

CHEMISTRY (CHEM)

CHEM 100 Big Ideas in Chemistry (4 Credits)

An exploration of significant questions and integrative concepts in Chemistry, their grounding in the process of scientific discovery and application, and their broader relevance to society. Designed for first-year students. Although topics vary, the courses also seek to improve students' communication skills beyond the written word.

College Curriculum: C100

CHEM 103 General Chemistry I (3 Credits)

For science majors and pre-health science students. A study of the nature of atoms and molecules, the periodic table, chemical bonding and reactions, thermochemistry, states of matter, solutions, and equilibrium.

Domain: NQR

CHEM 103L General Chemistry Lab I (1 Credit)

Laboratory techniques in chemistry.

Prerequisite(s): (CHEM 103 (may be taken concurrently) or CHEM 205 (may be taken concurrently) or CHEM 335 (may be taken concurrently))

Additional fees apply

CHEM 150 First-Year Seminar (4 Credits)

An exploration of a specific topic in Chemistry. A grade of C- or better fulfills the COLL 150 requirement. Although topics vary, the courses emphasize academic writing skills, reading and analysis of texts, and discussion.

College Curriculum: C150

CHEM 190 Introductory Research (1 Credit)

Introduction to chemical research with an assigned faculty mentor. May be taken only with the consent of the department. Credit obtained cannot be used towards an ACS approved degree and the 120 hour graduation credit minimum.

Prerequisite(s): CHEM 195 (may be taken concurrently)

CHEM 195 Research Practices in Chemistry (0 Credits)

Laboratory safety and environmental health in the practice of chemistry research. Includes instruction in the responsible and ethical conduct of research. Chemistry 195 is a pre-/co-requisite for all chemistry research courses, and thus must be taken concurrently with the student's first research course. Graded (Pass/Fail)

CHEM 201 Color, Light, & Chemistry (4 Credits)

Intended for non-science majors, Color, Light, & Chemistry will use the theme of color and light to weave a narrative through basic concepts in chemistry. Students will develop their understanding not only of the foundations of chemistry (e.g., organic and inorganic structure, acid-base chemistry, light, spectroscopy) through the color and light theme, but also how scientific approaches can be used to create tangible products (e.g., dyed textiles, paint analysis). This course will place the chemistry of color and light in the broader context of art, philosophy, literature, culture, dye industry, artifact analysis, and world trade. Students will put course concepts into practice through hands-on experiments, demonstrations, and a project portfolio.

College Curriculum: C200

Domain: NQR

CHEM 205 Advanced General Chemistry (3 Credits)

A systematic study of the properties and reactions of chemical elements and their compounds, including acid/base chemistry, thermodynamics, electrochemistry, bonding, and an introduction to kinetics. This course will explore how the quest for natural resources and synthetic chemicals has shaped modern society. Enrollment is restricted to freshmen who receive William and Mary credit for Chemistry 103 with a score of 4 or 5 on the Advanced Placement Examination or International Baccalaureate scores of 5, 6, or 7 in Chemistry or have instructor consent. Note:

Students may not obtain credit for both CHEM 205 and CHEM 208.

Prerequisite(s): CHEM 103

College Curriculum: C200

Domain: NQR

CHEM 206 Organic Chemistry I (3 Credits)

A mechanistic approach to the study of the chemistry of carbon compounds. Particular emphasis is placed on the relationship between structure and reactivity in organic reactions.

Prerequisite(s): CHEM 103 or CHEM 335 or CHEM 205

Domain: NQR

CHEM 206D Organic Chemistry Lab I Disc (0 Credits)

CHEM 206L Organic Chemistry Lab I (1 Credit)

Laboratory techniques in organic chemistry.

Prerequisite(s): CHEM 206 (may be taken concurrently)

Additional fees apply

CHEM 207 Organic Chemistry II for Life Sciences (3 Credits)

A continuation of the development of the chemistry of organic functional groups started in Chemistry 206. Particular emphasis is placed on the role of metals in living systems and the biosynthesis of organic molecules. Recommended for students expecting to major in the life sciences. Students may not receive credit for more than one of the following: CHEM 207 and CHEM 209.

Prerequisite(s): CHEM 206

CHEM 208 General Chemistry II and Introduction to Inorganic Chemistry (3 Credits)

A continuation of the study of the principles of chemistry begun in Chemistry 103. Topics include aqueous equilibria, thermodynamics, electrochemistry, advanced bonding theories, nuclear chemistry, chemical kinetics, and coordination chemistry.

