

CHEMISTRY

Faculty

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The chemistry department at Concordia College is approved by the American Chemical Society (ACS). Approval indicates that the department has the facilities, faculty, and curriculum to provide undergraduate education in chemistry according to guidelines established by the ACS.

The chemistry department faculty has agreed upon the following list of goals that graduating seniors are to develop by the time they complete the chemistry major.

Concordia College Chemistry Department Assessment Plan

Department Goals (Revised Spring 2013)

The chemistry department faculty has agreed upon the following list of goals and student learning outcomes that graduating seniors are to develop by the time they complete the chemistry major.

The goals of the department are that a chemistry major should:

1. Have a firm understanding of the core principles of chemistry as they apply to each of the major subdivisions of the discipline.
 - a. Students will demonstrate competency within the discipline on standardized national exams.
 - b. Students will be able to gather experimental data safely and accurately using a wide variety of laboratory instruments and methods.
 - c. Students can apply their knowledge of chemistry to the explanation and interpretation of new or unfamiliar chemical information.
 - d. Students illustrate good problem-solving skills, independently and collaboratively.
2. Be able to communicate their knowledge of the field, both through writing and speaking.
 - a. Students can select and interpret relevant scientific literature from a variety of sources including libraries, electronic databases and the internet.
 - b. Students can prepare a professional scientific paper.
 - c. Students can prepare, present and defend a professional scientific talk.
 - d. Students employ knowledge and implement skills in professional experiences such as teaching, research and internships.
3. Be comfortable and competent in the use of modern technology for the acquisition, analysis, and presentation of chemical data and information.
 - a. Students are able to design and implement experiments using the principles of the scientific method.

- b. Students are able to use modern instrumentation to collect and analyze data.
4. Possess a holistic understanding of the relationship of chemistry to other sciences and to the needs of society as a whole.
 - a. Students can connect relevant scientific literature to real-world situations.
 - b. Students can discuss the impact of the discipline on the environment.
 - c. Students recognize the ethical issues related to the use and misuse of chemical information and materials.

The chemistry department offers a major and minor in chemistry, several American Chemical Society majors in chemistry, and teaching majors in chemistry for grades 5-12 and for grades 9-12. The chemistry department also sponsors an honors program for motivated students; for further information, consult any faculty member or visit the department website (<https://www.concordiacollege.edu/academics/programs-of-study/chemistry/>).

Programs Offered

Majors

- American Chemical Society (ACS) Major (<https://catalog.concordiacollege.edu/arts-sciences/chemistry/american-chemical-society-major/>)
- Chemistry Major (<https://catalog.concordiacollege.edu/arts-sciences/chemistry/chemistry-major/>)

Minors

- Chemistry Minor (<https://catalog.concordiacollege.edu/arts-sciences/chemistry/chemistry-minor/>)

Chemistry Education

Students seeking licensure to teach chemistry must also fulfill the requirements for a major in education (<https://catalog.concordiacollege.edu/arts-sciences/education/education-major/>). For additional information about teaching chemistry, see the chemistry department chair or the education department chair.

General Science add-on education endorsement: Students majoring in chemistry and earning a licensure for teaching may complete an add-on option for grades 5-8 licensure (<https://catalog.concordiacollege.edu/arts-sciences/education/#endorsementoptionstext>).

Courses

CHEM 117 - Principles of Chemistry, 4 credits.

No Laboratory. Stoichiometry, atomic structure, thermochemistry and chemical reactions. Emphasis on developing problem solving skills and mathematical ability. Students who do not feel comfortable with their chemistry preparation should consider this course which tracks with Chemistry 127 at approximately 2/3 the pace. This course does not satisfy the science core requirement nor satisfy chemistry prerequisites of most health professions schools.

Frequency: Every Year - First Semester

CHEM 127 - General Chemistry I, 4 credits.

First college course in chemistry for most students. Topics include: stoichiometry; states of matter; periodicity; nomenclature; atomic structure; geometry of molecules; chemical bonding; thermochemistry; chemical reactions; and related consumer, environmental and industrial problems. Three class periods and three hours of laboratory per week. Prerequisite: high school chemistry. This course can also count toward the environmental and sustainability studies program.

