

# CHEMISTRY

## Faculty

Elizabeth J.O. Atkinson, Ph.D. (Chair)  
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## Laboratory Coordinator

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The rise of modern science is coupled with the development of chemistry. Chemistry is the study of matter and its interactions, and its development provides one of the most exciting chapters in the history of the human intellect. An inherent beauty exists in the theoretical structure of matter which is sufficient in itself as an area of study. But the opportunities for application of the principles of chemistry are limitless. The chemist is called upon with growing frequency to provide solutions to the difficult problems created by increasing environmental pressures and increasing demands for food and resources.

The Department of Chemistry offers a sequence of courses to provide a solid background for employment as a professional chemist or for graduate training in the various branches of chemistry. Courses are organized so that certain parts of the sequence can provide a foundation of chemical knowledge for pre-professional students or for majors in departments requiring chemistry.

## Student Recognition

Each year in May, the Chemistry Department grants to appropriate students majoring in chemistry or biochemistry and molecular biology the following awards and scholarships:

- The Albert Stout Award; to an outstanding current junior
- The Lois Gunning Fry Award; to a current sophomore or junior who has done outstanding research and shows promise of a successful professional career in chemistry or biochemistry
- The D.S. and E.Z. Taylor Scholarship; to current sophomores or juniors who need financial assistance and possess qualities desired by the department in its students
- The Erickson-Cole Endowed Scholarship; a merit award to a student interested in chemistry or biochemistry showing great promise in the sciences
- The Baguley Summer Research Internship created in honor of Dr. Brittany Hartzel-Baguley (2000); to support student summer research with Linfield chemistry faculty
- The American Chemical Society Undergraduate Awards in Analytical, Physical or Organic Chemistry; to outstanding students for their performance in courses and research
- The General Chemistry Achievement Award; to the top first-year students in general chemistry
- The Outstanding Senior in Chemistry and the Outstanding Senior in Biochemistry & Molecular Biology

## Programs

- Chemistry Major (<https://catalog.linfield.edu/programs-az/arts-sciences/chemistry/chemistry-major/>)

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

The chemistry department's curriculum is approved by the American Chemical Society (ACS).

Students may select an **ACS-certified chemistry major** by taking the specific set of courses indicated in the Chemistry Major, and participate in a minimum of 400 laboratory hours.

- Students seeking the **ACS Materials Track** should take INORGANIC CHEMISTRY I (CHEM 350), INORGANIC CHEMISTRY II (CHEM 351), and BIOCHEMISTRY (CHEM 440) in addition to the standard chemistry major; as well as participate in a minimum of 400 laboratory hours.
- Students seeking the **ACS Biochemistry Track** should take INORGANIC CHEMISTRY I (CHEM 350), BIOCHEMISTRY (CHEM 440), and BIOCHEMISTRY AND MOLECULAR BIOLOGY (BIOL 441) in addition to the standard chemistry major; as well as participate in a minimum of 400 laboratory hours.

The chemistry department also contributes to the Biochemistry and Molecular Biology (<https://catalog.linfield.edu/programs-az/arts-sciences/biochemistry-molecular-biology/>) major.

## Courses

### Paracurricular Courses

#### CHEM 050 RESEARCH METHODS IN CHEMISTRY (1 credit)

Introduction to scientific research methods in chemistry. Use of spreadsheets, symbolic mathematics, and techniques for searching chemistry databases. May be repeated once. Graded Satisfactory/Unsatisfactory only.

*Prerequisites:* Consent of instructor.  
*(EXPERIENTIAL LEARNING)*

### Chemistry Courses

*A list of the department's infrequently taught courses can be found on the Registrar's webpages.*

#### CHEM 198 SPECIAL TOPICS: JAN TERM TRAVEL (4 credits)

Topics vary according to faculty availability and interest. May be repeated for credit with different topics.

*Prerequisites:* IDST 098 previous fall.  
*Typically offered:* January Term

#### CHEM 200 INTRODUCTION TO THE CHEMISTRY OF FOOD AND BEVERAGES (4 credits)

An introduction to the basic chemistry of foods and beverages. Chemicals and chemical reactions involved in cooking, baking, fermentation, and desserts. Laboratory measurement of chemistry related to foods and beverages.

