

Biochemistry

Bachelor of Science

www.uis.edu/biochemistry/

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Office Location: HSB 314

The Biochemistry curriculum is designed to prepare students for the biomedical sciences and/or health professions through a strong background in chemistry and its application to biological systems. The degree, hosted by the Chemistry Department, meets or exceeds the requirements for those students pursuing a professional degree, e.g. medicine, dentistry, and pharmacy, as well as those interested in graduate work in associated sciences, e.g. biochemistry, pharmacology, and molecular biology. The department is accredited by the America Chemical Society's Committee on Professional Training and the curriculum meets the recommendations of the American Society for Biochemistry and Molecular Biology.

Undergraduate Research

One of the advantages of earning a Biochemistry degree from UIS is involvement in hands-on original lab research. The requirement is fulfilled by earning three credits of CHE 302 or **CHE 400 ECCE**: Undergraduate Research. These credits can be earned on campus in a project with one of the Chemistry Department faculty, another faculty member in the Natural Science Division, or in an off-campus research internship. The three credits of CHE 302 or **CHE 400** meet the University requirements for three credits of ECCE Engaged Citizenship. The course includes a final written report of the research results and a professional presentation. Contact a Chemistry faculty member to discuss possible projects or to get approval of a research opportunity outside the department.

Additional Engaged Citizenship credits can be earned in an internship. There are local paid internships in the sciences. Contact the Internships and Prior Learning office for the current list of available internships at (217) 206-6640 (<http://www.uis.edu/ipl/>).

Honors in Biochemistry

Biochemistry majors may elect to participate in the honors program in Biochemistry. To graduate with honors in Biochemistry, a student must:

1. complete all degree requirements,
2. earn a minimum cumulative GPA of 3.0 for all UIS Chemistry courses and 3.50 for UIS courses overall, and
3. make a public presentation of the results of undergraduate research (CHE 302 or CHE 400 or similar experiential learning project). Students must apply for honors designation to the chair of the Chemistry Department prior to their final semester at UIS.

The Bachelor's Degree

Advising

Students wishing to major in Biochemistry should consult with an academic advisor upon admission to the University to make sure they are taking their required courses in the proper sequence. In order to declare a Biochemistry major, students need to complete a Change of

Curriculum form on the Records and Registration website. There is no separate admission to the major.

First-year students should contact the science advisor in the Undergraduate Academic Advising Center. Students with more than 30 hours (transfer students and sophomores) should contact the College of Liberal Arts and Sciences.

It is imperative that students beyond their first year regularly consult with a faculty member in the Chemistry department regarding their major. All students are assigned a faculty member as their primary advisor upon declaring their major in Biochemistry. We suggest that you meet with your faculty advisor at least one time each semester to discuss courses, careers, and research opportunities. To set an appointment, contact the office manager at (217) 206-6589.

Refer to the Chemistry website at www.uis.edu/chemistry/ to view the department's *Sample Curriculum/ Program Guide*.

Assessment of Learning within the Discipline

A biochemist graduating from UIS will be characterized as being able to:

- Integrate chemical knowledge
- Perform appropriate laboratory skills
- Communicate scientific information
- Apply the scientific process(es)
- Participate in the biochemistry profession

Students majoring in biochemistry may be asked to participate in surveys of focus groups in order to assist the department in assessing the learning outcomes of the program. Other evidences of student learning (exam scores, research papers) will be used in an anonymous and confidential manner for Chemistry department curriculum review and planning.

Grading Policy

Chemistry courses for which the student has attained a grade of C- or better will be applied toward their B.S. degree in biochemistry (grades of D+ or lower will not be accepted). Biochemistry majors may repeat program courses for grade improvement only once.

General Education

All biochemistry majors must fulfill the undergraduate general education requirements as described at the beginning of this catalog. Certain courses required for the UIS Biochemistry Bachelor of Science degree also fulfill general education requirements (listed in the table below). Consult with your academic advisor before registering to ensure that you take the correct courses in the correct sequence.

