Nebraska Wesleyan University

Chemistry

Catalog

2022-2023

About the Program

The department offers both a Bachelor of Arts (B.A.) and a Bachelor of Science (B.S.) degree in Chemistry. The B.A. degree is for those who want a core of chemistry courses with a broader background in the liberal arts. The B.S. degree is for those who wish to emphasize their study of chemistry.

The B.S. degree with a major in Biochemistry and Molecular Biology consists of a combination of chemistry-based curriculum with a significant biology component that prepares our students for postgraduate studies in fields such as biochemical, biomedical, and bioengineering sciences. While biochemistry focuses on the structure and function of compounds like DNA, enzymes and proteins, molecular biology focuses on how molecules convert information into chemical reactions.

Chemists also regularly study in any of Nebraska Wesleyan's health-related pre-professional programs. A program of study emphasizing a strong background in chemistry is available for students planning a future in medicine.

Students interested in chemical engineering can participate in the Engineering Dual-Degree Program described in the Department of Physics and Astronomy section of this catalog. Chemical Engineering students complete either a B.A. or B.S. degree in Chemistry at NWU and any remaining engineering program requirements at one of our participating schools of engineering.

The Department of Chemistry is on the approved list of the American Chemical Society (ACS). Approval is received after an examination of curriculum, laboratory facilities, library, and staff of the department by the Committee on Professional Training of the ACS.

Students who wish to be certified as having met the minimum requirements of the American Chemical Society for professional training must work closely with the department chair in developing their program of study.

Department Learning Outcomes
Majors will be able to:

1. Demonstrate knowledge of the core descriptive material in inorganic, physical, analytical, organic and polymer (macromolecular) chemistry, and biochemistry.
2. Describe the structure of atoms and molecules.
3. Understand relationships between structure and reactivity.
4. Predict mechanisms and products of chemical transformations.
5. Use retrosynthetic analysis to design syntheses of organic compounds.
6. Understand thermodynamic and kinetic aspects of physical and chemical transformations.
7. Use mathematical methods to solve quantitative problems dealing with stoichiometry and quantitative analysis, thermodynamics and equilibrium, kinetics, and quantum mechanics.
8. Analyze and interpret the data derived from modern methods of spectroscopic, electrometric, and chromatographic analysis, and understand the fundamental principles upon which these instrumental methods of measurement are based.
9. Evaluate and understand error and uncertainties in physical measurements.

Majors, Minors & Degrees

Majors

1. Biochemistry and Molecular Biology (B.S.)
2. Chemistry (B.A.)
3. Chemistry (B.S.)

Minors

1. Chemistry

Courses

CHEM 1100 Prep Chemistry

3 hours

A preparatory course for CHEM 1110 Chemical Principles I , with a focus on developing both the quantitative, mathematical, problem-solving skill set and fundamental chemical concept knowledge encountered in a college-level general chemistry course. Topics include characteristics and classification of matter, measurements, mathematics of chemistry, dimensional analysis, and problem-solving.
This course may not be used for the major or for general education.

CHEM 1110 Chemical Principles I

3 hours

A study of fundamental principles of chemistry including structures of atoms and molecules, periodicity, stoichiometry, reactions, solutions, gases, and thermochemistry.
Three classes per week.
(Normally offered each fall semester.)

Archway Curriculum: Foundational Literacies: Scientific Investigations: Natural Science Laboratory

CHEM 1110L Chemical Principles I Laboratory

1 hour

Laboratory supporting CHEM 1110 Chemical Principles I .
One three-hour lab per week.
Pre or corequisite(s): CHEM 1110 Chemical Principles I .
(Normally offered each fall semester.)

Archway Curriculum: Foundational Literacies: Scientific Investigations: Natural Science Laboratory

CHEM 1120 Chemical Principles II

3 hours

A continuation of CHEM 1110 Chemical Principles I . Topics include reaction kinetics, aqueous equilibria, thermodynamics (Entropy and Gibbs Free Energy), electrochemistry, colligative properties, nuclear and coordination chemistry.
Prerequisite(s): CHEM 1110 Chemical Principles I and CHEM 1110L Chemical Principles I Laboratory with grades of "C-" or better.
(Normally offered each spring semester.)