*Corequisites:* CHEM 200L required co-requisite.  
*Typically offered:* Fall Semester, Annually  
*(NATURAL WORLD)*

**CHEM 201 GENERAL, ORGANIC, AND BIOLOGICAL CHEMISTRY (I) (4 credits)**

Basic principles of general, organic, and biological chemistry: atomic structure, mole concept, chemical reactions, stoichiometry, gases/gas laws, oxidation-reduction, acid-base chemistry, equilibrium, solutions, and nuclear chemistry. Content is presented through the application of chemistry in health sciences, comparable to courses described as chemistry for allied health at other institutions. Designed for students requiring a broad introduction to chemical principles such as nursing, emergency medical technician (EMT), health education, and similar; not for chemistry, biology or biochemistry majors. Lecture, Lab.

*Total Course fees:* \$60.00

*Prerequisites:* MATH 150 recommended.

*Corequisites:* CHEM 201L required co-requisite.

*Typically offered:* Fall Semester

(NATURAL WORLD)

**CHEM 202 GENERAL, ORGANIC, AND BIOLOGICAL CHEMISTRY (II) (4 credits)**

Basic principles of general, organic, and biological chemistry: organic hydrocarbons, organic functional groups, and nomenclature; biological macromolecules (proteins, lipids, carbohydrates, and nucleic acids), membrane transport, and metabolic reactions. Content is presented through the application of chemistry in health sciences, comparable to courses described as chemistry for allied health at other institutions. Designed for students requiring a broad introduction to chemical principles such as nursing, emergency medical technician (EMT), health education, and similar; not for chemistry, biology or biochemistry majors. Lecture, lab.

*Total Course fees:* \$60.00

*Prerequisites:* CHEM 201 or equivalent with grade of C- or better.

*Corequisites:* CHEM 202L required co-requisite.

*Typically offered:* Spring Semester

(NATURAL WORLD)

**CHEM 210 GENERAL CHEMISTRY (4 credits)**

Principles of chemistry, including stoichiometry; gases, liquids, and solids; atomic and molecular structures; solutions; properties of selected elements, including introduction to transition metals. Quantitative and inorganic qualitative analysis in the lab. Lecture, lab.

*Total Course fees:* \$60.00

*Prerequisites:* High school algebra I and II, or equivalent; or MATH 150 completed or concurrent.

*Corequisites:* CHEM 210L required co-requisite.

*Typically offered:* Fall Semester

(NATURAL WORLD)

**CHEM 211 GENERAL CHEMISTRY (4 credits)**

Principles of chemistry, including solutions; equilibrium; thermodynamics, reaction kinetics and electrochemistry. Quantitative and inorganic qualitative analysis in the lab. Lecture, lab.

*Total Course fees:* \$60.00

*Prerequisites:* CHEM 210 or equivalent with a grade of C- or better.

*Corequisites:* CHEM 211L required co-requisite.

*Typically offered:* Spring Semester

(NATURAL WORLD)

**CHEM 298 SPECIAL TOPICS: JAN TERM TRAVEL (4 credits)**

Topics vary according to faculty availability and interest. May be repeated for credit with different topics.

*Prerequisites:* IDST 098 previous fall.

*Typically offered:* January Term

**CHEM 300 THE ART AND SCIENCE OF BREWING (4 credits)**

Academic approach to the production and critique of brewed beverages. Malting, brewing, fermentation and bottling/kegging. Historical development of brewing science. Human health aspects related to brewing and the consumption of fermented beverages.

*Total Course fees:* \$60.00

*Prerequisites:* CHEM 200 or CHEM 210 or BIOL 210 or consent of instructor

*Typically offered:* Spring Semester, Annually

(NATURAL WORLD)

**CHEM 301 FOOD SCIENCE (4 credits)**

Overview of the chemical and physical properties of food and beverage; quality and safety; preservation, fermentation and cooking methods; objective and subjective food evaluation, recipe modification. (Listed as CHEM 301 and HHPA 301)

*Total Course fees:* \$35.00

*Prerequisites:* Nutrition, Chemistry, and/or Biology Recommended.

*Typically offered:* January Term, Alternate Years

(NATURAL WORLD)

**CHEM 321 ORGANIC CHEMISTRY (4 credits)**

The chemistry of carbon, including preparation, properties, and reactions of alkanes, alkenes, alkyl halides and alcohols and their spectroscopic structure determination. Emphasis on reaction mechanisms, synthesis, and analysis. Lecture/discussion, lab.