Life Science

BIO 141	General Biology I	4
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Physical Science

CHE 141	General Chemistry I	4
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Mathematical Skills

MAT 115	Calculus I	4
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Applied Mathematics

MAT 121	Applied Statistics	3
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ECCE Engagement Experience

CHE 400	ECCE: Undergraduate Research	3
or CHE 302	ECCE: Undergraduate Research	

Degree Requirements

Introductory Courses

CHE 141	General Chemistry I	4
CHE 142	General Chemistry II	4
CHE 143	Recitation for General Chemistry I	0
CHE 144	Recitation for General Chemistry II	0
CHE 267	Organic Chemistry I	3
CHE 268	Organic Chemistry I Laboratory	1
CHE 269	Organic Chemistry II	3
CHE 271	Organic Chemistry II Lab	1

Calculus (one year):

MAT 115	Calculus I	8
& MAT 116	and Calculus II	

Physics (one year):

ASP 201	University Physics I	8
& ASP 202	and University Physics II	

Total Hours **32**

Transfer students with deficiencies in the introductory courses may enter the program conditionally but will be required to make up the deficiencies during their first year of study. This extra work may mean that some students will require more than four years to complete the B.S. degree. Transcripts submitted by transfer students must show that the following course requirement categories have been met:

- General Chemistry I and II
- Organic Chemistry with lab (one year)
- Calculus (one year)
- Introductory Biology with lab (one year)
- Physics, calculus based (one year)

Intermediate and Advanced Courses

CHE 301	General Seminar	3
or BIO 301	General Seminar	
CHE 321	Chemical Analysis	4
CHE 400	ECCE: Undergraduate Research	3
or CHE 302	ECCE: Undergraduate Research	
CHE 401	Physical Chemistry I - Thermodynamics	3
CHE 418	Bioanalytical Chemistry	3
CHE 475	General Biochemistry	3
CHE 476	General Biochemistry Laboratory	2
CHE 485	Advanced Biochemistry	4

400-level Chemistry Electives **3**

Upper Division Biology Electives (choose from the list below): **6**

BIO 311	Cell Biology	
BIO 381	Genetics	
BIO 425	Medicinal Chemistry	
or CHE 425	Medicinal Chemistry	
BIO 432	Introduction to Neuroscience	
or CHE 432	Introduction to Neuroscience	

Total Hours **34**

Courses

CHE 101. Preparatory Chemistry. 3 Hours.

Course is designed to enhance problem solving skills and develop background for the general chemistry sequence. Course Information: Placement in MAT 094. This course fulfills a general education requirement at UIS in the area of Physical Science without a Lab.

CHE 103. Introduction to Nanotechnology. 3 Hours.

Nanotechnology is a rapidly growing force in world economics, driving the next Industrial Revolution. This course will examine what nanotechnology is through lecture and laboratory exercises. Additionally, societal and environmental implications of nanotechnology will be explored through readings and discussions. Course Information: This course cannot be counted toward any science major or minor. This course fulfills a general education requirement at UIS in the area of Physical Science without a Lab.

CHE 104. Introduction to Nanotechnology Lab. 1 Hour.

Nanotechnology is a rapidly growing force in world economics, driving the next Industrial Revolution. This course will examine what nanotechnology is through lecture and laboratory exercises. Additionally, societal and environmental implications of nanotechnology will be explored through readings and discussions. Course Information: This course cannot be counted toward any science major or minor. This optional lab to be taken with CHE 103. This course fulfills a general education requirement at UIS in the area of Physical Science with a Lab.

CHE 121. Materials of the Artist. 3 Hours.

Art from cave paintings to digital images has been closely intertwined with chemistry and technology. In this course we will investigate the properties and applications of materials used by artists (minerals, metals, dyes, pigments, paper, glass, ceramics, and polymers). Course Information: This course cannot be counted toward any science major or minor. The optional laboratory (CHE 122) provides hands-on experience with these materials. This course fulfills a general education requirement at UIS in the area of Physical Science without a Lab (IAI Code: P1 903).

