

# DEPARTMENT OF CHEMISTRY AND PHYSICAL SCIENCES

For students majoring in chemistry or biochemistry, the department provides an intensive program of study in the major areas of chemistry with an emphasis on developing skills in analytical thinking and problem-solving, evaluation and interpretation of data, effective communication of scientific information, and research methodologies, while also exploring the applications of chemistry that permeate our lives. Sufficient flexibility through open electives allows students to emphasize personal career goals.

Students are prepared for entry-level positions in chemical, pharmaceutical or academic research laboratory settings or in non-traditional settings, which rely on the background and skills that have been acquired. Their education also prepares them for entry into graduate programs of study in chemistry, biochemistry, environmental science, biomedical sciences, pharmacy, secondary education, medicine or law.

The department also provides a chemistry minor program structured to give students a balanced exposure to the major areas of chemistry and opportunities to develop associated skills. Providing this opportunity is an important asset for students studying in other programs, particularly those pursuing careers in the biomedical and biological sciences.

The department also offers courses in chemistry and physics tailored to the support of programs in the basic and health sciences, nursing and engineering. These programs all have a strong reliance on the ability of students to understand and apply the fundamental concepts of chemistry and physics and to demonstrate clear analytical thinking and problem-solving skills developed in these courses.

The mission of the Department of Chemistry and Physical Sciences is to provide undergraduate course work in chemistry and the physical sciences in a student-centered, supportive learning environment characterized by small classes with access to faculty and well-equipped laboratory facilities where students can actively engage in the investigative process of science.

In addition, it is the mission of the department to offer stimulating course work in the physical sciences for non-science majors as part of the University Curriculum so that all students can develop an appreciation of the process of science, engage in scientific investigative experiences, understand the role of science in their everyday lives and be prepared to make informed value judgments in our highly technological society.

- Bachelor of Science in Chemistry (<http://catalog.qu.edu/arts-sciences/chemistry-physical-sciences/chemistry-bs>)
- Bachelor of Science in Biochemistry (<http://catalog.qu.edu/arts-sciences/chemistry-physical-sciences/biochemistry-bs>)
- Minor in Chemistry (<http://catalog.qu.edu/arts-sciences/chemistry-physical-sciences/chemistry-minor>)

## Chemistry (CHE)

**CHE 101. Fundamentals of General, Organic and Biological Chemistry I. 3 Credits.**

Students study the general fundamentals of chemistry: which includes atomic theory and radioactivity, bonding (including ions and molecules), stoichiometry, states of matter, and solutions including solubility, acids, bases and buffers. Students who have already received credit for CHE 110 with a grade of C- or higher are not eligible to take CHE 101.

**Prerequisites:** Take MA 107; Minimum grade C- or Math placement score of 3.

**Corequisites:** Take CHE 101L.

**Offered:** Every year, Fall and Spring

**UC:** Natural Sciences

**CHE 101L. Fundamentals of General, Organic and Biological Chemistry I Lab. 1 Credit.**

Lab must be taken with CHE 101. (2.5 lab hrs.)

**Corequisites:** Take CHE 101.

**Offered:** Every year, Fall and Spring

**UC:** Natural Sciences

**CHE 102. Fundamentals of General, Organic and Biological Chemistry II. 3 Credits.**

Students study the fundamental chemistry of carbon and the structural and functional relationships of hydrocarbons, alcohols, aldehydes, ketones, esters, carboxylic acids, amines, carbohydrates, lipids, proteins, and their application to biochemistry.

**Prerequisites:** Take CHE 101-101L; Minimum grade C-.

**Corequisites:** Take CHE 102L.

**Offered:** Every year, Spring

**UC:** Natural Sciences

**CHE 102L. Fundamentals of General, Organic and Biological Chemistry II Lab. 1 Credit.**

Lab must be taken with CHE 102. (2.5 lab hrs.)

