Chemistry

Website: Chemistry (https://new.sewanee.edu/programs-of-study/chemistry/)

Chemistry is often referred to as the central science. As such, it interfaces with and illuminates numerous disciplines including physics, biology, forestry, and geology. Sewanee's course in general chemistry serves future majors and students from such other disciplines by providing a solid foundation in the central organizational principles of chemistry. Courses in the major amplify this understanding by providing an in-depth exploration of the major sub-disciplines: organic, inorganic, analytical, environmental, physical, and biochemistry. Majors are encouraged to participate in research projects with faculty members, during the school year and in the summer, and are also encouraged to participate in research groups at other schools during the summers. An active seminar series allows students to gain proficiency in oral presentation of technical material as well as to learn about the frontiers of chemical research from eminent scientists.

Entering students with an interest in the Chemistry major are strongly encouraged to discuss their academic planning with faculty in the Department of Chemistry as early as possible in their academic career.

Faculty

Professors: Bachman (Chair), Durig, Miles, Pongdee

Associate Professors: Joslin, Seballos, R. Summers

Assistant Professor: Raeber

Major

Requirements for the Major in Chemistry

The major requires successful completion of the following:

Code	Title	Semester Hours
Course Requirements		
CHEM 120	General Chemistry (Lab) [1]	4
or CHEM 150	Advanced General Chemistry (Lab)	
CHEM 201	Organic Chemistry I (Lab) [2]	4
CHEM 202	Organic Chemistry II (Lab)	4
CHEM 210	Solution and Solid State Chemistry (Lab)	4
CHEM 301	Junior Seminar I	1
CHEM 307	Mechanistic Biochemistry (Lab)	4
or CHEM 316	Biochemistry of Metabolism and Molecular Biology (Lab)	
CHEM 308	Inorganic Chemistry (Lab)	4
CHEM 311	Instrumental Analysis (Lab)	4
CHEM 352	Thermodynamics and Kinetics (Lab)	4
Complete four credits from the following courses in Scientific Speaking:		4
CHEM 301	Junior Seminar I	
CHEM 302	Junior Seminar II	
CHEM 334	Mentored Scientific Speaking	
CHEM 401	Senior Seminar I	
CHEM 402	Senior Seminar II	
Select one additional course in Chemistry (CHEM) numbered above 402		4
MATH 102	Calculus II [3]	4
or MATH 207	Multidimensional Calculus	
Select one of the following:		8
PHYS 101 and PHYS 102	General Physics I (Lab) and General Physics II (Lab)	

PHYS 103 and PHYS 104	Modern Mechanics (Lab) and Electric and Magnetic Interactions (Lab)	
Total Semester Hours		**53**

Code	Title	Semester Hours
Additional Requirements		
A comprehensive examination		

1
Completion of this requirement is a prerequisite to all Chemistry courses numbered 201 or higher.

2
Students interested in advanced placement into CHEM 201 should consult the department chair.

3
MATH 207 is strongly recommended.

Honors

In order to receive honors in the Chemistry program, a student must have a 3.00 or higher GPA in the major, take two advanced electives in Chemistry at the 400 level, and complete a research project that the chemistry faculty considers worthy of honors. The research project may be done as part of a course (usually CHEM 494), or it may be done in the context of a summer research program at this University or at another institution. The honors project must involve some original work. A formal written report and a seminar presentation on the research are required. Students must inform the department of their intention to seek honors no later than the middle of the first semester of their senior year. Please see the departmental web page for additional information about honors.

Pre-engineering Program

A Chemistry major in the pre-engineering track is for students who intend to pursue engineering. The major is slightly abbreviated to accommodate a student's shortened time at Sewanee and is completed during the subsequent two years of study at the relevant engineering institution. Scheduling of courses during the three years at Sewanee is often complex; students should consult departmental advisors within their major of interest in their first year to avoid scheduling conflicts. Research participation and laboratory assistantships are encouraged.

A student must complete all core curriculum requirements of the College.

Code	Title	Semester Hours
Course Requirements [1]		
CHEM 120 or CHEM 150	General Chemistry (Lab) Advanced General Chemistry (Lab)	4
CHEM 201 and CHEM 202	Organic Chemistry I (Lab) and Organic Chemistry II (Lab)	8
CHEM 210	Solution and Solid State Chemistry (Lab)	4
CHEM 301	Junior Seminar I	2
CHEM 308 or CHEM 311	Inorganic Chemistry (Lab) Instrumental Analysis (Lab)	4
CHEM 352	Thermodynamics and Kinetics (Lab)	4
MATH 102	Calculus II	4
PHYS 103 and PHYS 104	Modern Mechanics (Lab) and Electric and Magnetic Interactions (Lab)	8

Code	Title	Semester Hours
Additional Requirements		
A comprehensive examination [2]		

1
PHYS 103 and PHYS 104 are recommended for first-year students who are interested in the pre-engineering track.

2

The comprehensive exam is only required for 4-2 engineering students, and is not required for 3-2 engineering students.