Prerequisite(s): CHEM 103

CHEM 209 Organic Chemistry II (3 Credits)

A continuation of the development of the chemistry of organic functional groups started in Chemistry 206. Recommended for students expecting to major in chemistry. Students may not receive credit for more than one of the following: CHEM 207 and CHEM 209.

Prerequisite(s): CHEM 206

CHEM 217 History of Modern Medicinal Chemistry and Drug Development (3 Credits)

This class constitutes a survey of the history of medicinal chemistry and drug development. The course will begin by briefly looking at ancient medicine of the antiquity and middle-ages before highlighting the modern-era discovery of groundbreaking drugs and medicinal practices and culminate with an outlook on both industrial and academic research structure. The processes governing modern day pharmaceutical drug development and the different phases of clinical research will also be discussed in this context. This course is recommended for pre-medical students or students pursuing careers in the health sector.

Prerequisite(s): CHEM 206

College Curriculum: C200

Domain: NQR

CHEM 253 Organic Chemistry Laboratory II (1 Credit)

Laboratory techniques in organic chemistry.

Prerequisite(s): (CHEM 206L) and (CHEM 207 (may be taken concurrently) or CHEM 209 (may be taken concurrently) or CHEM 307 (may be taken concurrently))

Additional fees apply

CHEM 254 General Chemistry Laboratory II (1 Credit)

Laboratory techniques in chemistry.

Prerequisite(s): (CHEM 103L) and (CHEM 205 (may be taken concurrently) or CHEM 208 (may be taken concurrently) or CHEM 305 (may be taken concurrently) or CHEM 308 (may be taken concurrently) or CHEM 335 (may be taken concurrently))

Additional fees apply

CHEM 256 Inorganic and Quantitative Laboratory Methods (1 Credit)

A second semester general laboratory course designed for chemistry majors. Emphasis on quantitative analysis, inorganic synthesis, and graphing and data analysis.

Prerequisite(s): CHEM 103L and (CHEM 205 (may be taken concurrently) or CHEM 208 (may be taken concurrently) or CHEM 305 (may be taken concurrently) or CHEM 308 (may be taken concurrently) or CHEM 335 (may be taken concurrently))

Additional fees apply

CHEM 290 Sophomore Research (1 Credit)

Introduction to chemical research with an assigned faculty member for sophomore students. May be taken only with the consent of the department. Credit obtained cannot be used towards an ACS approved degree and the 120 hour graduation credit minimum. Repeatable for credit.

Prerequisite(s): CHEM 195 (may be taken concurrently)

CHEM 301 Physical Chemistry: Quantum Mechanics & Spectroscopy (3 Credits)

An introduction to quantum mechanics and spectroscopy for physical chemistry; topics include quantization of energy, quantum mechanical models, atomic and molecular spectroscopy, and applications to chemistry. Note: MATH 212 or 213 is strongly recommended as an additional co-/pre-requisite.

Prerequisite(s): (CHEM 205 or CHEM 208) and (PHYS 101 or PHYS 101P or PHYS 101H) and (PHYS 101L) and (PHYS 102 or PHYS 102P or PHYS 102H) and (PHYS 102L) and (MATH 111 and MATH 112)

CHEM 302 Physical Chemistry: Thermodynamics & Kinetics (3 Credits)

An introduction to thermodynamics and chemical kinetics for physical chemistry; topics include the states of matter, thermodynamics and its chemical applications, chemical kinetics, and introductory statistical mechanics. Note: MATH 212 or 213 is strongly recommended as an additional co-/pre-requisite.

Prerequisite(s): (CHEM 205 or CHEM 208) and (PHYS 101 or PHYS 101P or PHYS 101H or PHYS 102P) and (PHYS 101L) and (PHYS 102 or PHYS 102P or PHYS 102H) and (PHYS 102L) and (MATH 111 and MATH 112)

CHEM 302L Physical Chemistry Lab (1 Credit)

A series of experiments designed to accompany CHEM 301 and CHEM 302

Prerequisite(s): CHEM 301 and CHEM 302 (may be taken concurrently) and (CHEM 254 or CHEM 256)

CHEM 309 Instrumental Analysis (4 Credits)

Principles and applications of analytical methodology and instrumentation to chemical analysis; topics covered include electrochemistry, spectroscopy, mass spectrometry, and chromatography. Three class hours.