Frequency: *Every Semester*

CHEM 128 - General Chemistry II, 4 credits.

Further study in general chemistry. Topics include redox chemistry, thermodynamics, chemistry of solutions, chemical kinetics, chemical equilibrium, buffer solutions and electrochemistry. Three class periods and three hours of laboratory per week. This course can also count toward the environmental and sustainability studies program.

Frequency: *Every Semester*

Prerequisites: CHEM 127 or CHEM 137

Core designations: Natural Science N

CHEM 137 - Honors General Chemistry I, 4 credits.

This is the first of a two-course sequence covering the same fundamental topics as in CHEM 127 - General Chemistry I but with significantly greater depth. It is designed for those students interested in the chemistry major and/or a chemistry-related career. Three class periods and one three-hour laboratory each week. Prerequisites: a strong high school background in chemistry and mathematics

Frequency: *Not offered on a Regular Basis*

CHEM 138 - Honors General Chemistry II, 4 credits.

This is the second of a two-course sequence covering the same fundamental topics as in CHEM 128 - General Chemistry II but with significantly greater depth. More emphasis is placed on student-directed projects. The course is designed for those students interested in the chemistry major and/or a chemistry-related career. Three class periods and one three-hour laboratory each week.

Frequency: *Not offered on a Regular Basis*

Prerequisites: CHEM 137

CHEM 142 - Survey of Organic and Biochemistry, 4 credits.

A survey of organic and biological chemistry. This course is intended for students in nursing, nutrition and other related health professions. It does not count toward a chemistry major or minor. Three class periods and three hours of laboratory per week. Prerequisite: high school chemistry

Frequency: *Every Year - Second Semester*

CHEM 152 / BIOL 152 - Vocation and the Health Professions, 1 credits.

Intended for freshmen and sophomore students interested in various careers in the health professions. This course offers a balance of personal reflection and practical information. The concept of "vocation as calling" will be emphasized and students will be asked to reflect upon their reasons for choosing a particular career path. Practical information will include various career options in the health professions, undergraduate expectations, professional school admissions requirements, and non-traditional career paths.

Frequency: *Every Semester*

CHEM 171 - Consumer and Environmental Chemistry, 4 credits.

A study of the relationship between the environment and our use of energy and everyday goods. Topics may include global climatic change, ozone depletion, and acid rain. The course is designed for non-science students with little or no science background. It has no prerequisite. It fulfills the laboratory science requirement but does not count toward a science major. Three class periods and three hours of laboratory per week.

Frequency: *Not offered on a Regular Basis*

Core designations: Natural Science N

CHEM 172 - Survey of Biochemistry, 2 credits.

A survey of biological chemistry. Carbohydrates, lipids, proteins, enzyme, metabolism, and other major topics of biochemistry will be introduced. This course is intended for nursing, nutrition, and other related health profession and education majors. Three hours of lecture and three hours of laboratory per week.

Frequency: *Not offered on a Regular Basis*

Prerequisites: CHEM 341

CHEM 174 - From Space to Deep Ocean: Chemistry at the Extremes of Nature, 4 credits.

This course satisfies the natural science (N) exploration area by focusing on the chemistry of gases in several extreme environments. From space exploration, to climbing Mount Everest, to deep sea diving, gases play a critical role. The course will mix science with the excitement of exploration and will deal with operating at the limits of animal endurance. Limited to gases, the science should be comprehensible to all students. The associated lab will explore the properties of gases. Students will be given an opportunity to investigate one special topic of their interest. Students will present these topics to a peer audience.

Frequency: *Not offered on a Regular Basis*

Core designations: Natural Science N

CHEM 175 - Forensic Science-Where the Dead Do Tell Tales, 4 credits.

An introduction to the field of forensic science, including the areas of trace evidence, DNA, firearms, and drug analysis. Students will develop a thorough understanding of the scientific method and an appreciation of the ethical nature of scientific inquiry through laboratory investigations and mock-crime scene analysis. Three class periods and three hours of laboratory per week.

Frequency: *Not offered on a Regular Basis*

Core designations: Natural Science N

CHEM 304 - Pharmacology, 2 credits.