Course Sequencing

For a first-year student planning to major in Physics, the following curriculum is recommended. The second-year program should be planned in consultation with the department chair. Students may seek advanced placement in chemistry, mathematics, and foreign language.

Sample Schedule

Code	Title	Semester Hours
Advent (fall) Semester		
CHEM 120	General Chemistry (Lab)	4
or CHEM 150	Advanced General Chemistry (Lab)	
PHYS 103	Modern Mechanics (Lab)	4
MATH 102	Calculus II	4
General Education requirement/elective		4
Easter (spring) Semester		
CHEM 201	Organic Chemistry I (Lab)	4
PHYS 104	Electric and Magnetic Interactions (Lab)	4
MATH 207	Multidimensional Calculus	4
General Education requirement/elective		

Student Learning Outcomes

A student majoring in Chemistry will

1. Demonstrate mastery of the fundamental concepts of each of the subdisciplines of chemistry: analytical, biochemistry, inorganic, organic, and physical.
2. Evaluate and interpret chemistry-related information such as scientific literature, databases, and public reports.
3. Identify problems, generate hypotheses, develop and implement experimental methods, and analyze and interpret resulting qualitative and quantitative data.
4. Demonstrate proficiency in written and verbal communication skills through the production of descriptive reports and oral presentations of the presenters' scientific studies or the scientific work of others.

Minor

Requirements for the Minor in Chemistry

The minor requires successful completion of the following:

Code	Title	Semester Hours
Course Requirements		
CHEM 120	General Chemistry (Lab)	4
or CHEM 150	Advanced General Chemistry (Lab)	
CHEM 201	Organic Chemistry I (Lab)	4
Select three additional Chemistry (CHEM) courses numbered above 200.		12
Total Semester Hours		**20**

Courses

Chemistry Courses

CHEM 100 Topics in Contemporary Chemistry (4)
An introductory course focusing on topics in contemporary chemical research that also connect to societal issues. The course is designed to develop a student's understanding of scientific models, analytical reasoning, and applied problem-solving.

CHEM 110 The Science of Food and Cooking (Lab) (4)
An introduction to the science of food and food preparation. Students learn the scientific method through the examination of food and cooking in the laboratory setting. Recent food-related controversies, such as low-carbohydrate diets, are considered. Designed for the general student, this course may not be used to satisfy requirements for the major or minor in Chemistry. Lecture, three hours; laboratory, three hours.

CHEM 112 Chemistry of Art and Artifacts (4)
This course addresses both of these intersections between science and the arts by considering the role of chemistry in the production and interpretation of art and artifacts from theoretical and practical perspectives. The course also examines the application of chemistry to art conservation and archaeology. This course may not be used in to satisfy requirements for the major or minor in Chemistry. Lecture, three hours.

CHEM 114 Life, Energy, and the Atomic Bomb: How the Science of Metals Shapes Society (4)
This course provides an understanding of how chemistry and metals influence everyday lives. Using the periodic table as a touchstone, the course examines the role of metals and their chemistry in society. Specific themes include the use of metals in medicine and health; the role of metals in the production of modern materials and products; the use of metals in both traditional and alternative fuels; and the ways in which metals have been used to influence global political power through the atomic bomb and other devices. This course may not be used in to satisfy requirements for the major or minor in Chemistry. Lecture, three hours.

CHEM 115 Crime Scene Chemistry (Lab) (4)
A studio course designed for students who would like to learn about forensic chemistry and the basic science needed to understand it. Chemical concepts, on the level of an introductory chemistry course and their applications to forensic science are explored. Topics include the collection and analysis of physical evidence such as drugs, fibers, glass, fingerprints, and documents. Other topics may include arson investigation, DNA analysis, and how forensic science is portrayed in literature and media. This course may not be used in to satisfy requirements for the major or minor in Chemistry. Lecture, three hours; laboratory, three hours.

CHEM 119 Principles of Chemistry (4)
This course provides the fundamental vocabulary, concepts, and principles that appear throughout the chemistry and biochemistry curriculum. Topics include basic chemistry calculations, atomic and molecular structure, chemical properties, molecular and reaction stoichiometry, periodicity, chemical bonding, and nomenclature. Lecture, three hours.