CHE 122. Materials of the Artist-Lab. 1 Hour.

Art from cave paintings to digital images has been closely intertwined with chemistry and technology. In this course we will provide hands-on experience with the materials used by artists (minerals, metals, dyes, pigments, paper, glass, ceramics, and polymers). This optional laboratory to be taken with CHE 121. Course Information: This course cannot be counted toward any science major or minor. This course, with CHE 121, fulfills a general education requirement at UIS in the area of Physical Science with a Lab (IAI Code: P1 903L).

CHE 124. General Chemistry for the Health Professions. 4 Hours.

First semester of a chemistry sequence for health professions majors. Topics include unit analysis, properties of matter, reactions in solutions, basic stoichiometry, behavior of gases, nuclear chemistry, basic atomic structure and chemical bonding. Three hours of lab experience per week. Course Information: Excludes CHE, BIO, and MLS majors. Prerequisites: Placement in MAT 094 or higher. This course fulfills a general education requirement at UIS in the area of Physical Science with Lab.

CHE 131. Introduction to Forensic Science. 3 Hours.

Introduces the scientific basis of forensics investigations, using a case history/problem-solving approach. Discusses scientific procedures for evidence collection at crime scenes and the laboratory analysis of evidence. Topics include fingerprints, soil/imprints, toxicology, ballistics, arson/explosions, blood/body fluid analysis, DNA profiles, and PCR technology. Course Information: This course cannot be counted towards a CHE major or minor. Same as MLS 131. This course fulfills a general education requirement at UIS in the area of Physical Science without a Lab.

CHE 132. Introduction to Forensic Science Laboratory. 1 Hour.

This laboratory illustrates many of the basic scientific procedures and analyses used in forensic science laboratories. Exercises include fingerprinting, hair/fiber analysis, soil/glass analysis, PCR and DNA profiling, toxicology, blood spatter analysis, and field tests for blood, semen, and drugs. This optional laboratory to be taken with CHE 131. Course Information: Same as MLS 132 This course cannot be counted towards a CHE major or minor. This course, along with CHE 131, fulfills a general education requirement at UIS in the area of Physical Science with a Lab.

CHE 137. Chemistry Cooks. 3,4 Hours.

A laboratory course emphasizing the general principles and theories of chemistry including atomic structure and states of matter, bonding, stoichiometry, acid-base concepts, periodicity and solution chemistry. The chemical principles will be demonstrated with laboratory exercises that involve the use of materials and methods common to the ordinary kitchen. Course Information: This course cannot be counted toward any science major or minor. The course is intended for non-majors. This course fulfills a general education requirement at UIS in the area of Physical Science with a Lab (4 hours) or without a Lab (3 hours).

CHE 141. General Chemistry I. 4 Hours.

First semester of general chemistry for science students. Topics: properties of matter, stoichiometry, solutions chemistry, thermodynamics, gas laws, atomic structure, molecular geometry and chemical bonding. Course Information: Three hours-lab per week. Prerequisites: High school chemistry, placement in MAT 094. Co-requisite: CHE 143. This course fulfills a general education requirement at UIS in the area of Physical Science with Lab (IAI Code: P1 902L).

CHE 142. General Chemistry II. 4 Hours.

The second semester of general chemistry for science students. Topics include solid structures, solution properties, kinetics, entropy, nuclear chemistry, electrochemistry and equilibria (acid-base and solubility). Course Information: Three hours of lab weekly. Co-requisite: Enrollment in CHE 144. Prerequisites: CHE 141 or equivalent. This course fulfills a general education requirement at UIS in the area of Physical Science with a Lab.

CHE 143. Recitation for General Chemistry I. 0 Hours.

Designed for practice in problem solving in General Chemistry. Course Information: Co-requisite: CHE 141. This course fulfills a general education requirement at UIS in the area of Physical Science with Lab.

CHE 144. Recitation for General Chemistry II. 0 Hours.

Designed for practice in problem solving in General Chemistry II. Course Information: Co-requisites: CHE 142. This course fulfills a general education requirement at UIS in the area of Physical Science with Lab.

