

# Chemistry

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Chemistry. It's the core science: the study of the properties, composition and changes that occur in matter. When you study chemistry, you analyze issues that influence every aspect of life on Earth.

Whether you choose the bachelor of science degree (for those targeting careers in industry or planning to pursue a graduate degree) or the bachelor of arts degree (appropriate for those seeking work in medicine, dentistry or secondary school teaching), Cal Lutheran's chemistry curriculum provides the knowledge base required of the discipline.

Because of the program's strong emphasis on laboratory experience, our advanced chemistry students are taught how to design and carry out their own experiments and encouraged to work on independent research projects. They also have the opportunity to do supported research with faculty members during the summer. Many students have been accepted to summer research programs at Ph.D.-granting institutions.

The department possesses modern instruments which students use regularly in their classes and research projects. These include:

- Fourier transform infrared and nuclear magnetic resonance spectrometers
- gas chromatographs with several types of detectors
  - mass spectrometer
  - electron capture
  - flame ionization
- rapid-scan UV-vis spectrometer

Cal Lutheran chemistry students are encouraged to pursue internships and REU programs during the course of their studies. Recent Cal Lutheran students have interned at Ventura County Crime Lab, Amgen and Rockwell Science Center, and have attended REU programs at Colorado State and SUNY Stonybrook.

These undergraduate research opportunities translate into success for Cal Lutheran's chemistry graduates, who have been accepted into many of the nation's most respected medical, dental, and graduate programs including:

- University of California at
  - San Diego
  - Irvine
  - Santa Barbara
- Yale University
- Indiana University
- University of Ohio

## Bachelor of Arts in Chemistry

32 credits minimum, 20 credits upper division

|  |   |    |
|--|---|----|
| CHEM 151   | General Chemistry                                   | 4  |
| CHEM 151L  | General Chemistry Lab                               | 1  |
| CHEM 152   | General Chemistry II                                | 4  |
| CHEM 152L  | General Chemistry II Lab                            | 1  |
| CHEM 305/305L  | Quantitative Analysis and Quantitative Analysis Lab | 4  |
| CHEM 331   | Organic Chemistry                                   | 4  |
| CHEM 332   | Organic Chemistry II                                | 4  |
| CHEM 341   | Organic Chemistry Lab                               | 1  |
| CHEM 342   | Organic Chemistry II Lab                            | 1  |
| CHEM 485   | Capstone Seminar                                    | 2  |
| Chemistry Elective Credits (at least 4 Upper Division) |   | 6  |
| Total Hours  |   | 32 |

## Required Supporting Courses

Select one of the following:

8-10

|                        |   |
|------------------------|---|
| PHYS 201/201L/202/202L | Mechanics and Thermodynamics-Algebra and Mechanics and Thermodynamics-Algebra Lab and Electricity, Magnetism, and Optics - Algebra and Electricity, Magnetism, and Optics - Algebra Lab |
|------------------------|---|

|                        |   |       |
|------------------------|---|-------|
| PHYS 211/211L/212/212L | Mechanics and Thermodynamics-Calculus and Mechanics and Thermodynamics-Calculus Lab and Electricity, Magnetism, and Optics - Calculus and Electricity, Magnetism, and Optics - Calculus Lab |       |
| MATH 251               | Calculus I  | 4     |
| Total Hours            |   | 12-14 |

## Recommended

|             |             |   |
|-------------|-------------|---|
| MATH 252    | Calculus II | 4 |
| Total Hours |             | 4 |

## Bachelor of Science in Chemistry

40 Credits minimum, 28 credits upper division

|                            |   |    |
|----------------------------|---|----|
| CHEM 151                   | General Chemistry   | 4  |
| CHEM 151L                  | General Chemistry Lab                                     | 1  |
| CHEM 152                   | General Chemistry II                                      | 4  |
| CHEM 152L                  | General Chemistry II Lab                                  | 1  |
| CHEM 305/305L              | Quantitative Analysis and Quantitative Analysis Lab       | 4  |
| CHEM 306/306L              | Chemical Instrumentation and Chemical Instrumentation Lab | 4  |
| CHEM 331                   | Organic Chemistry   | 4  |
| CHEM 332                   | Organic Chemistry II                                      | 4  |
| CHEM 341                   | Organic Chemistry Lab                                     | 1  |
| CHEM 342                   | Organic Chemistry II Lab                                  | 1  |
| CHEM 405/405L              | Physical Chemistry and Physical Chemistry Lab             | 4  |
| CHEM 406/406L              | Physical Chemistry and Physical Chemistry Lab             | 4  |
| CHEM 485                   | Capstone Seminar  | 2  |
| Chemistry Elective Credits |   | 2  |
| Total Hours                |   | 40 |