CHEM 120 General Chemistry (Lab) (4)
A survey of the basic chemical principles and theories, with emphasis on applying these concepts to chemically related fields such as environmental science and biological chemistry. Topics considered include atomistic and molecular structure, kinetics, thermodynamics, and chemical equilibrium. The course's laboratory portion emphasizes the collection and interpretation of data, as well as the formation and testing of hypotheses. Lecture, three hours; laboratory, three hours. *Prerequisite: CHEM 119 or placement..*

CHEM 150 Advanced General Chemistry (Lab) (4)
Development of chemistry's foundational concepts in greater detail than "General Chemistry" and with special emphasis on both theoretical understanding and analytical reasoning. Intended for students with strong preparation in chemistry and high motivation, the course focuses on the molecular basis of matter and its transformation as well as the role of chemistry in the broader scientific and societal enterprise. The laboratory portion of the course emphasizes the collection and interpretation of empirical data. Lecture, three hours; laboratory, three hours. *Open only to new first-year students. Prerequisite: Placement..*

CHEM 201 Organic Chemistry I (Lab) (4)
A study of the nomenclature and the properties of the most important classes of organic compounds with an emphasis on concepts relating molecular structure and properties. Stereochemistry, functional group transformations and reaction mechanisms are studied in depth. Lecture, three hours; laboratory, three and one-half hours. *Prerequisite: CHEM 120 or CHEM 150.*

CHEM 202 Organic Chemistry II (Lab) (4)
A continuation of CHEM 201. A portion of the course is devoted to the study of important classes of biochemical compounds. Lecture, three hours; laboratory, three and one-half hours. *Prerequisite: CHEM 201.*

CHEM 210 Solution and Solid State Chemistry (Lab) (4)
Solution and solid state chemistry is fundamental in a variety of contexts from biological to geological systems. This course explores the behavior of these systems as well as applications of chemical theory in a variety of contexts. Students gain experience with the measurements and analysis necessary to characterize both solution and solid samples in the laboratory setting. Lecture, three hours; laboratory, three and one-half hours. *Prerequisite: CHEM 120 or CHEM 150.*

CHEM 301 Junior Seminar I (1)
The first in a series of experiences designed to strengthen scientific communication skills. Students will observe and engage with a variety of presenters, such as invited speakers, faculty, and peers. Throughout the course participants will learn skills to assist in preparation and delivery of a scientific presentation to an audience. Junior majors will design a scientific presentation on a topic agreed upon with a faculty mentor. *Open only to juniors pursuing majors in chemistry.*

CHEM 302 Junior Seminar II (1)
The second in a series of experiences designed to strengthen scientific communication skills. Students will observe and engage with a variety of presenters, such as invited speakers, faculty, and peers. Throughout the course, participants will learn skills to assist in the preparation and delivery of a scientific presentation to an audience. Junior majors will deliver a scientific presentation on a topic agreed upon with a faculty mentor. *Open only to juniors pursuing majors in chemistry.*

CHEM 307 Mechanistic Biochemistry (Lab) (4)
An examination of all aspects of protein science, including protein biosynthesis, protein structure, and the mechanisms of enzyme catalysis, with particular emphasis on the biochemistry of enzyme catalysis. Lecture, three hours; laboratory, three and one-half hours. *Prerequisite: CHEM 202.*

CHEM 308 Inorganic Chemistry (Lab) (4)
A detailed examination of the chemistry of the elements, with a particular emphasis on structure and bonding, structure-property relationships, and reaction energetics. Course topics include organometallics and catalysis, aquatic chemistry of the metals, solid-state chemistry, and the role of metals in biology. Lecture, three hours; laboratory, four hours. *Prerequisite: CHEM 201 and CHEM 210.*

CHEM 311 Instrumental Analysis (Lab) (4)
An introduction to the theory and practice of the fundamental principles of chemical analysis and the use of chemical instrumentation in research. Course topics include spectrophotometric and spectroscopic methods; electrochemical fundamentals and electroanalytical techniques; chromatographic and separation methods; and statistical analysis of data. Lecture, three hours; laboratory, three and one-half hours. *Prerequisite: CHEM 201 and CHEM 210.*

CHEM 316 Biochemistry of Metabolism and Molecular Biology (Lab) (4)
A study of the biochemical reactions of eukaryotic cellular metabolism and bioenergetics, focusing on enzyme regulation and function, protein structure, nucleic acid structure and function, and selected topics in molecular biology and physiological biochemistry. Prior coursework in cell/molecular biology is recommended. Lecture, three hours; laboratory, three hours. *Prerequisite: BIOL 233 and (BIOL 223 or BIOL 243) and CHEM 201.*

CHEM 334 Mentored Scientific Speaking (1)
The student will engage in the development of a scientific presentation under the mentorship of a faculty member. This course may be repeated for credit when the topic differs. *Open only to seniors pursuing majors in chemistry. Prerequisite: Instructor prerequisite override required.*

