

# Chemistry

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The emphasis in the chemistry program is on assisting the students to develop a working knowledge of basic chemical principles and to prepare them for possible careers or graduate training in chemistry.

The B.S. degree is appropriate for students interested in pursuing a professional career in chemistry or chemistry-related fields.

A typical range of undergraduate courses is offered. In addition to the formal coursework taken for the B.S. degree, chemistry majors may also elect to participate in one or more semesters of industrial experience or academic research.

The chemistry program is housed in the Science Center and includes four well-equipped, modern laboratories, a classroom, study areas, a computer room, and faculty offices. The arrangement is such that faculty and fellow students are readily available for consultation and assistance. The laboratories house modern instruments which may be used by all chemistry students.

We recommend an appropriate computer course. Additional courses in mathematics, physics, or applied chemistry may also be recommended.

## Departmental Learning Outcomes

### 1. *Synthesize foundational knowledge of chemistry.*

A foundational knowledge of chemistry includes basic knowledge in all of the following fields:

- Inorganic Chemistry
- Organic Chemistry
- Organic Laboratory Techniques
- Physical Chemistry
- Analytical Chemistry
- Environmental Chemistry

### 2. *Apply scientific reasoning to increasingly complex problems.*

Different types of problems will require different skill sets, including proficiency in the following areas:

- Quantitative Skills
- Analytical Skills
- Literature Research
- Laboratory Research

### 3. *Perform as an effective member of the scientific community.*

## 2 Chemistry

Working within the scientific community requires a wide variety of communication and interpersonal skills in addition to knowledge of equipment and safety. Of particular importance are the following abilities:

- Listening to instruction and constructive criticism
- Reading scientific literature and texts
- Writing clear laboratory reports and research papers
- Presenting research clearly and concisely
- Demonstrating integrity
- Working effectively as a member of a group
- Working safely and knowledgeably with chemistry lab equipment

### Major

- B.S. in Chemistry (<http://catalog.principiacollege.edu/majors-minors/chemistry/bs/>)

### Minor

- Minor in Chemistry (<http://catalog.principiacollege.edu/majors-minors/chemistry/minor/>)

#### **CHEM 110 Environmental Chemistry Issues 3.0 SH [GESN]**

Introduction to environmental problems and the chemical aspects of these concerns. Basic concepts of chemistry are introduced in the context of environmental issues. Designed to develop an awareness of environmental issues and to use that information as informed global citizens and voters.

#### **CHEM 111 Environmental Chemistry 4.0 SH [GESL]**

Introduction to environmental problems and the chemical aspects of these concerns. Basic concepts of chemistry are introduced in the context of environmental issues. Designed to develop an awareness of environmental issues and to use that information as informed global citizens and voters. Includes labs.

#### **CHEM 113 Chemistry: A Vector of History 3.0 SH [GESN]**

The evolution of chemistry through history follows the development of the scientific method and the role that new material plays in defining the society one lives in. Demonstration of experiments that mark turning points in chemistry will form the central theme of the course and examining the lives of notable scientists will form the context in which their discoveries occur.

#### **CHEM 114 Chemistry of Art Objects/Media 4.0 SH [GESL]**

Selected fundamentals of chemistry relevant to the creation, conservation, and preservation of art objects. Survey of pigments, dyes, paints, ceramics, glassy and metallic media, paper, lithography, engraving, and fresco. Other topics will include conservation, the museum environment, scientific examination of art, forgery detection by scientific means, and safety in the studio. Includes labs.

#### **CHEM 115 Introduction to Chemistry 4.0 SH [GESL]**

A one-semester introduction to chemistry relevant to biology and environmental science. Students learn how understanding chemical concepts and chemical reactions is important to biology and environmental science. Includes labs. Prepares students for taking Organic Survey.

**Prerequisite:** Success in this course depends upon students having completed a high school second-year algebra course and a high school geometry course with a grade of C or above.

#### **CHEM 117 Food Chemistry 4.0 SH [GESL]**

The course applies basic scientific principles to food systems and their practical applications. Chemical/biochemical reactions of carbohydrates, lipids, proteins, and other constituents in fresh and processed foods are discussed with respect to food quality and processing. Reaction conditions that affect color, flavor, texture, nutrition, and food safety are studied. Food-related lab experiments and an independent project are included.