CHEM 1120L Chemical Principles II Laboratory

1 hour

A laboratory supporting CHEM 1120 Chemical Principles II.
One 3-hour lab per week.
Corequisite(s): CHEM 1120 Chemical Principles II.
(Normally offered each spring semester.)

CHEM 1900 Selected Topics

1-5 hours

A course designed to treat subject matter not covered in other departmental courses or to provide advanced study of subject matter introduced in other courses. The title, content, and credit will be determined by current mutual interests of students and faculty.
Prerequisite(s): Permission of department chair. Other prerequisites to be determined.

CHEM 1950 Independent Study

1-2 hours

Individual laboratory project in chemistry or biochemistry. Independent Study may not duplicate courses described in the catalog.
Prerequisite(s): Permission of the department chair.

Archway Curriculum: Essential Connections: Experiential Learning: Exploratory

CHEM 1960 Special Projects

1-2 hours

Supervised work on an approved project involving subject matter not included in any of the standard courses. Projects are normally developed individually but may be arranged for organized groups. Registration should designate the area of work.
Prerequisite(s): Permission of department chair.

CHEM 1970 Internship

1-8 hours

An on-the-job experience oriented toward the student's major interest. The student is to secure a position in an organization that satisfies the mutual interests of the instructor, the sponsor, and the student. P/F only.
Prerequisite(s): Permission of the department chair.

CHEM 2100 Organic Chemistry I

3 hours

A survey of the structure and reactions of carbon-containing molecules.
Three lectures per week.
Prerequisite(s): CHEM 1110 Chemical Principles I with a grade of "C-" or better.
(Normally offered each spring semester.)

CHEM 2100L Organic Chemistry I Laboratory

1 hour

A laboratory supporting CHEM 2100 Organic Chemistry I .
One 3-hour lab per week.
One 1-hour pre-lab lecture per week.

Prerequisite(s): CHEM 1110L Chemical Principles I Laboratory with grade of "C-" or better.
Corequisite(s): CHEM 2100 Organic Chemistry I .
(Normally offered each spring semester.)

CHEM 2110 Organic Chemistry II: Synthesis and Mechanisms

3 hours

A continuation of CHEM 2100 Organic Chemistry I . A study of reactions of importance in the synthesis and biosynthesis of carbon compounds, including reaction mechanisms and spectroscopic methods for the determination of structures.
Three lectures per week.
Prerequisite(s): CHEM 2100 Organic Chemistry I with grade of "C-" or better.
(Normally offered each fall semester.)

CHEM 2110L Organic Chemistry II Laboratory

1 hour

A laboratory supporting CHEM 2110 Organic Chemistry II: Synthesis and Mechanisms.
One 3-hour lab per week.
One 1-hour pre-lab lecture per week.

Prerequisite(s): CHEM 2100L Organic Chemistry I Laboratory with grade of "C-" or better.
Corequisite(s): CHEM 2110 Organic Chemistry II: Synthesis and Mechanisms.
(Normally offered each fall semester.)

CHEM 2500 Introduction to Neuroscience

3 hours

A comprehensive introduction to the field of neuroscience that will cover cellular and gross neuroanatomy, signaling, neural systems, and behavior. This course will explore these topics in the context of neurological disorders including stroke, neurodegeneration, and behavioral disorders, as well as the social, economic, and ethical ramifications of these diseases.

Prerequisite(s): BIO 2200 Genetics and Cell Biology, CHEM 2100 Organic Chemistry I , PSYCH 1010FYW Introduction to Psychological Science.