An introduction to the study of the properties, effects, and therapeutic value of drugs. For each major drug group, the pharmacokinetics, pharmacodynamics, and adverse drug reactions will be outlined based upon a group prototype. The objective of the course is to give students the ability to place major drugs into correct therapeutic categories with an understanding of their mechanisms of action, indications, and side effects. This course will be asynchronous online, with in-person exams. This course does not count toward a chemistry major or minor.

Frequency: *Every Year - Second Semester*

Prerequisites: BIOL 306 (may be taken concurrently)

CHEM 330 - Analytical Chemistry I, 4 credits.

An overview of the fundamentals of chemical analysis. Topics include statistics and sampling, chemical equilibrium, volumetric analysis, electrochemistry, and an introduction to instrumentation. Laboratory work emphasizes representative sampling, sample preparation, volumetric analysis, gas and liquid chromatography, atomic and molecular spectroscopy, data analysis, and scientific writing. Three class periods and four hours of laboratory per week.

Frequency: *Every Year - Second Semester*

Prerequisites: CHEM 128 or CHEM 138

Core designations: Natural Science N

CHEM 341 - Organic Chemistry I, 4 credits.

An examination of the fundamental classes of carbon compounds and the relationship of their physical and chemical properties to structure. Three class periods and one three-hour laboratory per week.

Frequency: *Every Year - First Semester*

Prerequisites: CHEM 128 or CHEM 138

CHEM 342 - Organic Chemistry II, 4 credits.

A study of organic compounds containing oxygen, nitrogen and sulfur, including many of commercial and/or biochemical importance. Three class periods and one three-hour laboratory per week.

Frequency: *Every Year - Second Semester*

Prerequisites: CHEM 341

CHEM 344 - Spectroscopy, 4 credits.

This course provides detailed exposure to the theory and application of the four fundamental molecular spectroscopies (nuclear magnetic resonance, infrared, ultraviolet, and mass spectrometry). Focus is placed upon spectra interpretation toward molecular structure elucidation. Practical, hands-on experience with each instrument is highlighted. Three class periods per week.

Frequency: *Alternate Years - 2nd Semester*

Prerequisites: CHEM 341

CHEM 351 - Physical Chemistry I, 4 credits.

The first of two courses that explore the fundamental physical principles of chemistry. The course progresses from a microscopic to a macroscopic point of view moving from quantum mechanics to statistical mechanics and finally to thermodynamics. Topics include one-dimensional quantum models, atoms and molecules, the Boltzmann distribution, the laws of thermodynamics, chemical equilibrium, and electrochemistry. Three class periods and one four-hour laboratory per week.

Frequency: *Every Year - First Semester*

Prerequisites: MATH 122)

CHEM 352 - Physical Chemistry II, 4 credits.

The second of two courses that explores the fundamental physical principles of chemistry. The course builds on the fundamentals of quantum mechanics, statistical mechanics, and thermodynamics introduced in CHEM 351 - Physical Chemistry I. Additionally, physical and chemical kinetics are discussed. Topics include: two and three dimensional quantum models, operator formalism, angular momentum, group theory, lasers, kinetics, and thermodynamics of solutions. Three class periods per week.

Frequency: *Every Year - Second Semester*

Prerequisites: CHEM 351

CHEM 373 - Biochemistry I, 4 credits.

A survey of the chemistry and biology of the fundamental molecules of life: carbohydrates, lipids, nucleic acids, amino acids, proteins, enzymes, vitamins and cofactors. The metabolic pathways for producing energy by degradation of carbohydrates, lipids and proteins are also a major component of the course. Three class periods plus one three-hour lab per week.

Frequency: *Every Year - First Semester*

Prerequisites: CHEM 342

CHEM 374 - Biochemistry II, 4 credits.

Building on the content of Biochemistry I, this course surveys selected biochemical pathways for synthesizing the molecules of life such as fatty acids, triglycerides, cholesterol, heme, starch and glycogen. A second major focus of the course is the transfer of biological information as it flows from DNA to RNA to proteins. Three class periods plus one three-hour lab per week.

Frequency: *Every Year - Second Semester*

Prerequisites: CHEM 373

CHEM 380 - Special Topics, 0-4 credits.

Courses covering various topics of interest in this particular discipline are offered regularly. Contact department or program chair for more information.