Prerequisite(s): (CHEM 205 or CHEM 208) and (CHEM 207 or CHEM 209) and (CHEM 254 or CHEM 256) and CHEM 253

Corequisite(s): CHEM 309L

CHEM 309L Instrumental Analysis Laboratory (0 Credits)

A series of experiments designed to accompany Chemistry 309.

Prerequisite(s): (CHEM 205 or CHEM 208) and (CHEM 254 or CHEM 256)

Corequisite(s): CHEM 309

CHEM 312 Inorganic Chemistry (3 Credits)

A survey of inorganic chemistry. Topics include: coordination chemistry, organometallics, solid state chemistry, band theory, and the applications of symmetry to structure, bonding and spectroscopy.

Prerequisite(s): CHEM 205 or CHEM 208 or CHEM 305 or CHEM 308 or CHEM 335

CHEM 314 Biochemistry (3 Credits)

The molecular basis of living processes; the chemistry of important constituents of living matter, biosynthesis, metabolism, bioenergetics, enzyme kinetics, metabolic control, transport mechanisms.

Prerequisite(s): (CHEM 207 or CHEM 307 or CHEM 209) and (CHEM 205 (may be taken concurrently) or CHEM 208 (may be taken concurrently) or CHEM 305 (may be taken concurrently) or CHEM 308 (may be taken concurrently) or CHEM 335 (may be taken concurrently))

CHEM 314B Chemistry of Cultures (1 Credit)

This 1-credit supplement to Biochemistry 314 (CHEM/BIOL 314) will fulfill the COLL 200 requirement by reaching beyond the chemical transformations performed by microorganisms during fermentation.

We will explore the "cultural" aspects of food fermentation through the lens of history, anthropology and archaeology (the CSI domain). We will explore ways in which human evolution has been shaped by microorganisms, primarily through diet. Readings are from an array of areas to highlight differing perspectives of social and natural scientists.

Prerequisite(s): CHEM 314 or BIOL 314

College Curriculum: C200

Domain: NQR

CHEM 314C Biochemistry at the Bar (1 Credit)

With the recent sequencing of the human genome, increasing prevalence of various diseases and disorders including cancer, Alzheimer's, etc., and advancing sophistication of numerous biotechnologies, new social and ethical responsibilities fall upon the scientist. This 1-credit supplement AND Biochemistry 314 course fulfills the COLL 200 requirement, and aims to "reach-out" beyond the science and put the responsibilities of the biochemist on trial. Through the integration science with the fields of philosophy, law, and government, this course aims to produce a "global scientist." Drawing from multiple sources including film, current events, and guest lectures students will be afforded a holistic perspective on science in society and the implications of biochemical research. This class must be taken concurrently with CHEM 314: Biochemistry; however will result in an independent grade.

Prerequisite(s): CHEM 314 (may be taken concurrently) or BIOL 314 (may be taken concurrently)

College Curriculum: C200

Domain: NQR

CHEM 341 Physical and Analytical Chemistry for Life Sciences (3 Credits)

Principles in physical chemistry developed for and applied to examples from the biological sciences. Topics include thermodynamics, kinetics, spectroscopy, and instrumentation relevant to biophysical and bioanalytical chemistry. Course may not be used for a major in chemistry. Prerequisite(s): (CHEM 308 or CHEM 305 or CHEM 205 or CHEM 208 or CHEM 335) and (MATH 112 or MATH 132)

CHEM 353 Organic Chemistry Lab II (1 Credit)

Laboratory techniques in organic chemistry.

Prerequisite(s): (CHEM 252 (may be taken concurrently) or CHEM 207 (may be taken concurrently) or CHEM 209 (may be taken concurrently) or CHEM 307 (may be taken concurrently)) and CHEM 206L

Additional fees apply

CHEM 360 General Topics in Chemistry (1-3 Credits)

General topics in Chemistry. Chemistry 360 courses will not count toward a concentration in Chemistry or any other concentration, unless specifically designated.

CHEM 361 Global Topics in Chemistry (1-3 Credits)

General topics in chemistry that is held off-campus, abroad. Chem 361 courses will not count toward a concentration in Chemistry or any other concentration, unless specifically designated.