(Normally offered each spring semester)

Archway Curriculum: Integrative Core: Human Health and Disease Thread

CHEM 2800 Introduction to Research

2 hours

An introduction to experimental research in which you will actively explore a designated research topic through a combination of weekly experimentation and exploration of the primary literature. You will learn relevant laboratory techniques and instrumentation as needed to support your project and gain a greater understanding of the rewards and challenges of independent laboratory research. Your work will culminate in a formal summary of your discoveries in the form of a poster or an oral presentation. One 3-hour lab and one 1-hour lecture per week.

Prerequisite(s): Grade of "C" or better in CHEM 1110 Chemical Principles I or equivalent.

Archway Curriculum: Essential Connections: Experiential Learning: Exploratory

CHEM 2900 Selected Topics

1-2 hours

A course designed to treat subject matter not covered in other departmental courses or to provide advanced study of subject matter introduced in other courses. The title, content, and credit will be determined by current mutual interests of students and faculty.
Prerequisite(s): Permission of department chair. Other prerequisites to be determined.

CHEM 2910 Stockroom Assistant Experience

1 hour

A supervised laboratory experience enabling observation and participation in laboratory setting related to Chemistry by working as a stockroom prep assistant. Requirements include: submission of a learning plan, journal, reflection project, and oral

presentation. P/F only.
Prerequisite(s): Approval of the Department Chair in consultation with the Stockroom Manager and approval of the coordinating full-time faculty member.

Archway Curriculum: Essential Connections: Experiential Learning: Exploratory

CHEM 2920 Teaching Assistant Experience

1 hour

A supervised laboratory experience enabling observation and participation in laboratory setting related to Chemistry by working as a teaching assistant. Requirements include: submission of a learning plan, journal, reflection project, and oral presentation. P/F only.
Prerequisite(s): Approval of the Department Chair in consultation with the Stockroom Manager, and approval of the coordinating full-time faculty member.

Archway Curriculum: Essential Connections: Experiential Learning: Exploratory

CHEM 2950 Independent Study

1-2 hours

Individual laboratory project in chemistry of biochemistry. Independent Study may not duplicate courses described in the catalog.
Prerequisite(s): Permission of the department chair.

Archway Curriculum: Essential Connections: Experiential Learning: Exploratory

CHEM 2960 Special Projects

1-2 hours

Supervised work on an approved project involving subject matter not included in any of the standard courses. Projects are normally developed individually but may be arranged for organized groups. Registration should designate the area of work.
Prerequisite(s): Permission of department chair.

CHEM 2970 Internship

1-8 hours

An on-the-job experience oriented toward the student's major interest. The student is to secure a position in an organization that satisfies the mutual interests of the instructor, the sponsor, and the student. P/F Only.
Prerequisite(s): Permission of the department chair.

CHEM 3090 Organic Chemistry III: Intermediate Organic Chemistry

2 hours

The application of infrared, 1H NMR, 13C NMR, and mass spectrometry to molecular structure determination are presented. Emphasis is placed on the interpretation of spectra to determine structures of organic molecules. The laboratory involves the use of the spectrometers, and problem solving with discussion groups.
One lecture and one three-hour lab per week.
Prerequisite(s): CHEM 2110 Organic Chemistry II: Synthesis and Mechanisms with a grade of "C-" or better.
(Normally offered each spring semester.)

CHEM 3410 Biochemistry

3 hours

A comprehensive introduction to the field of biochemistry that will stress the role of molecular structure and reactivity in determining biological function. The course will emphasize biochemical problem solving by the application of basic chemical principles.
Three lectures per week.

Prerequisite(s): CHEM 1120 Chemical Principles II and CHEM 2110 Organic Chemistry II: Synthesis and Mechanisms with grades of "C-" or better. A basic biology background is strongly recommended.
(Normally offered each fall semester.)

CHEM 3410L Biochemical Methods

1 hour

An introduction to biochemical methods used to isolate and characterize biomolecules from natural sources. A variety of analytical and physical methods, including UV/visible and NMR spectroscopy, will be used to determine structural features and to measure functional properties of the isolated biomolecules.
One three-hour lab per week.
Corequisite(s): CHEM 3410 Biochemistry.
(Normally offered each fall semester.)