**Prerequisites:** Take CHE 101-101L; Minimum grade C-.

**Corequisites:** Take CHE 102.

**Offered:** Every year, Spring

**UC:** Natural Sciences

**CHE 106. Chemical Principles with Biological Applications. 3 Credits.**

Students learn about atomic theory (including radioactivity), bonding (including ions and molecules) and intermolecular forces, states of matter, solutions (including solubility, acids and bases, buffers, electrolytes and nonelectrolytes), carbon compounds and functional groups, biomolecules (such as carbohydrates, fatty acids, and amino acids and proteins), receptors, enzymes, nucleic acids and DNA. Students apply these fundamental chemical principles to a variety of health-related case studies. (Enrollment restricted to nursing majors)(3 lecture hrs.)

**Prerequisites:** Take MA 107; Minimum grade C-; or Math placement score of 3.

**Corequisites:** Take CHE 106L.

**Offered:** Every year, Fall and Spring

**CHE 106L. Chemical Principles with Biological Applications Lab. 1 Credit.**

Lab to accompany CHE 106. (3 lab hrs.)

**Corequisites:** Take CHE 106

**Offered:** Every year, Fall and Spring

<p><b>CHE 110. General Chemistry I.</b> <b>3 Credits.</b> Students study the atomic theory of matter, nomenclature, chemical formulas and reaction equations, stoichiometry, the gas laws and the kinetic molecular theory, thermochemistry, atomic structure, periodicity of the elements, chemical bonding and molecular structure. (Note: this course is designed for science majors.) <b>Corequisites:</b> Take CHE 110L. <b>Offered:</b> Every year, All <b>UC:</b> Natural Sciences</p>	<p><b>CHE 211. Organic Chemistry II.</b> <b>3 Credits.</b> This course is a continuation of CHE 210. Students study specific groups such as aromatic compounds, alcohols and phenols, aldehydes, ketones, carboxylic acids and their derivatives and amines, and their analysis by infrared and nuclear magnetic resonance spectroscopy. Must be taken in conjunction with CHE 211L. <b>Prerequisites:</b> Take CHE 210-210L; Minimum grade C-. <b>Corequisites:</b> Take CHE 211L. <b>Offered:</b> Every year, Spring and Summer</p>
<p><b>CHE 110L. General Chemistry I Lab.</b> <b>1 Credit.</b> Lab must be taken with CHE 110. (3 lab hrs.) <b>Corequisites:</b> Take CHE 110. <b>Offered:</b> Every year, All <b>UC:</b> Natural Sciences</p>	<p><b>CHE 211L. Organic Chemistry II Lab.</b> <b>1 Credit.</b> Lab must be taken with CHE 211. (3 lab hrs.) <b>Corequisites:</b> Take CHE 211. <b>Offered:</b> Every year, Spring and Summer</p>
<p><b>CHE 111. General Chemistry II.</b> <b>3 Credits.</b> Students study intermolecular forces, properties of solutions, kinetics, chemical equilibrium, pH, acid-base solution chemistry, thermodynamics and electrochemistry. Problem-solving is emphasized. <b>Prerequisites:</b> Take CHE 110-110L; Minimum grade C-. <b>Corequisites:</b> Take CHE 111L. <b>Offered:</b> Every year, Spring and Summer <b>UC:</b> Natural Sciences</p>	<p><b>CHE 215. Analytical Chemistry.</b> <b>3 Credits.</b> Students study the principles and practice of modern chemical analysis. The following topics are studied: treatment of analytical data, experimental design and sample preparation, simple and complex equilibria, potentiometry, chromatography and spectrophotometry. Intended for chemistry and biochemistry majors and chemistry minors. <b>Prerequisites:</b> Take CHE 111-111L; Minimum grade C-. <b>Corequisites:</b> Take CHE 215L. <b>Offered:</b> Every year, Fall and Spring</p>