CHEM 390 Junior Research (1 Credit)

Introduction to chemical research with an assigned faculty member for junior students. May be taken only with the consent of the department. Requires attendance at weekly departmental seminars. Credit obtained cannot be used towards an ACS approved degree and the 120 hour graduation credit minimum. Repeatable for credit.

Prerequisite(s): CHEM 320 (may be taken concurrently) or CHEM 195 (may be taken concurrently)

CHEM 401 Advanced Physical Chemistry (3 Credits)

Advanced topics in quantum chemistry, spectroscopy, atmospheric chemistry, modern experimental physical chemistry, and other selected topics.

Prerequisite(s): CHEM 301 and CHEM 302

CHEM 401W Adv Physical Chemistry Writing (0 Credits)

Corequisite(s): CHEM 401

CHEM 402 Advanced Inorganic Chemistry (3 Credits)

Advanced topics in inorganic chemistry, including solid state materials, crystallography, organometallics, spectroscopy, bioinorganic chemistry, and other selected topics.

Prerequisite(s): CHEM 312 and CHEM 302 (may be taken concurrently)

CHEM 402W Adv Inorganic Chem Writing (0 Credits)

Corequisite(s): CHEM 402

CHEM 403 Advanced Organic Chemistry (3 Credits)

A structure-reactivity approach to reaction mechanisms and modern synthetic chemistry.

Prerequisite(s): CHEM 207 or CHEM 209 or CHEM 307

CHEM 403W Adv Organic Chemistry Writing (0 Credits)

Corequisite(s): CHEM 403

CHEM 404 Advanced Analytical Chemistry (3 Credits)

Advanced topics in analytical chemistry.

Prerequisite(s): CHEM 309

CHEM 404W Adv Analytical Chem Writing (0 Credits)

Corequisite(s): CHEM 404

CHEM 408 Computational Chemistry (3 Credits)

Principles and applications of computational methods currently used for the determination of molecular structure and energetics. Topics include: ab initio molecular orbital theory, density functional theory, semi-empirical calculations, and molecular force field methods.

Prerequisite(s): CHEM 301

CHEM 408W Computational Chem Writing (0 Credits)

Corequisite(s): CHEM 408

CHEM 410 Seminar Applied Chemistry (1 Credit)

A series of seminars by scientists primarily from industry and government. The course is open to students who have completed four semesters of chemistry or by permission of the instructor.

CHEM 411 Polymer Science I (3 Credits)

An introduction to the chemical aspects of polymer science at the molecular level. Topics include the preparation, modification, degradation and stabilization of polymers. Reaction mechanisms are stressed.

Prerequisite(s): (CHEM 207 or CHEM 209 or CHEM 307) and CHEM 301

CHEM 411W Polymer Science I (0 Credits)

Corequisite(s): CHEM 411

CHEM 415 Advanced Biochemistry (3 Credits)

A continuation of the study of biological processes on a molecular level begun in Chemistry 314. Biosynthesis, metabolism, bioenergetics, enzyme kinetics, metabolic control, transport mechanisms. Students may not receive credit for more than one of the following: CHEM 415, CHEM 453 and BIOL 453.

Prerequisite(s): CHEM 314 or BIOL 314 or CHEM 414 or BIOL 414

CHEM 415P Advanced Biochemistry Tutorial (0 Credits)

Corequisite(s): CHEM 415

CHEM 415W Advanced Biochemistry Writing (0 Credits)

Corequisite(s): CHEM 415

CHEM 416 Scientific and Social Aspects of Drug Development (3 Credits)

An exploration of different drug classes including their medicinal properties, synthesis, and mechanism of action. Drug development will be viewed through a historical lens to investigate the impacts of drugs on society. One additional aspect of this course will be the practice of science communication. In this context students will communicate topics in drug development to both scientific and diverse non-scientific audiences. This course constitutes a senior capstone experience and satisfies the COLL 400 requirement.

Prerequisite(s): BIOL 314 or CHEM 314

College Curriculum: C400

CHEM 417 Neurochemistry (3 Credits)

A study of the biochemistry and pharmacology of the nervous system.

Topics include excitatory and inhibitory neurotransmitters, structure and function of receptors, reuptake transporters, and second messengers.

The biochemical basis of neuro-active drugs, toxins, and diseases will be covered. Recommended for chemistry, biology, and neuroscience majors, and premedical students.