Frequency: *Not offered on a Regular Basis*

Repeatable: Yes

CHEM 390 - Cooperative Education, 1-8 credits.

Frequency: *Not offered on a Regular Basis*

Repeatable: Yes

CHEM 397 - ACS Research, 0 credits.

This course documents successful completion of the chemistry research requirement for all American Chemical Society (ACS) degrees. This requirement includes at least 84 hours of directed research, as well as completion of a research paper. Prerequisite: permission of instructor.

Frequency: *Every Semester*

Repeatable: Yes

CHEM 398 - ACS Research, 0 credits.

This course documents successful completion of the chemistry research requirement for all American Chemical Society (ACS) degrees. This requirement includes at least 126 hours of directed research, as well as completion of a research paper. Prerequisite: permission of instructor.

Frequency: *Every Semester*

CHEM 403 - Senior Seminar I, 1 credits.

The first in a two-course sequence (Chem 403/404) focusing on the preparation and presentation of a major paper related to the field of chemistry. Chem 403 emphasis is on the fundamentals of conducting research for the paper, writing the paper, and giving the presentation. Additional topics include scientific ethics and career preparation. May be required for completion of PEAK project in Chemistry Department.

Frequency: *Every Year - First Semester*

This course is PEAK Optional

CHEM 404 - Senior Seminar II, 1 credits.

Oral and written presentation of a topic of interest to the chemistry department. The student works with a chosen faculty mentor to apply the skills learned in CHEM 403 - Senior Seminar I.

Frequency: *Every Year - Second Semester*

Prerequisites: CHEM 403 (may be taken concurrently)

CHEM 431 - Analytical Chemistry II, 4 credits.

A continuation of the topics introduced in CHEM 330, with an emphasis on instrumental methods of chemical analysis. In addition to the instrumental techniques introduced in the previous course, this course includes computer-to-instrument interfaces, electronics, electrochemical techniques, capillary electrophoresis, mass spectrometry, and surface analysis methods. One class period and six hours of laboratory per week.

Frequency: *Every Year - First Semester*

Prerequisites: CHEM 330

CHEM 445 - Organic Chemistry III, 4 credits.

A study of modern concepts of organic reaction mechanisms and the relationship of spectroscopic properties to molecular structure. Three class periods and one four-hour laboratory per week.

Frequency: *Not offered on a Regular Basis*

Prerequisites: CHEM 342

CHEM 462 - Advanced Inorganic Chemistry, 4 credits.

A study of theoretical inorganic chemistry at an advanced level. The primary concerns are with modern concepts of bonding, coordination chemistry, acid-base behavior, reaction mechanisms and properties of less familiar elements. Three class periods.

Frequency: *Every Year - Second Semester*

Prerequisites: CHEM 351

CHEM 474 - Biochemistry of Cancer, 4 credits.

Biochemistry of Cancer will collaboratively investigate the long history of cancer, overview the mechanism of cancer and the development and progression of cancer in the body, look at approaches to the cure of cancer, and investigate treatments on the horizon as well as societal and cultural impacts of cancer. This course pulls together diverse course background to understand the impact of cancer. Prerequisites: 16 credits in science courses.

Frequency: *Not offered on a Regular Basis*

CHEM 475 / NEU 475 - Neurochemistry, 4 credits.

This junior/senior level course studies the chemical and biochemical aspect of neuroscience including ligand binding, pharmacokinetics and second messenger cascades. Three class periods per week.

Frequency: *Every Year - Second Semester*

Prerequisites: NEU 109 and (CHEM 373 or CHEM 142)

This course is PEAK Optional

CHEM 480 - Independent Study, 1-4 credits.

This course provides an opportunity for individual students to conduct in-depth study of a particular topic under the supervision of a faculty member. Contact the department or program chair for more information.

Frequency: *Not offered on a Regular Basis*

Repeatable: Yes

CHEM 487 - Directed Research, 1-4 credits.

This course provides an opportunity for individual students to conduct research in a specific area of study, completed under the direction of a faculty mentor. Specific expectations of the research experience to be determined by the faculty. Repeatable for credit. Prerequisite: consent of instructor.

Frequency: *Not offered on a Regular Basis*

Repeatable: Yes