

PHYSICAL SCIENCES

Mission

The physical sciences program at Chadron State College prepares students for careers as problem solvers, investigating the physical properties and processes of the natural world. By observing, building hypotheses and communicating results, students are engaged in the methods and culture of science. As part of the global scientific community, they learn firsthand the contributions of science to the values of leadership, lifelong learning, and maintaining a sustainable society.

Student Learning Outcomes

- Students will have a strong knowledge base and the skills to be lifelong learners. Students will:
 - Have a strong foundational knowledge to be able to critically evaluate information.
 - Be able to recognize the limits of their knowledge and have the skills to seek and evaluate additional information.
 - Be able to apply logical reasoning and organizational skills to integrate new information into their functional knowledge base.
 - Students will be prepared for their profession in the science discipline. Students will:
 - Understand the interrelatedness of science and society and exhibit the professional skills appropriate for their chosen career path.
 - Be able to communicate scientific knowledge to a diverse audience using appropriate technology and media tools.
- Bachelor of Science - Comprehensive Major in Physical Sciences (<http://catalog.csc.edu/undergraduate/programs/physical-sciences/bs-comprehensive-major-physical-sciences>)
 - Bachelor of Science - Education - Subject Endorsement in Chemistry (Grades 7-12) (<http://catalog.csc.edu/undergraduate/programs/physical-sciences/bs-education-subject-endorsement-chemistry-7-12>)
 - Bachelor of Science - Education - Subject Endorsement in Earth and Space Science (Grades 7-12) (<http://catalog.csc.edu/undergraduate/programs/physical-sciences/bs-education-subject-endorsement-earth-space-science-7-12>)
 - Bachelor of Science - Education - Field Endorsement in Science (Grades 7-12) (<http://catalog.csc.edu/undergraduate/programs/physical-sciences/bs-education-field-endorsement-science-7-12>)
 - Bachelor of Science - Education - Middle Level Education Academic Area in Sciences (Grades 5-9) (<http://catalog.csc.edu/undergraduate/programs/physical-sciences/bs-education-middle-level-education-academic-area-sciences-grades-5-9>)
 - Chemistry (<http://catalog.csc.edu/undergraduate/programs/physical-sciences/chemistry-minor>)
 - Environmental Geoscience (<http://catalog.csc.edu/undergraduate/programs/physical-sciences/environmental-geoscience-minor>)
 - Geoscience (<http://catalog.csc.edu/undergraduate/programs/physical-sciences/geoscience-minor>)
 - Physics (<http://catalog.csc.edu/undergraduate/programs/physical-sciences/physics-minor>)

- Water Resources Management (<http://catalog.csc.edu/undergraduate/programs/physical-sciences/water-resources-management-minor>)
- Science (<http://catalog.csc.edu/undergraduate/programs/physical-sciences/areaofconcentration>)

Chemistry

CHEM 110 CAREERS IN SCIENCE1 Credit

Introduction for Physical Sciences majors to career options. Students will conduct independent research of selected firms or agencies. A required field trip to a major metropolitan area will provide knowledge of opportunities and challenges of the technical job market.

CHEM 121 INTRODUCTORY CHEMISTRY3 Credits

Fundamental principles of chemistry and the application of chemical principles to health, environment, and society.

Requirements: Required of students who have not taken high school chemistry who plan to enroll in CHEM 131 or CHEM 140.

CHEM 131 COLLEGE CHEMISTRY I3 Credits

Principles and applications of general college chemistry.

Prerequisites: CHEM 121 and MATH 142

Co-requisites: CHEM 131L

Notes: Enrollment in this course assumes competencies in math and chemistry equivalent to those accrued in high school algebra or MATH 142 and high school chemistry or CHEM 121; an ACT Math Section score of 22 or higher is recommended.

CHEM 131L COLLEGE CHEMISTRY I LABORATORY1 Credit

Laboratory experience in basic chemical concepts, including concentrations, reaction mechanisms, molecular structure and spectroscopy.

Co-requisites: CHEM 131

CHEM 132 COLLEGE CHEMISTRY II3 Credits

Continuation of College Chemistry I with qualitative analysis.

Prerequisites: CHEM 131 and CHEM 131L

Co-requisites: CHEM 132L

CHEM 132L COLLEGE CHEMISTRY II LABORATORY1 Credit

Laboratory experience in qualitative analysis.

Co-requisites: CHEM 132

CHEM 140 SURVEY OF CHEMISTRY3 Credits

Survey of chemistry principles and applications for students requiring a one semester freshman chemistry course.

Prerequisites: CHEM 121 and MATH 142

Co-requisites: CHEM 140L

Notes: Does not duplicate CHEM 131 and is not a prerequisite for CHEM 132.

CHEM 140L SURVEY OF CHEMISTRY LABORATORY1 Credit

Laboratory experiences in basic chemical processes and mechanisms. Basic chemistry laboratory operations.

Co-requisites: CHEM 140

CHEM 200 INDEPENDENT STUDY OR RESEARCH1-3 Credits

Study or research in an area of special interest.

Add Consent: Department Consent

Notes: The number of credit hours is determined by the topic and the amount of work required.

Requirements: Approval of instructor, School Dean, and Academic Vice President.

CHEM 231 SURVEY OF ORGANIC CHEMISTRY3 Credits

Survey of organic chemistry principles and applications for students requiring one semester of Organic Chemistry. The nomenclature, structure, physical and chemical properties and reactions of the principle families of organic compounds are covered. Carbohydrates, lipids, enzymes, amino acids and protein synthesis are also covered at an introductory level.