CHEM 3440 Analytical Chemistry and Instrumental Analysis

4 hours

The course will cover the principles and applications of chemical equilibrium and chemical analysis, data acquisition and analysis, as well as the theory and practice of instrumental methods of chemical analysis.
Prerequisite(s): CHEM 1120 Chemical Principles II and CHEM 1120L Chemical Principles II Laboratory with grades of "C-" or better.
(Normally offered each spring semester.)

CHEM 3510 Physical Chemistry I, Thermodynamics and Kinetics

3 hours

An introduction to physical chemistry consisting of fundamentals of chemical thermodynamics, chemical and physical equilibrium, and chemical kinetics presented using a calculus-based mathematical treatment.
Three lectures per week.
Prerequisite(s): CHEM 2110 Organic Chemistry II: Synthesis and Mechanisms, CHEM 1120 Chemical Principles II and MATH 1600 Calculus I.
(Normally offered each fall semester.)

CHEM 3510L Physical Chemistry Laboratory

1 hour

Laboratory exercises in the measurement of physical and chemical properties of chemical systems. This course is designed to accompany CHEM 3510.
One three-hour lab per week.
Corequisite(s): CHEM 3510 Physical Chemistry I, Thermodynamics and Kinetics.
(Normally offered each fall semester.)

Archway Curriculum: Essential Connections: Writing Instructive

CHEM 3520 Physical Chemistry II, Quantum Chemistry and Spectroscopy

3 hours

An introduction to quantum chemistry and an exploration of the theoretical concepts of selected spectroscopic techniques presented using a calculus-based, mathematical treatment.
Three lectures per week.
Prerequisite(s): CHEM 3510 Physical Chemistry I, Thermodynamics and Kinetics, CHEM 3510L Physical Chemistry Laboratory and MATH 1610 Calculus II.
(Normally offered in the spring semester of odd years.)

Archway Curriculum: Integrative Core: Innovation Thread

CHEM 3520L Physical Chemistry Laboratory

1 hour

Continuation of CHEM 3510L Physical Chemistry Laboratory. The course is designed to accompany CHEM 3520 Physical Chemistry II, Quantum Chemistry and Spectroscopy.
One 3-hour lab per week.
Corequisite(s): CHEM 3520 Physical Chemistry II, Quantum Chemistry and Spectroscopy.
(Normally offered in the spring semester of odd years.)

CHEM 3620 Inorganic Chemistry

3 hours

A survey of inorganic systems including the study of periodic trends, bonding and structure, coordination compounds, nonaqueous solvents, inorganic mechanisms, bio-inorganic chemistry, and organometallic compounds.
Prerequisite(s): CHEM 3510 Physical Chemistry I, Thermodynamics and Kinetics.
(Normally offered each spring semester of even years.)

CHEM 3620L Inorganic Chemistry Laboratory

1 hour

A laboratory in support of Inorganic Chemistry. The laboratory work consists of the preparation and chemical and spectroscopic analysis of a variety of inorganic compounds and provides experience with a range of synthetic and spectroscopic techniques.
(Normally offered each spring semester of even years.)

CHEM 3900 Selected Topics

1-2 hours

A course designed to treat subject matter not covered in other departmental courses or to provide advanced study of subject matter introduced in other courses. The title, content, and credit will be determined by current mutual interests of students and faculty.
Prerequisite(s): Permission of department chair. Other prerequisites to be determined.

CHEM 3950 Independent Study

1-2 hours

Individual laboratory project in chemistry or biochemistry. Independent Study may not duplicate courses described in the catalog.
Prerequisite(s): Permission of the department chair.

Archway Curriculum: Essential Connections: Experiential Learning: Intensive

CHEM 3960 Special Projects

1-2 hours

Supervised work on an approved project involving subject matter not included in any of the standard courses. Projects are normally developed individually but may be arranged for organized groups. Registration should designate the area of work.
Prerequisite(s): Permission of department chair.