## Required Supporting Courses

|                              |   |       |
|------------------------------|---|-------|
| MATH 251                     | Calculus I  | 4     |
| MATH 252                     | Calculus II   | 4     |
| Select one of the following: |   | 8-10  |
| PHYS 201/201L/202/202L       | Mechanics and Thermodynamics-Algebra and Mechanics and Thermodynamics-Algebra Lab and Electricity, Magnetism, and Optics - Algebra and Electricity, Magnetism, and Optics - Algebra Lab     |       |
| PHYS 211/211L/212/212L       | Mechanics and Thermodynamics-Calculus and Mechanics and Thermodynamics-Calculus Lab and Electricity, Magnetism, and Optics - Calculus and Electricity, Magnetism, and Optics - Calculus Lab |       |
| Total Hours                  |   | 16-18 |

## Recommended

|             |                              |    |
|-------------|------------------------------|----|
| CHEM 411    | Advanced Inorganic Chemistry | 3  |
| MATH 261    | Calculus III                 | 4  |
| MATH 265    | Differential Equations       | 4  |
| Total Hours |                              | 11 |

## Minor in Chemistry

|  |                          |    |
|--|--------------------------|----|
| CHEM 151   | General Chemistry        | 4  |
| CHEM 151L  | General Chemistry Lab    | 1  |
| CHEM 152   | General Chemistry II     | 4  |
| CHEM 152L  | General Chemistry II Lab | 1  |
| Select three courses from chemistry <sup>1</sup> |                          | 12 |
| Total Hours                                      |                          | 22 |

- <sup>1</sup> Taken in at least two areas of chemistry (200 level or above). CHEM 425 cannot be used to fulfill the minor if it is also being used to fulfill a major requirement.

## Courses

### Lower Division

#### **CHEM 111. Chemistry and the Environment. (4).**

Explores the interface between chemistry and the world we live in, with particular emphasis on environmental issues such as pollution, energy depletion and global warming. The chemical principles required to understand these topics are introduced on an as-needed basis. This course is primarily intended for non-science majors and cannot be used for credit toward a chemistry degree. Lecture, 3 hours/week; Laboratory, 3 hours/week.

#### **CHEM 111L. Chemistry and the Environment Lab. (0).**

#### **CHEM 151. General Chemistry. (4).**

Covers the fundamental theories, principles and laws of chemistry, plus the properties of elements and compounds. Prerequisites: MATH 151: high school chemistry; Math Placement Exam section I score of 14 or better or completion of MATH 110; Corequisite: CHEM 151L.

#### **CHEM 151L. General Chemistry Lab. (1).**

Covers the laboratory techniques and apparatus of chemistry, plus the illustrations of quantitative relationships in chemistry. Includes a systematic course in theory and techniques of inorganic qualitative analysis. Corequisite: CHEM 151L: CHEM 151.

#### **CHEM 152. General Chemistry II. (4).**

Covers the fundamental theories, principles and laws of chemistry, plus the properties of elements and compounds. Prerequisites: CHEM 151: high school chemistry; Math Placement Exam section I score of 14 or better or completion of MATH 110; Corequisite: CHEM 152L.

#### **CHEM 152L. General Chemistry II Lab. (1).**

Covers the laboratory techniques and apparatus of chemistry, plus the illustrations of quantitative relationships in chemistry. Includes a systematic course in theory and techniques of inorganic qualitative analysis. Corequisite: CHEM 152.

#### **CHEM 201. Elementary Organic Chemistry. (4).**

An introduction to the study of the aliphatic and aromatic compounds of biochemical interest. Includes fundamentals of organic chemistry for students of biology, nursing, physical education and elementary education. Lecture, 3 hours/week; Laboratory, 3 hours/week. Prerequisite: CHEM 111 or CHEM 152.

#### **CHEM 201L. Elementary Organic Chemistry Lab. (0).**

#### **CHEM 282. Selected Topic. (1-4).**

#### **CHEM 282C. ST: Select Topic (core). (1-4).**

Select Topic approved for core requirement.

### Upper Division

#### **CHEM 301. Environmental Chemistry. (4).**

In this course, principles of chemistry will be applied to environmental problems including water, air and soil chemistry and toxicology. Lecture, 3 hours/week; Lab, 3 hours/week. Prerequisite: CHEM 201.