CHE 151. Survey of Organic and Biochemistry. 4 Hours.

This course will give students an overview of the principles of organic chemistry and biochemistry. It will focus on their application to the health sciences and is designed for students in nursing and applied health sciences. Course Information: Three hours of lab per week. Prerequisites: CHE 141, or equivalent.

CHE 199. Tutorial in Chemistry. 2-4 Hours.

Students interested in a tutorial must secure the consent of the faculty member concerned before registration and submit any required documentation to him or her. Course Information: May be repeated to a maximum of 12 credit hours.

CHE 267. Organic Chemistry I. 3 Hours.

First semester of university-level organic chemistry. Study of organic structure, reactions and mechanisms. Includes relationship of structure to function. Course Information: Prerequisite: CHE 141 and CHE 142 or equivalent.

CHE 268. Organic Chemistry I Laboratory. 1 Hour.

Laboratory course cultivating techniques for separation, purification, and identification of organic compounds. Includes an introduction to spectroscopy and application of techniques to illustrative organic preparations. Course Information: Prerequisite: CHE 267, or equivalent, or concurrent enrollment.

CHE 269. Organic Chemistry II. 3 Hours.

Second-semester of university level-organic chemistry that builds on a basic knowledge of organic structure, reactions, and mechanisms. Focus on organic synthesis and reaction mechanisms. Includes an introduction to bio-molecules. Course Information: Prerequisite: CHE 267 and CHE 268, or equivalent.

CHE 271. Organic Chemistry II Lab. 1 Hour.

Second-semester course in organic chemistry laboratory. Continues to expose students to new laboratory techniques and integrates spectroscopy with synthesis. Course Information: Prerequisite: CHE 267 and CHE 268 or equivalent.

CHE 301. General Seminar. 3 Hours.

Development of writing skills and discussion of professional ethics. Mastery of library skills and ability to organize material demonstrated by production of a paper on a scientific topic of interest and a seminar based on that paper. Course Information: Same as BIO 301. Prerequisite: ENG 101 and 102 or equivalents. COM 112 recommended. For the sophomore or junior year. Restricted to Chemistry and Biology majors.

CHE 302. ECCE: Undergraduate Research. 3 Hours.

Design and conduct an original research project integrating knowledge introduced in the lower-division chemistry core. Students will also receive instruction on a variety of topics important to the conduct of scientific research and their continued professional development. At the conclusion students produce individual scientific reports and make a professional group presentation. Course information: Prerequisites: CHE/BIO 301 and instructor approval. This course fulfills an Engaged Citizenship Common Experience requirement at UIS in the area of Engagement Experience.

CHE 321. Chemical Analysis. 4 Hours.

Introduction to acquisition and analysis of chemical data, statistical analysis, and method evaluation. Discussion of equilibrium, acid-base chemistry, electrochemistry and optical spectroscopy. Three hours of lab per week. Course Information: Prerequisites: CHE 141 and CHE 142 or equivalent.

CHE 322. Laboratory Techniques. 1 Hour.

Introduction to basic laboratory techniques and procedures necessary for competent performance. Topics will include laboratory safety, volumetric and gravimetric measurements, titrations, critical evaluation of data, laboratory mathematics, preparing solutions and dilutions, and basic spectrophotometric measurements. Course Information: Prerequisite: CHE 141 and CHE 142 or equivalent.

CHE 361. Global Greening for a Sustainable Future. 3 Hours.

An integrated approach to environmental issues that explore the contribution and roles of the physical sciences to achieve sustainability as the ultimate goal with a global perspective. Issues include population growth, energy and alternative fuels, and green chemistry.

CHE 362. Science and World Religions. 3 Hours.

This interdisciplinary course explores the relationship among science and the five major world religions: Hinduism, Judaism, Christianity, Buddhism, and Islam. Topics include the creation/evolution controversy, the existence of soul, and the possibility of miracles.

CHE 363. Energy and the Environment. 3 Hours.

