 0.5

Chemistry (CHE) Faculty

Timothy Daniel Cook

Scott E Feller

Walter Ray Pendola Novak

Lon A Porter

Paul David Schmitt

Ann Taylor

Laura Wysocki (chair)

James Gaylon Ross