CHEMISTRY (CHEM)

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As the science of matter and its transformations, chemistry is the foundation of many interdisciplinary subjects such as nanotechnology, pharmacology, materials science, molecular biology, biochemistry, and environmental science. The Guilford chemistry major explores the fundamental principles of chemistry and examines how those principles are applied to the observable world. Chemistry majors develop chemical reasoning and experimental skills, as well as an understanding of chemistry's interdisciplinary nature.

Students with a major in chemistry are prepared to work in the chemical industry; pursue graduate research in chemistry (or a related field); or attend medical, dental or pharmacy school. A chemistry major can lead to many careers outside of chemical or biochemical research, include teaching, medicine and other health professions, patent law, or business.

Key features of the Guilford chemistry program are an emphasis on research and direct student access to instrumentation. Students in chemistry at all levels are encouraged to participate in research, whether integrated into courses, through collaboration with faculty during the semester, or through summer research experiences at Guilford or other institutions. In addition, students are encouraged to pursue the practical applications of chemistry through internships. State-of-the-art facilities are available in the Frank Family Science Center for student/faculty research.

Degrees Offered

The Bachelor of Arts and Bachelor of Science degrees are offered in chemistry.

- Chemistry Major (https://catalog.guilford.edu/catalog/academic-departments-majors/chemistry/chemistry/)
- Chemistry (https://catalog.guilford.edu/catalog/academic-departments-majors/chemistry/chemistry-minor/)

CHEM 105. Chemistry of Recycling. 4.
This course uses basic chemistry to explore the science behind recycling, as well as the context for recycling and the political and economic realities of treating and using recycled materials. Laboratory component includes investigation of properties of metals, glass and plastics, molecular modeling, and papermaking and recycling. Does not count towards the chemistry major or minor. Prerequisite: Mathematics background at the level of college algebra. Fulfills natural science/mathematics and social justice/environmental responsibility requirements (1998). Fulfills natural science/mathematics and evaluating systems and environments requirements (2019).

CHEM 110. Real World Chemistry. 4.
Chemistry is connected to everything in our lives: from food to fuel, natural to artificial, medicine to the environment, consumer products to toxic waste. This course is designed to educate students about chemistry and its effects on our world using illustrations from our common experience. Laboratory component includes stoichiometry, chemical synthesis and analysis, molecular modeling, and interaction of light with matter. Does not count towards the chemistry major or minor. Prerequisite: Mathematics background at the level of college algebra. Fulfills natural science/mathematics and social justice/environmental responsibility requirements (1998). Fulfills natural science/mathematics and evaluating systems and environments requirements (2019).

CHEM 111. Chemical Principles I. 4.
Basic principles of chemistry, periodicity, bonding, and atomic and molecular structure. Laboratory components include classification of chemical reactions, stoichiometry, molecular modeling, interaction of light with matter, and introduction to organic synthesis. Prerequisite: Mathematics background at the level of college algebra. Fulfills natural science/mathematic requirement (1998 & 2019). Embodied and creative engagement requirement (2019). Fall 12-week

CHEM 112. Chemical Principles II. 4.
Molecular and ionic equilibria, chemical kinetics and reaction mechanisms, intermolecular interactions, electrochemistry, and thermodynamics. Laboratory component includes chemical reaction energetics and kinetics, oxidation- reduction and electrolysis, and equilibrium and acid-base properties. Prerequisite: CHEM 111 with a grade of C- or better. Fulfills natural science/mathematic requirement (1998 & 2019). Spring 12-week

CHEM 115. Chemistry of Food and Cooking. 4.
This course surveys food's chemical constituents in proteins, carbohydrates, vitamins, minerals, preservatives and flavoring, as well as cooking processes with respect to chemistry. Students will gain a better understanding of the food we eat and how to prepare it safely, nutritionally and tastefully. Laboratory component includes analysis of fats, chemical synthesis, acid-base reactions and food preparation as related to chemical transformation. Does not count towards the chemistry major or minor. Prerequisite: Mathematics background at the level of college algebra. Fulfills natural science/mathematic requirement (1998 & 2019).

CHEM 150. Special Topics. 1-8.
May also be offered at 250, 350 and 450 levels.

CHEM 151. HP:History of Science. 4.
A historical perspective on the rise of science over the past centuries. The course examines the development of the scientific method and traces the people, institutions, movements and false starts that led to modern science. Does not count towards the chemistry major. Prerequisite: ENGL 102. Fulfills historical perspectives requirement (1998 and 2019).

CHEM 231. Organic Chemistry I. 4.
An introduction to the structure and reactivity of organic molecules. Topics covered include chemical nomenclature, bonding and structure of carbon compounds, acid-base relationships, mechanisms of reactions and structure determination. Laboratory component includes techniques for the synthesis and characterization of organic compounds and determination of reaction mechanisms including experimental, chromatographic and spectroscopic methods commonly employed in modern organic chemistry. Prerequisite: CHEM 112 with grade of C- or better. Fall 3-week, Spring 12-week

CHEM 232. Organic Chemistry II. 4.
Topics covered include mechanisms of more complex reactions, multi-step organic synthesis, applications of molecular orbital theory to reactions and the chemistry of biologically important molecules such as sugars and peptides. Laboratory component focuses on multistep synthesis of organic compounds using a variety of reactions, employing chromatographic and spectroscopic techniques in the purification and analysis of reaction products. Prerequisite: CHEM 231 with grade of C- or better. Fall 12-week