This course will critically explore the scientific, economic, political, and ethical relationships between energy and the environment. Students will be asked to examine their own values and propose how they will use/conservate energy in the present and in the future.

CHE 375. General Biochemistry. 3 Hours.

This is an introductory one semester course in biochemistry that provides a foundation for health science by investigation of the simple molecular components of the cell to the complex dynamics of metabolism and information transfer. Course Information: Prerequisite: CHE 267.

CHE 399. Tutorial. 1-12 Hours.

Independent studies are meant to serve as a mini project to help prepare students for CHE 400, Undergraduate Research. It is intended to supplement, not supplant, regular course offerings. Students interested in an independent study must secure the consent of a faculty advisor prior to registration and submit any required documentation to the advisor. Course Information: May be repeated to a maximum of 12 hours.

CHE 400. ECCE: Undergraduate Research. 1-6 Hours.

Investigation of a specific problem of interest to the student. Directed and reviewed by a faculty member. At the conclusion of the project, the student will write a scientific report and make a professional presentation evaluated by the faculty. Course Information: May be repeated with approval. This course fulfills an Engaged Citizenship Common Experience requirement at UIS in the area of Engagement Experience.

CHE 401. Physical Chemistry I - Thermodynamics. 3 Hours.

Development of principles of classical thermodynamics; equations of state; first, second, and third laws and their applications. Course Information: Prerequisite: MAT 115 and MAT 116, ASP 201 and passing grade or concurrent enrollment in ASP 202, CHE 269, and CHE 271, or equivalent.

CHE 402. Physical Chemistry II. 3 Hours.

Examination of thermodynamic considerations that control the position of chemical equilibrium and kinetic factors that govern reaction rates. Discussion of current theories of chemical bonding in ionic and covalent compounds. Emphasis on correlation of experimental data and prediction of structures of chemical compounds. The laboratory portion includes calorimetry, fluorescence spectroscopy, and scanning probe microscopy. Course Information: Prerequisite: CHE 401 or equivalent and a passing grade in ASP 202.

CHE 403. Physical Chemistry Laboratory. 1 Hour.

A stand-alone course designed to introduce students to various laboratory techniques used in the fields of physical chemistry, and applications of theories taught in lecture. Characterization methods such as infrared spectroscopy, viscometry, and electrochemical methods will be utilized. Computer modeling of chemical systems will be included. Course Information: Prerequisites: CHE 401, or concurrent enrollment.

CHE 405. Chemistry Laboratory Assistant. 1,2 Hour.

For students desiring to gain teaching and service experience in chemistry and improve their laboratory skills. Students will assist faculty members in setting up and conducting laboratory classes. Students are expected to prepare reagents accurately and assist others in developing laboratory techniques and operating instrumentation under supervision of a faculty member.

CHE 415. Biochemistry I. 3,4 Hours.

The general objectives of this course include, but are not limited to, developing an appreciation for the fundamentals of biochemistry and the study of molecules with biological significance, namely proteins, lipids, carbohydrates, and nucleic acids. This course will examine the building blocks essential of the assembly of these chemical macromolecules, as well as the resultant structural consequences. Course Information: Prerequisite: CHE 267 and CHE 268 or equivalent.

CHE 416. Biochemistry II. 3,4 Hours.

The general objectives of this course include, but are not limited to, developing an appreciation for the fundamentals of biochemistry and the study of biomolecules and their role in biological systems. The course will include a comprehensive review of enzymology, protein dynamics, metabolism, and biosynthesis. Course Information: Prerequisite: CHE 415 (with lab) or equivalent.

CHE 418. Bioanalytical Chemistry. 3 Hours.

The general objectives of this course include, but are not limited to, developing an appreciation for the fundamentals of bioanalytical chemistry. The course will emphasize the manipulations of biologically relevant molecules through laboratory exercises that include techniques in proteins enzymes, and nucleic acid chemistry. Course Information: Prerequisites: CHE 267 and CHE 268, or equivalent and CHE 475, or equivalent.

CHE 421. Instrumental Analysis. 4 Hours.