CHEM 3970 Internship

1-8 hours

This course allows students to participate at a meaningful level in an internship with a public official, political figure, public agency, campaign or interest group and to use that experience as the basis for an academic paper.

Pass/Fail only.
Prerequisite(s): Permission of the department chair.

CHEM 4000 Introduction to Polymer Chemistry

3 hours

Introduce students to the chemical reactions, properties, and applications of both thermoset and thermoplastic polymers. Physical and mechanical test methods specific to the polymer industry will studied with emphasis placed on instrumentation unique to the commercial and polymer chemistry and material science field.
Two lectures per week.
Prerequisite(s): CHEM 3090 Organic Chemistry III: Intermediate Organic Chemistry and CHEM 3510 Physical Chemistry I, Thermodynamics and Kinetics. MATH 1610 Calculus II strongly recommended.

CHEM 4050 Advanced Organic Chemistry

4 hours

Topics presented in this course are reaction mechanisms, modern synthetic methodology, and the application of molecular modelling computational methods to organic chemistry. The laboratory work includes syntheses illustrative of special techniques, experiments concerned with the determination of reaction mechanisms, use of molecular modelling and molecular orbital computational programs, and research simulation.
Three lectures and one 3-hour laboratory per week.
Prerequisite(s): CHEM 3090 Organic Chemistry III: Intermediate Organic Chemistry and CHEM 3510 Physical Chemistry I, Thermodynamics and Kinetics. MATH 1610 Calculus II strongly recommended.
(Normally offered each fall semester of even years.)

CHEM 4420 Advanced Biochemistry

3 hours

An advanced study of selected areas of biochemistry that will include enzyme reaction mechanisms, DNA-protein interactions, rational drug design, and other topics.
Three lectures per week.
Prerequisite(s): CHEM 3410 Biochemistry.
(Normally offered each spring semester.)

CHEM 4900 Selected Topics

1-2 hours

A course designed to treat subject matter not covered in other departmental courses or to provide advanced study of subject matter introduced in other courses. The title, content, and credit will be determined by current mutual interests of students and faculty.
Prerequisite(s): Permission of department chair. Other prerequisites to be determined.

CHEM 4910 Directed Readings

1-6 hours

An opportunity for students, under the supervision of a faculty member, to pursue scientific literature not covered in other coursework.

CHEM 4950 Independent Study

1-2 hours

Individual laboratory project in chemistry of biochemistry. Independent Study may not duplicate courses described in the catalog.
Prerequisite(s): Permission of the department chair.

Archway Curriculum: Essential Connections: Experiential Learning: Intensive

CHEM 4960 Special Projects

1-2 hours

Supervised work on an approved project involving subject matter not included in any of the standard courses. Projects are normally developed individually but may be arranged for organized groups. Registration should designate the area of work.
Prerequisite(s): Permission of department chair.

CHEM 4970 Internship

1-6 hours

This course allows students to participate at a meaningful level in an internship with a public official, political figure, public agency, campaign or interest group and to use that experience as the basis for an academic paper.
Pass/Fail only.
Prerequisite(s): Permission of the department chair.

CHEM 4980 Chemistry Seminar

1 hour

Reading, study, and discussion of one or more major topics in chemistry with significant implications for the broader society. Students will search the chemical literature, and will make both oral and written presentations.
One lecture per week.
Prerequisite(s): Upper-division standing and a major declared in the natural and health sciences division or permission of the instructor.
(Normally offered each fall semester.)

Archway Curriculum: Essential Connections: Writing Instructive
Archway Curriculum: Essential Connections: Speaking Instructive

CHEM 4990 Senior Research

1-3 hours

Independent field research for all majors.

CHEM 5900 Selected Topics: Chemistry

3 hours

This graduate-level course is designed to give students the opportunity for in-depth study of a chemistry- based concept. Topics will consist of a highly specialized area of study or revolve around issues or recent trends and innovations related to the field of chemistry.