- CHEM 131 Fundamentals of Chemistry I** 4.0 SH [GESL]  
 First of a three-course introductory sequence in chemistry. Develops problem-solving and research skills. Includes atomic structure, stoichiometry, bonding, gases, liquids, and solids. Includes labs. Students should consider taking MATH 181 concurrently.  
**Prerequisite:** Success in this course depends upon students having completed a high school second year algebra course and a high school geometry course with a grade of C or above.  
**Class Level Restriction:** Freshman only.
- CHEM 132 Fundamentals of Chemistry II** 4.0 SH [ ]  
 Second part of the introductory chemistry sequence. Introduction to physical chemistry including solutions, kinetics, equilibrium concepts, acid-base chemistry, thermodynamics, and electrochemistry. Includes labs.  
**Prerequisite:** CHEM 131.  
**Class Level Restriction:** Freshman and Sophomore only.
- CHEM 133 Fundamentals of Chemistry III** 4.0 SH [ ]  
 Third part of the introductory chemistry sequence. Topics covered include nuclear, organic, and descriptive chemistry of metals and non-metals. Introduces laboratory methods of quantitative analysis and instrumentation. Topics include titrimetric and gravimetric methods of analysis, statistical treatment of data, error propagation and analysis, and instrumental techniques of chromatography and spectroscopy. Includes labs. Students should consider taking MATH 182 concurrently.  
**Prerequisite:** CHEM 131 and CHEM 132.  
**Class Level Restriction:** Freshman and Sophomore only.
- CHEM 201 Environmental Testing** 4.0 SH [GESL]  
 Application of chemistry to field analysis of contaminants in the environment. Focuses on writing a site assessment manual for testing of air, water, and soil. Includes labs.  
**Prerequisite:** high school chemistry or equivalent.
- CHEM 241 Research Project** 1.0-3.0 SH [ ]  
 Research under faculty supervision. May receive a star (\*) grade, with final grade being assigned on completion of the project. May be taken for variable credit from one to three semester hours. May be repeated twice for a maximum of 9.0 SH.
- CHEM 260 Organic Survey** 4.0 SH [ ]  
 Principal classes of organic compounds, nomenclature, properties, reactions, essentials of structure and mechanisms. Applications to biological systems. Includes labs.  
**Prerequisite:** CHEM 115 or CHEM 131.
- CHEM 262 Organic Chemistry I** 4.0 SH [ ]  
 First of a two-course sequence on organic chemistry. Includes major classes of organic compounds, nomenclature, structure and properties, acid-base theory, spectroscopy, stereochemistry, thermodynamics, reactions, and mechanisms. Includes labs.  
**Prerequisite:** CHEM 133.
- CHEM 263 Organic Chemistry II** 4.0 SH [ ]  
 A continuation of CHEM 262. Includes labs.  
**Prerequisite:** CHEM 262.
- CHEM 274 General Biochemistry** 4.0 SH [ ]  
 Molecular components of cells, metabolic and energy transfer pathways, biosynthesis, molecular genetics. Includes labs.  
**Prerequisite:** CHEM 260 or CHEM 262.
- CHEM 301 Adv Environmental Chemistry** 4.0 SH [ ]  
 Study of the chemistry of air, water, and soil and how industries and activities affect the chemical balances in nature. Includes a laboratory section which concentrates on environmental chemical analysis.  
**Prerequisite:** BNR 191 or CHEM 133 or CHEM 201.  
**Class Level Restriction:** Junior and Senior only.

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**CHEM 311 Phys Chem I: Thermodynamics 4.0 SH [ ]**

The study of classical thermodynamics both from a theoretical and an experimental viewpoint. Topics include gas laws, enthalpy, entropy, liquids, solutions, mixtures, kinetic rates, and mechanisms. Includes labs.

**Prerequisite:** CHEM 133 or PHYS 203.

**Class Level Restriction:** Junior and Senior only.

**CHEM 313 Phys Chem II: Quantum Chem 4.0 SH [ ]**

Quantum mechanics is developed from simple systems to the hydrogen atom to molecules. Valence bond theory, molecular orbital theory, and group theory are used along with spectroscopy to explore atomic and molecular structure. The laboratory includes one research project. Includes labs.

**Prerequisite:** CHEM 133 and PHYS 202.

**Class Level Restriction:** Junior and Senior only.

**CHEM 321 Applied Spectroscopy 4.0 SH [ ]**

The study of interaction of electromagnetic radiation with matter in order to elucidate its structure. Various spectroscopic techniques, including NMR, EPR, IR and atomic absorption, will be applied to identify the structures of organic and inorganic compounds. Includes labs.

**Prerequisite:** CHEM 262 and CHEM 311.

**Class Level Restriction:** Junior and Senior only.

**CHEM 333 Instrumental Analysis 4.0 SH [ ]**

Theory and use of analytical instruments, including infrared, UV-visible, atomic absorption and nuclear magnetic resonance spectrometers, and the gas-liquid chromatograph. Emphasis will be on laboratory use of the instruments and the interpretation of results for molecular structure determination, compound identification, and quantitative analysis. Includes labs.

**Prerequisite:** CHEM 133 and CHEM 263.

**Class Level Restriction:** Junior and Senior only.

**CHEM 441 Senior Research Project 1.0-6.0 SH [ ]**

Research under faculty supervision. May receive a star (\*) grade, with final grade being assigned on completion of the project. May be offered for variable credit from one to six semester hours. May be repeated multiple times, but only six semester hours may be used to fulfill major or minor requirements. Open only to chemistry majors.

**Class Level Restriction:** Junior and Senior only.

**Field of Study Restrictions:** Chemistry BS Majors only.