<p><b>CHE 111L. General Chemistry II Lab.</b> <b>1 Credit.</b> Lab must be taken with CHE 111. (3 lab hrs.) <b>Prerequisites:</b> Take CHE 110-110L; Minimum grade C-. <b>Corequisites:</b> Take CHE 111. <b>Offered:</b> Every year, Spring and Summer <b>UC:</b> Natural Sciences</p>	<p><b>CHE 215L. Analytical Chemistry Lab.</b> <b>1 Credit.</b> Lab must be taken with CHE 215. (3 lab hrs.) <b>Corequisites:</b> Take CHE 215. <b>Offered:</b> Every year, Fall and Spring</p>
<p><b>CHE 202. Chemistry of Macro- and Micronutrients.</b> <b>4 Credits.</b> Students investigate the fundamental chemistry of macro- and micronutrients through lectures, projects on current research in the chemistry of food, and integrated online chemistry activities. Emphasis is on the study of the chemistry of food components including: carbohydrates, fats, proteins, vitamins, minerals and water, with the additional assessment of how foods must meet nutrient needs in different ways for animals. Enrollment in this course is restricted to students in the BS in Health Science Studies online degree completion program. Students cannot receive credit for CHE 202 AND either SCI 161 or SCI 105. This course is offered online only. <b>Offered:</b> Every year, Summer</p>	<p><b>CHE 300. Special Topics.</b> <b>3 Credits.</b> <b>Prerequisites:</b> Take two 200-level chemistry courses. <b>Offered:</b> As needed</p>
<p><b>CHE 210. Organic Chemistry I.</b> <b>3 Credits.</b> Students study the principles that govern the properties, reactions and methods of preparation of organic compounds correlated with reaction mechanisms, stereochemistry, conformational analysis, resonance and transition state theory and the nomenclature of organic compounds. Specific groups studied include alkanes, alkyl halides, alkenes and alkynes. <b>Prerequisites:</b> Take CHE 111-111L; Minimum grade C-. <b>Corequisites:</b> Take CHE 210L. <b>Offered:</b> Every year, Fall and Summer</p>	<p><b>CHE 301. Physical Chemistry I.</b> <b>3 Credits.</b> Students investigate the underlying theories of chemical phenomena. The laws and fundamental equations of equilibrium thermodynamics are applied to the quantitative treatment of chemical equilibria, phase equilibria, electrochemical equilibria, and ionic equilibria. The principles of chemical kinetics and reaction mechanisms also are investigated. <b>Prerequisites:</b> Take CHE 111-111L; MA 141 or MA 151; and PHY 111-111L or PHY 122; Minimum grade C-. <b>Corequisites:</b> Take CHE 301L. <b>Offered:</b> Every other year, Fall</p>
<p><b>CHE 210L. Organic Chemistry I Lab.</b> <b>1 Credit.</b> Lab must be taken with CHE 210. (3 lab hrs.) <b>Corequisites:</b> Take CHE 210. <b>Offered:</b> Every year, Fall and Summer</p>	<p><b>CHE 301L. Physical Chemistry I Lab.</b> <b>1 Credit.</b> Lab must be taken with CHE 301. (3 lab hrs.) <b>Corequisites:</b> Take CHE 301. <b>Offered:</b> Every other year, Fall</p>
	<p><b>CHE 302. Physical Chemistry II.</b> <b>3 Credits.</b> Students study quantum theory, spectroscopy and statistical thermodynamics. The study of quantum mechanics is used to provide the basis for developing an understanding of atomic and molecular spectroscopy and chemical bonding. <b>Prerequisites:</b> Take CHE 301; Minimum grade C-. <b>Corequisites:</b> Take CHE 302L. <b>Offered:</b> Every other year, Spring</p>
	<p><b>CHE 302L. Physical Chemistry II Lab.</b> <b>1 Credit.</b> Lab must be taken with CHE 302. (3 lab hrs.) <b>Corequisites:</b> Take CHE 302. <b>Offered:</b> Every other year, Spring</p>