*Total Course fees:* \$50.00

*Prerequisites:* CHEM 211 with a grade of C or better.

*Corequisites:* CHEM 321L and CHEM 321D required co-requisites

*Typically offered:* Fall Semester

**CHEM 322 ORGANIC CHEMISTRY (4 credits)**

The chemistry of carbon continued, including preparation, properties, and reactions of conjugated, aromatic and carbonyl compounds. Emphasis on reaction mechanisms, synthesis, and analysis. Lecture/discussion, lab.

*Total Course fees:* \$50.00

*Prerequisites:* CHEM 321 with a grade of C or better.

*Corequisites:* CHEM 322L and CHEM 322D required co-requisites.

*Typically offered:* Spring Semester

**CHEM 330 WRITING IN CHEMISTRY (4 credits)**

Introduction to the genres of scientific writing, emphasizing writing and library skills in scientific research. Completion of a collaborative research project prior to enrollment in CHEM 330 is encouraged.

*Prerequisites:* CHEM 322, INQS 125 or instructor consent.

*Typically offered:* Fall Semester

(MAJOR WRITING INTENSIVE)

**CHEM 335 QUANTITATIVE ANALYSIS (4 credits)**

Principles of analytical chemistry, emphasizing applications of equilibrium. Lecture, lab, discussion.

*Total Course fees:* \$50.00

*Prerequisites:* CHEM 211 with a grade of C or better.

*Corequisites:* CHEM 335L required co-requisite.

*Typically offered:* January Term, Even Years

**CHEM 340 INSTRUMENTAL METHODS OF ANALYSIS (5 credits)**

Introduction to the theory and principles of instrumental methods of chemical analysis. Emphasis on spectrophotometry, electrochemistry, chromatography, electronics, and writing in the discipline. Experimental emphasis on medical, forensic, and industrial analysis. Lecture/lab.

*Total Course fees:* \$50.00

*Prerequisites:* CHEM 321 or CHEM 335 with a grade of C or better.

*Corequisites:* CHEM 340LAB required co-requisite.

*Typically offered:* Spring Semester, Even Years

*(MAJOR WRITING INTENSIVE)*

**CHEM 350 INORGANIC CHEMISTRY I (4 credits)**

Periodic properties of elements, including descriptive chemistry of the main group elements and coordination compounds of the transition metals. Emphasis on basic chemical bonding in molecules, an introduction to symmetry with term symbols, and acid/base reactions. Lecture/ discussion.

*Prerequisites:* CHEM 211 or equivalent.

*Typically offered:* Fall Semester, Even Years

**CHEM 351 INORGANIC CHEMISTRY II (4 credits)**

Presentation of theoretical and descriptive material on inorganic chemical compounds, synthetic and reaction strategies for important transformations including structures and bonding models, inorganic reaction mechanisms, transition metal chemistry, electron deficient compounds, organometallic compounds, and the main group elements. Laboratory experiments illustrate common synthetic and characterization processes for inorganic compounds. Lecture/discussion/lab.

*Prerequisites:* CHEM 350 or equivalent.

*Corequisites:* CHEM 351LAB required co-requisite.

*Typically offered:* Spring Semester, Odd Years

**CHEM 361 PHYSICAL CHEMISTRY I (4 credits)**

Chemical thermodynamics, kinetics and molecular spectroscopy. Applications including thermochemistry and calorimetry; bulk properties of pure substances; methods of describing the properties of solutions; reaction rates; mechanisms of chemical reactions; transition state theory; spectroscopic determination of molecular structure. Lecture/lab.

*Prerequisites:* CHEM 211 or equivalent, MATH 175, or consent of instructor. Recommended: MATH 200.

*Corequisites:* CHEM 361L required co-requisite.

*Concurrent Or Previous Courses:* PHYS 211 (may be taken concurrently).

*Typically offered:* Fall Semester

**CHEM 362 PHYSICAL CHEMISTRY II (4 credits)**

The quantum mechanical description of matter with emphasis on atomic structure and chemical bonding. Introduction to statistical mechanics. Four hours of lecture.