Prerequisite(s): (CHEM 414 or CHEM 314 or BIOL 414 or BIOL 314) and (BIOL 345 or PSYC 313)

College Curriculum: C400

CHEM 417W Neurochemistry (0 Credits)

Corequisite(s): CHEM 417

CHEM 419 Bioinorganic Chemistry (3 Credits)

An intensive examination of current research approaches in the field of bioinorganic chemistry. Students will gain experience in reading and critically analyzing articles from the primary literature.

Prerequisite(s): BIOL 314 or CHEM 314 or BIOL 414 or CHEM 414

CHEM 419W Bioinorganic Chem Writing (0 Credits)

Corequisite(s): CHEM 419

CHEM 420 Biochemistry Lab (1 Credit)

Laboratory techniques of modern biochemistry and molecular biology.

Prerequisite(s): CHEM 309 and CHEM 415 (may be taken concurrently)

CHEM 453 Protein Structure & Function (3 Credits)

The functionality of a protein is an integral part of its structure. This course provides a comprehensive analysis of how to use sequence data to understand a protein's physical properties, and to predict its function and interaction. Students may not receive credit for more than one of the following: CHEM 415, CHEM 453 and BIOL 453.

Prerequisite(s): BIOL 310 or (BIOL 314 or CHEM 314 or BIOL 414 or CHEM 414)

CHEM 456 Mass Spectrometry (3 Credits)

Principles and applications of modern mass spectrometric methods in chemistry. Topics include: instrumentation, spectral interpretation, gas-phase ion chemistry and spectroscopy, proteomics and metabolomics, forensic applications, and stable isotope chemistry.

Prerequisite(s): CHEM 309

CHEM 456W Mass Spectrometry (0 Credits)

Corequisite(s): CHEM 456

CHEM 457 Organic Synthesis (3 Credits)

An advanced treatment of organic synthetic methods which includes examples of natural product synthesis.

Prerequisite(s): CHEM 207 or CHEM 209 or CHEM 307

CHEM 457W Organic Synthesis Writing (0 Credits)**CHEM 458 Organic Spectroscopy (3 Credits)**

Theory and application of spectroscopic methods to the analysis of organic compounds. Topics include absorption, fluorescence, infrared, and proton and carbon nuclear magnetic resonance spectroscopies with an emphasis on structural elucidation and other practical applications.

Prerequisite(s): (CHEM 207 or CHEM 209 or CHEM 307) and CHEM 309

CHEM 458W Organic Spectroscopy Writing (0 Credits)**CHEM 460 Special Topics in Chemistry (1-3 Credits)**

Treatment of a selected chemistry topic that is not routinely covered in the regular course offerings.

CHEM 490 Senior Research (1-3 Credits)

A course for the advanced student affording an opportunity for individual work on a problem under the supervision of a faculty member. May be taken only with the consent of the department. Attendance at the departmental seminar is required. When taken for 3 credits and paired with CHEM 490W will meet College 400 requirement.

Prerequisite(s): CHEM 320 (may be taken concurrently) or CHEM 195 (may be taken concurrently)

CHEM 490W Senior Research Writing (0 Credits)

Senior Research Writing

Corequisite(s): CHEM 490

CHEM 495 Honors (3 Credits)

Requirements include a program of research with readings from the original literature, presentation of an Honors essay, and the satisfactory completion of a comprehensive oral examination in the subject area of the research. Attendance at the departmental seminar is required; otherwise, hours are to be arranged.

Prerequisite(s): CHEM 195

CHEM 496 Honors (3 Credits)

Requirements include a program of research with readings from the original literature, presentation of an Honors essay, and the satisfactory completion of a comprehensive oral examination in the subject area of the research. Attendance at the departmental seminar is required; otherwise, hours are to be arranged.

Prerequisite(s): CHEM 195

College Curriculum: C400

CHEM 496W Honors (0 Credits)

Corequisite(s): CHEM 496

CHEM 498 Chemistry Internship (1 Credit)

The chemistry internship course is designed to allow students to apply their academic knowledge in a professional setting. Chemistry internships will differ based on the individual program, but are generally intended to: (1) reinforce how chemical knowledge is applied in the professional world, (2) help students to think critically about real-world problems, and (3) expose students to networking opportunities outside of academia. CHEM 498 may be taken only with the consent of the Chemistry Department and a faculty mentor prior to the start of the internship and is not repeatable for credit.

Prerequisite(s): CHEM 195