- CHE 305. Instrumental Analysis. 3 Credits.**  
Students investigate the following instrumental analysis techniques: FTIR, NMR, UV-VIS, spectroscopy and separation methods including gas and liquid chromatography, mass spectrometry and other current techniques.  
**Prerequisites:** Take CHE 211-211L and CHE 215-215L; Minimum grade C-.  
**Corequisites:** Take CHE 305L.  
**Offered:** Every other year, Spring
- CHE 305L. Instrumental Analysis Lab. 1 Credit.**  
Lab must be taken with CHE 305. (3 lab hrs.)  
**Corequisites:** Take CHE 305.  
**Offered:** Every other year, Spring
- CHE 315. Biochemistry I. 3 Credits.**  
Students engage in a comprehensive study of biologically active compounds and their metabolism, biosynthesis and relationship to biological systems, and a detailed study of bioenergetics, enzyme kinetics and buffer systems.  
**Prerequisites:** Take CHE 211-211L; Minimum grade C-.  
**Corequisites:** Take CHE 315L.  
**Offered:** Every year, Fall and Spring
- CHE 315L. Biochemistry Lab I. 1 Credit.**  
Students carry out a series of experiments that expose them to the basic principles of biochemical techniques including biomolecule quantitation, protein and carbohydrate purification and analysis, and enzyme kinetics. Lab must be taken with CHE 315. (3 lab hrs.)  
**Corequisites:** Take CHE 315.  
**Offered:** Every year, Fall and Spring
- CHE 316. Biochemistry II. 3 Credits.**  
Students study the biochemical and mechanistic basis of key metabolic pathways and their tie-ins with pathology and pharmacology. Nucleic acids, DNA and RNA, are studied to understand the chemical principles that govern the flow of genetic information with an emphasis on the key roles that RNA plays as an intermediate in the flow of genetic information, a catalyst, a sensor of small metabolites, and a regulator of gene expression.  
**Prerequisites:** Take CHE 315-315L; Minimum grade C-.  
**Offered:** Every other year, Spring
- CHE 399. Independent Study in Chemistry I. 1-3 Credits.**  
Permission of the chairperson is required. May be taken in more than one semester for up to a total of 6 credits.  
**Offered:** All
- CHE 410. Inorganic Chemistry. 3 Credits.**  
Students study the electronic structure of atoms, ionic and covalent bonding, acid-base chemistry and non-aqueous solvents, coordination chemistry, and periodicity. Symmetry and chemical applications of group theory are introduced.  
**Prerequisites:** Take CHE 111; Minimum grade C-.  
**Offered:** Every other year, Fall
- CHE 420. Chemistry Integrative Capstone. 3 Credits.**  
Topics in chemistry including history, ethics, environmental issues and current developments are explored from a scientific perspective. Through oral and written work students demonstrate connections between their Roadmap and Milestones, general education, co-curricular activities, their major course work and experiential learning project(s) in chemistry.  
**Prerequisites:** Senior status as a chemistry/biochemistry major or approval of Chairperson.  
**Offered:** Every year, Spring
- CHE 475. Chemistry Seminar I. 1 Credit.**  
Students attend research group meetings and outside seminars, and prepare and present a literature-based seminar on a topic approved by their research mentor. (Enrollment restricted to senior chemistry and biochemistry majors.)  
**Corequisites:** Take CHE 490.  
**Offered:** Every year, Fall
- CHE 476. Chemistry Seminar II. 1 Credit.**  
Students attend research group meetings and outside seminars and prepare and present a seminar and a poster presentation on their research project. (Enrollment restricted to senior chemistry and biochemistry majors.)  
**Prerequisites:** Take CHE 475 and CHE 490.  
**Corequisites:** Take CHE 491.  
**Offered:** Every year, Spring
- CHE 490. Chemistry Research I. 3 Credits.**  
Students work closely with a faculty mentor on a chemistry research project. A minimum of 100 lab hours or equivalent is required. (Enrollment restricted to senior chemistry and biochemistry majors.)  
**Corequisites:** Take CHE 475.  
**Offered:** Every year, Fall
- CHE 491. Chemistry Research II. 3 Credits.**  
Students continue their work on a chemistry research project, which they began in CHE 490. A minimum of 100 lab hours or equivalent is required. (Enrollment restricted to senior chemistry and biochemistry majors.)  
**Prerequisites:** Take CHE 475 and CHE 490.  
**Corequisites:** Take CHE 476.  
**Offered:** Every year, Spring