*Prerequisites:* CHEM 361 or equivalent; MATH 175; PHYS 211; or consent of instructor. Recommended: MATH 200, MATH 210.

*Typically offered:* Spring Semester

**CHEM 370 ADVANCED TOPICS IN CHEMISTRY (4 credits)**

Selected advanced chemistry topics not regularly offered at Linfield.

*Prerequisites:* CHEM 321 or consent of instructor.

**CHEM 381 RESEARCH IN MOLECULAR AND ADVANCED MATERIALS (1-3 credits)**

Collaborative research experience in molecular and advanced materials. Discussion of current readings, experience with research methodology, experimental design, data collection and analysis. May be repeated twice.

*Prerequisites:* CHEM 210 or consent of instructor.

*Typically offered:* Spring Semester

**CHEM 382 RESEARCH IN BASIC AND APPLIED NANOTECHNOLOGY (1-3 credits)**

Introduction to basic and applied research in nanotechnology. Weekly meetings include seminars, discussions of research methods, review of current scientific research, experimental design, and ethical issues in chemistry. Each student prepares an independent research proposal and an oral presentation, and carries out research. May be repeated twice.

*Prerequisites:* CHEM 210 or consent of instructor.

*Typically offered:* Spring Semester

**CHEM 384 RESEARCH: BIOCHEMISTRY OF MITOCHONDRIA (1-3 credits)**

Collaborative research experience in biochemistry focusing on biochemical processes within the mitochondria using in vitro biochemical/molecular biology techniques, and/or yeast as a model organism. Research methods, review of current scientific research, experimental design, and ethical issues in chemistry. Preparation of independent research proposal and oral presentation; implementation of research. May be repeated twice.

*Prerequisites:* CHEM 210, or consent of instructor.

*Typically offered:* Spring Semester

**CHEM 385 RESEARCH IN SMALL MOLECULE SYNTHESIS (1-3 credits)**

Introduction to small molecule synthesis and organic method development, projects carried out individually or in small groups. Projects feature organic reactions, purifications, analysis, and biochemical protein-based assays. Weekly meetings feature discussion of results and literature. Each student prepares independent research proposal and oral presentation, and carries out research. May be repeated twice.

*Prerequisites:* CHEM 211 or consent of instructor.

*Typically offered:* Spring Semester

**CHEM 398 SPECIAL TOPICS: JAN TERM TRAVEL (4 credits)**

Topics vary according to faculty availability and interest. May be repeated for credit with different topics.

*Prerequisites:* IDST 098 previous fall.

*Typically offered:* January Term

**CHEM 439 PEER INSTRUCTION (1-5 credits)**

Advanced study opportunity for outstanding students to assist faculty members in the classroom or studio. Focus on course content and pedagogy. Repeatable for credit. Graded Satisfactory/Unsatisfactory only.

*Typically offered:* January Term, As Needed

*(EXPERIENTIAL LEARNING)*

**CHEM 440 BIOCHEMISTRY (4 credits)**

Chemical and physical properties of substances of biological origin and their interactions in living systems. Relationships among various metabolic pathways and how molecular traffic along these pathways is regulated. Recommended for pre-professional students. Lecture/ discussion, lab.

*Total Course fees:* \$60.00

*Prerequisites:* CHEM 322 or equivalent.

*Corequisites:* CHEM \*440L required co-requisite.

*Typically offered:* Fall Semester

**CHEM 480 INDEPENDENT STUDY (1-5 credits)**

Supplemental work for students with advanced standing in chemistry.

*Prerequisites:* Consent of instructor.

**CHEM 486 SENIOR CAPSTONE (1 credit)**

Senior capstone course emphasizing knowledge in foundational chemistry and depth of knowledge in advanced chemistry topics and research. Coursework includes discussions of primary literature, oral presentations, and written assignments.

*Prerequisites:* Senior standing.

*Typically offered:* Spring Semester

**CHEM 490 RESEARCH OR THESIS (1-4 credits)**

Individual investigative project culminating in a comprehensive written report or a baccalaureate thesis.

*Prerequisites:* Advanced standing in chemistry.

**CHEM 498 SPECIAL TOPICS: JAN TERM TRAVEL (4 credits)**

Topics vary according to faculty availability and interest. May be repeated for credit with different topics.

*Prerequisites:* IDST 098 previous fall.

*Typically offered:* January Term