Overview of separation methods such as Gas Chromatography, High Performance Liquid Chromatography and Capillary Electrophoresis. Spectroscopic techniques include Mass Spectrometry, Optical Spectroscopy including UV-Visible, Infrared and Atomic Absorption. Course Information: Prerequisite: CHE 267, or equivalent.

CHE 422. Inorganic Chemistry. 4 Hours.

Survey of the bonding, structure, and reactivity of solid-state materials, main group compounds, and transition metal complexes. Examples from the interdisciplinary areas of organometallic chemistry, bioinorganic chemistry, and materials science will be presented. The synthesis and characterization of inorganic materials will be explored in the laboratory. A strong emphasis will be placed on the rapidly emerging fields of materials science and nanotechnology. Course Information: Prerequisite: CHE 402.

CHE 425. Medicinal Chemistry. 3 Hours.

Pharmacotherapy is defined as the treatment of disease through the administration of drugs. Medicinal chemistry is an introductory course in pharmacology that introduces the underlying principles of the mechanisms of actions of drugs used to treat diseases (pharmacodynamics), the properties of drugs (pharmacokinetics), and how they vary from individual to individual (pharmacogenetics). Course Information: Same as BIO 425.

CHE 431. Environmental Chemistry. 4 Hours.

Chemical principles behind various environmental processes and analytical chemistry techniques used to solve environmental problems will be introduced. Interactions between the geosphere, the hydrosphere, and the atmosphere will be explored. Issues of waste remediation, disposal and energy resources will be addressed. Course Information: Same as ENS 447.

CHE 432. Introduction to Neuroscience. 3 Hours.

While neurobiology traditionally focuses on the biology of the nervous system, neuroscience is an interdisciplinary field that incorporates principles from biology, chemistry, mathematics and medicine to provide a more comprehensive overview of the nervous system. In order to understand how the nervous system is organized and functions to generate behavior, we will examine the central and peripheral nervous system in anatomical, electrophysiological, cellular, and molecular terms. Course Information: Same as BIO 432.

CHE 433. Physiological Chemistry. 4 Hours.

Physiological biochemistry includes a survey of biochemical structures and functions, with emphasis on human metabolism. Regulation and metabolic adaptation are discussed for physiologic conditions such as fasting, exercise, starvation, and various disease states. Course Information: Prerequisite: CHE 267. Anatomy and physiology recommended.

CHE 465. Environmental Toxicology. 3,4 Hours.

Study of the effects of chemical and physical agents on the health of the public and environment. Included are sources, transport, chemical behavior, and biochemical mechanisms for adverse health effects from environmental pollutants. Course Information: Same as MPH 449.

CHE 475. General Biochemistry. 3 Hours.

This is an introductory one semester course in biochemistry that provides a foundation for the health sciences by investigating the simple molecular components of the cell to the complex dynamics of metabolism and information transfer. Course Information: Same as BIO 475.

CHE 476. General Biochemistry Laboratory. 2 Hours.

This is a laboratory and supplemental discussion to CHE 475: General Biochemistry. The course will develop a competency with basic biochemical techniques, e.g. protein and DNA preparations. The course will also provide a more in depth coverage to the topics in CHE 475. Course Information: Same as BIO 476.

CHE 480. Special Topics In Chemistry. 1-4 Hours.

Advanced topics which may involve instruction, laboratory, and/or independent study. Topics will vary depending on student interest and area of expertise of instructor. Course Information: May be repeated if topics vary. Students may register in more than one section per term.

CHE 485. Advanced Biochemistry. 4 Hours.

This is an advanced one semester course in biochemistry that provides an in depth coverage of topics that expand upon the foundations established in CHE 475: General Biochemistry as well as explore developing areas of research in biochemistry. Course Information: Same as BIO 485.

CHE 499. Tutorial. 1-4 Hours.

Intended to supplement, not supplant, regular course offerings. Students interested in a tutorial must secure the consent of the faculty member concerned before registration and submit any required documentation to him or her. Course Information: May be repeated if topics vary.