CHEM 239. Integrated Research Lab I. 1.
Multidisciplinary chemistry laboratory course to explore an original research project in a team- based environment. Development of experimental techniques and research, presentation, and teamwork skills are emphasized. Prerequisite: CHEM 232. Spring 12-week

CHEM 241. Quantitative Analysis. 4.
Introduction to basic principles of quantitative analysis, including the components of an analysis, statistical tools to characterize the acceptability of an analysis, and topics in chemical equilibrium and electrochemistry that are applicable to chemical analysis. Prerequisite: CHEM 112 and MATH 220. Fall 12-week

CHEM 242. Introduction to Inorganic Chemistry. 4.
Study of the periodic table, including atomic structure, nature of chemical bonding and periodic trends. Chemistry of main group elements. Chemistry of transition metals with emphasis on d-shell chemistry and metal complexes. Thermodynamics of inorganic compounds. Solubility, acid-base concepts, and oxidation- reduction. Introduction to crystal structure and symmetry. The laboratory centers on synthesis, structure, properties and analysis of metal complexes and other interesting inorganic materials. Prerequisite: CHEM 231. Alternate years. Spring 12-week

CHEM 250. Special Topics. 8.

CHEM 260. Independent Study. 1-8.
Topics may include photoredox chemistry, organometallic synthesis, experimental design, chemical education, ionic liquids, computational chemistry, and advanced organic synthesis. May also be offered at 360 and 460 levels.

CHEM 290. Internship. 1-8.
May also be offered at the 390 level.

CHEM 337. Elements of Physical Chemistry. 4.
Fundamental concepts of physical chemistry including macroscopic and atomic and molecular level systems. Exploration of key ideas in thermodynamics, chemical kinetics, quantum chemistry, spectroscopy, and statistical mechanics. Laboratory work supports development of these concepts with a focus on experimental inquiry, design, and modelling in physical chemistry and computational chemistry. Prerequisites: PHYS 122 or PHYS 211, MATH 222, and CHEM 232 with a grade of C- or better, or instructor permission. Fall 12-week

CHEM 338. Applications of Physical Chemistry. 4.
Understanding of complex chemical phenomena using the tools of thermodynamics and quantum mechanics developed in CHEM 337. Topics include multicomponent systems, electrochemistry, molecular quantum mechanics and spectroscopy, and statistical mechanics as the connection between particle level and macroscopic behavior. Laboratory work continues work on experimental inquiry, design, and modelling in physical chemistry with a focus on new experimental and computational techniques. Prerequisite: CHEM 337 and MATH 222, or instructor permission. Alternate years. Spring 12-week

CHEM 339. Integrated Research Lab II. 1.
Multidisciplinary chemistry laboratory course to explore an original research project in a team-based environment. Leadership skills as well as development of experimental techniques and research, presentation, and teamwork skills are emphasized. Prerequisite: CHEM 239. Spring 12-week

CHEM 341. Instrumental Analysis. 4.
A systematic study of the modern instrumental methods of chemical analysis with emphasis on the theory behind the use of instruments, principles of operation of analytical instruments and their use for the analysis of real samples. Prerequisites: CHEM 112 and MATH 220. Spring 12-week

CHEM 350. Special Topics. 1-8.

CHEM 360. Independent Study. 1-8.

CHEM 390. Internship. 1-8.

CHEM 400. Chemistry Seminar. 2.
Focuses on the transition from college to graduate school, careers in the chemical industry or careers in other fields. The development of presentation skills and critical analysis of the chemical literature is stressed. Required of all chemistry majors and minors. Prerequisites: historical perspectives and any three chemistry courses that count for the chemistry major or minor. Spring 12-week

CHEM 425. Advanced Topics in Chemistry. 4.
Rotating titles and repeatable. Focus on a more specialized chemical discipline and its relations to foundational chemistry study. Topics may include medicinal chemistry, computational chemistry, polymer chemistry, geochemistry, pedagogical methods in chemistry, environmental chemistry. Prerequisite: CHEM 232 and other courses depending on topic.

CHEM 434. Biochemistry (BIOL 434). 4.
A study of the chemical structure and physiological function of the biochemical building blocks of living organisms including proteins, carbohydrates, lipid metabolism and nucleic acid synthesis. The laboratory experience includes techniques used in the isolation and identification of proteins, lipids and nucleic acids. Prerequisites: BIOL 203 and CHEM 232. Spring.

CHEM 439. Integrated Research Lab III. 1.
Multidisciplinary chemistry laboratory course to explore an original research project in a team-based environment. Research topic development and facilitation of team collaboration as well as leadership skills and development of experimental techniques and research, presentation, and teamwork skills are emphasized. Prerequisite: CHEM 339. Spring 12-week

CHEM 450. Special Topics. 8.

CHEM 460. Advanced Independent Study. 1-8.

CHEM 470. Senior Thesis. 1-8.
Original research on a specific topic in chemistry or chemistry-related field. Students are expected to begin work on their topics before they register.

CHEM 475. Research Seminar (BIOL 475). 2.
This course introduces the principles and concepts of presenting scientific research. Emphasis is placed on the preparation of oral and poster presentations and the implementation of proper etiquette for undergraduate symposia. This course also covers the preparation of funding proposals, curriculum vitae, Statements of Intent, and the interview process for post-undergraduate programs. Students are required to present their research at two undergraduate meetings including the Guilford Undergraduate Symposium.

CHEM 490. Departmental Honors. 1-8.