CHEM 352 Thermodynamics and Kinetics (Lab) (4)
An introduction to thermodynamics and kinetics. Lecture, three hours; laboratory, three and one-half hours. *Prerequisite: CHEM 201 and (MATH 102 or MATH 207). Prerequisite or Corequisite: PHYS 101 or PHYS 103.*

CHEM 401 Senior Seminar I (1)
The third in a series of experiences designed to strengthen scientific communication skills. Students will observe and engage with a variety of presenters, such as invited speakers, faculty, and peers. Throughout the course participants will learn skills to assist in preparation and delivery of a scientific presentation to an audience. Senior majors will design a scientific presentation on a topic agreed upon with a faculty mentor. Presentations describing student research are strongly encouraged. *Open only to seniors pursuing majors in chemistry.*

CHEM 402 Senior Seminar II (1)
The fourth in a series of experiences designed to strengthen scientific communication skills. Students will observe and engage with a variety of presenters, such as invited speakers, faculty, and peers. Throughout the course, participants will learn skills to assist in the preparation and delivery of a scientific presentation to an audience. Senior majors will deliver a scientific presentation on a topic agreed upon with a faculty mentor. *Open only to seniors pursuing majors in chemistry.*

CHEM 405 Organic Synthesis (4)
A comprehensive study of modern organic reactions and their application to the synthesis of biologically-active natural products. Lecture, three hours. *Prerequisite: CHEM 202.*

CHEM 408 Advanced Topics in Inorganic Chemistry (4)
Selected topics in modern inorganic chemistry, such as bioinorganic chemistry, materials chemistry, and organometallic chemistry. The course surveys relevant primary literature. This course may be repeated for credit when the topic differs. Lecture, three hours. *Prerequisite: CHEM 308.*

CHEM 412 Advanced Environmental Geochemistry (4)
An examination of the chemical principles that determine how natural systems work and how anthropogenic activities can have an impact on the function of these systems. Topics include both fundamental chemical principles and case studies of particular environmental systems. Lecture, three hours. *Prerequisite: CHEM 120 or CHEM 150.*

CHEM 417 Advanced Biochemistry (4)
An exploration of contemporary issues in biochemistry based largely on primary literature. Topics such as the biosynthesis and mode of action of antibiotics, protein engineering, signal transduction, chemical carcinogenesis, and isotope effects in enzyme kinetics will be addressed in detail. Lecture, three hours. *Prerequisite: BIOL 307 or BIOL 316 or BIOL 317 or CHEM 307 or CHEM 316.*

CHEM 418 Structural Methods (4)
This course examines the theory and praxis of molecular and macromolecular structure determination via spectroscopic and physical methods. Lecture, three hours. *Prerequisite: CHEM 202.*

CHEM 422 Quantum Chemistry and Spectroscopy (4)
An introduction to quantum mechanics in chemistry and spectroscopy. Lecture, three hours. *Prerequisite: CHEM 201 and MATH 102 and (PHYS 102 or PHYS 104).*

CHEM 424 Topics in Physical Chemistry (4)
Lecture, three hours. *Prerequisite: (CHEM 120 or CHEM 150) and (MATH 102 or MATH 207) and (PHYS 102 or PHYS 104).*

CHEM 425 Drug Design and Development (4)
An examination of the fundamental chemical aspects associated with the process of discovering new drugs. Both combinatorial and rational drug design methodologies are addressed. Emphasis is on the application of various structure-based and mechanism-based strategies for drug optimization. Additional topics include pharmacokinetics (how drugs move within the body), metabolism of drugs, and pharmacodynamics (effect of drugs and their molecular mechanism of action). Lecture, three hours. *Prerequisite: CHEM 202.*

CHEM 428 Advanced Topics in Analytical Chemistry (4)
This course covers the theory and practice of analytical techniques and recent advances in the field. Lecture, three hours. *Prerequisite: CHEM 311.*

CHEM 444 Directed Readings (2 or 4)
An in-depth investigation of an advanced topic or topics in chemistry conducted through readings from the primary and secondary literature and discussion with faculty mentor. This course may be repeated for credit when the topic differs. *Prerequisite: Instructor prerequisite override required.*

CHEM 494 Mentored Research (2 or 4)
Students engage in original research in chemistry under the mentorship of a faculty member. Students apply and integrate knowledge from their coursework while learning both specific laboratory techniques and practical problem-solving skills. Discussion of proper laboratory record-keeping, responsible conduct of research, presentation of research results, and laboratory safety are also emphasized. This course may be repeated for credit when the topic differs. *Prerequisite: Instructor prerequisite override required.*