#### **CHEM 301L. Environmental Chemistry Lab. (0).**

#### **CHEM 305. Quantitative Analysis. (4).**

Covers the principles and techniques of gravimetric and volumetric analysis. Lecture, 3 hours/week; Laboratory, 3 hours/week.

#### **CHEM 305L. Quantitative Analysis Lab. (0).**

#### **CHEM 306. Chemical Instrumentation. (4).**

Covers the theories and application of instrumentation in chemistry. Lecture, 2 hours/week; Laboratory, 6 hours/week. Prerequisite: CHEM 305.

#### **CHEM 306L. Chemical Instrumentation Lab. (0).**

#### **CHEM 331. Organic Chemistry. (4).**

Covers the structure, nomenclature, reactions and synthesis of organic compounds, plus the theory and mechanism of organic reactions. Lecture, 4 hours/week.

#### **CHEM 332. Organic Chemistry II. (4).**

Covers the structure, nomenclature, reactions and synthesis of organic compounds, plus the theory and mechanism of organic reactions. Lecture, 4 hours/week. Prerequisite CHEM 331.

#### **CHEM 341. Organic Chemistry Lab. (1).**

Laboratory work in isolation, characterization and synthesis of organic compounds. Laboratory, 3 hours/week. Corequisite: CHEM 331.

#### **CHEM 342. Organic Chemistry II Lab. (1).**

Laboratory work in isolation, characterization and synthesis of organic compounds. Laboratory, 3 hours/week. Corequisite: CHEM 332.

**CHEM 405. Physical Chemistry. (4).**

The study of kinetic theory, structure of condensed phases, thermodynamics, equilibria, electrochemistry, quantum chemistry and chemical kinetics. Lecture, 3 hours/week; Laboratory, 3 hours/week. Prerequisites: one year each of calculus and physics or consent of instructor.

**CHEM 405L. Physical Chemistry Lab. (0).****CHEM 406. Physical Chemistry. (4).**

The study of kinetic theory, structure of condensed phases, thermodynamics, equilibria, electrochemistry, quantum chemistry and chemical kinetics. Lecture, 3 hours/week; Laboratory, 3 hours/week. Prerequisites: one year each of calculus and physics or consent of instructor.

**CHEM 406L. Physical Chemistry Lab. (0).****CHEM 411. Advanced Inorganic Chemistry. (3).**

The advanced treatment of special topics in inorganic chemistry, including atomic structure, classification of elements and inorganic reactions in aqueous and non-aqueous solutions. Lecture, 3 hours/week. Prerequisite: consent of instructor. (on demand).

**CHEM 412. Advanced Organic Chemistry. (3).**

Further study in organic chemistry, emphasizing synthesis, reaction mechanisms and stereoisomerism. Lecture, 3 hours/week. Prerequisite: CHEM 332 or consent of instructor. (on demand).

**CHEM 421. Qualitative Organic Analysis. (3).**

The classification, reactions, derivatives and identification of organic compounds. Lecture, 1 hour/week; Laboratory, 6 hours/week. Prerequisite: CHEM 332 and CHEM 342 or consent of instructor. (on demand).

**CHEM 421L. Qualitative Organic Analysis Lab. (0).****CHEM 425. Biochemistry. (4).**

The structure and function of proteins is covered, along with the structure, function, and metabolism of carbohydrates, lipids, and amino acids. Regulation of proteins and metabolism is emphasized. Lecture, 3 hours; Laboratory, 3 hours/week. Prerequisites: CHEM 331 and CHEM 332. Recommended: BIOL 122 and BIOL 124L. (cross-listed with BIOL 425).

**CHEM 425L. Biochemistry Lab. (0).**

Prerequisite: Concurrent enrollment in BIOL 425 / CHEM 425. (cross-listed with BIOL 425L).

**CHEM 461. Chemical Preparations. (2).**

The preparation and purification of selected inorganic or organic compounds; introduces the student to chemical literature and laboratory research methods. Prerequisite: consent of instructor.

**CHEM 482. Selected Topics. (1-4).****CHEM 482C. ST: Select Topic (CORE). (1-4).**

Select Topic approved for core.

**CHEM 482L. Selected Topics Lab. (1-4).****CHEM 485. Capstone Seminar. (2).**

Introduces students to the skills and practices required of professional scientists. Students will gain experience with conducting literature searches, conducting and presenting scientific work, reviewing the work of others and writing research proposals. Prerequisite: senior standing.

**CHEM 490. Independent Study. (1-4).****CHEM 492. Internship. (1-4).****CHEM 496. Directed Research. (1-3).**