Prerequisites: CHEM 132 and CHEM 132L or CHEM 140 and CHEM 140L

Co-requisites: CHEM 231L

CHEM 231L SURVEY OF ORGANIC CHEMISTRY LABORATORY1 Credit

Principle laboratory operations of organic chemistry, organic synthesis, and spectroscopy.

Co-requisites: CHEM 231

CHEM 270 TOPICS (LD)1-3 Credits

Special topics in chemistry appropriate for lower division credit.

Notes: May be repeated with different emphases for up to six hours credit.

CHEM 310 CAPSTONE I: RESEARCH SEMINAR1 Credit

The student will choose a topic for research and conduct a literature survey of that topic. Preliminary results and a plan for conducting further independent research on the topic will be presented in oral and written form during the semester.

Prerequisites: Sophomore or above status

Notes: Normally taken during the student's Junior year.

CHEM 314 BIOTECHNOLOGY3 Credits

Hands-on procedures with discussions and readings to provide theoretical understanding and historical background of biotechnology work.

Cross-Listed: BIOL314/CHEM314

Prerequisites: BIOL 332 and Sophomore or above status

CHEM 320 SUPERVISED STUDY IN LAB AND FIELD METHODS1-2 Credits

Students will prepare, supervise, and evaluate laboratory exercises under the direction of faculty members. Designed to give students practical experience teaching in the laboratory setting.

Cross-Listed: BIOL/CHEM/GEOS/PHYS320

Prerequisites: Sophomore or above status

CHEM 332 ANALYTICAL INSTRUMENTATION2 Credits

A one-semester course in basic instrumentation with emphasis on the clinical and commercial setting.

CHEM 332L ANALYTICAL INSTRUMENTATION LABORATORY1 Credit

Laboratory experience in use and maintenance of scientific equipment.

CHEM 333 ORGANIC CHEMISTRY I3 Credits

Nomenclature, reactions, multi-step synthesis, stereochemistry, mechanisms, and spectroscopy of organic compounds.

Prerequisites: CHEM 132, CHEM 132L, and Sophomore or above status

Co-requisites: CHEM 333L

CHEM 333L ORGANIC CHEMISTRY I LABORATORY1 Credit

Principle laboratory operations of organic chemistry, organic synthesis, and spectroscopy.

CHEM 334 ORGANIC CHEMISTRY II3 Credits

A continuation of Organic Chemistry I.

Cross-Listed: CHEM234/CHEM334

CHEM 334L ORGANIC CHEMISTRY II LABORATORY1 Credit

A continuation of Organic Chemistry I laboratory.

Cross-Listed: CHEM234L/CHEM334L

CHEM 335 BIOCHEMISTRY3 Credits

Components and reactions of living matter. Topics include metabolism of major macromolecules including carbohydrates, lipids, proteins, and nucleic acids. Enzyme functions and regulation will be studied.

Prerequisites: CHEM 231 and CHEM 231L or CHEM 333 and CHEM 333L and Sophomore or above status

Co-requisites: CHEM 335L

CHEM 335L BIOCHEMISTRY LABORATORY1 Credit

Laboratory experience in purification, quantitation, and characterization of biological molecules.

CHEM 341 QUANTITATIVE ANALYSIS3 Credits

Principles of modern analytical chemistry.

Prerequisites: CHEM 132 and CHEM 132L and Sophomore or above status

Co-requisites: CHEM 341L

CHEM 341L QUANTITATIVE ANALYSIS LABORATORY1 Credit

Laboratory experience in quantitative analysis.

Prerequisites: Sophomore or above status

Co-requisites: CHEM 341

CHEM 342 INSTRUMENTAL ANALYSIS3 Credits

Emphasis on instrumental and radioisotopic analysis.

Prerequisites: CHEM 341 and CHEM 341L and Sophomore or above status

Co-requisites: CHEM 342L

CHEM 342L INSTRUMENTAL ANALYSIS LABORATORY1 Credit

Laboratory experience involving the use of quantitative instrumentation.

Prerequisites: Sophomore or above status

Co-requisites: CHEM 342

CHEM 390 INTERNSHIP IN CHEMISTRY1-12 Credits

Provides practical experience as a chemist in government, business or industry. Open to upper division students majoring in the area of chemistry.

Add Consent: Department Consent

Notes: Interested students should contact the Internship and Career Services office to secure application materials; application should be made prior to the semester the internship will be started; the amount of credit will be based on the availability of a suitable work position, the qualifications of the applicant, and the work hours.

CHEM 400 INDEPENDENT STUDY OR RESEARCH1-3 Credits

Study or research in an area of special interest.

Add Consent: Instructor Consent

Notes: The number of credit hours is determined by the topic and the amount of work required.

Requirements: Approval of instructor, Dean of Curriculum and Academic Advancement, and Academic Vice President is required.

CHEM 401 CAPSTONE II: SENIOR RESEARCH1 Credit

Independent research projects based on the results presented in CHEM 310. Data collection, analysis, and presentation of scientific papers.

Prerequisites: Junior or above status

Notes: May be repeated for a total of up to six hours of credit.

CHEM 410 CAPSTONE III: SENIOR RESEARCH/THESIS1 Credit

Research thesis is completed and presented at the Nebraska Academy of Sciences or other regional or national scientific forum approved by the faculty. Required field trip in late April.

Prerequisites: CHEM 401 and Junior or above status

CHEM 417 TOPICS IN CHEMISTRY1-3 Credits

Designed to meet the needs of students in a special area of interest. May be repeated for up to 6 hours.

CHEM 430 INORGANIC CHEMISTRY3 Credits

Advanced principles of inorganic chemistry.

Prerequisites: CHEM 132, CHEM 132L, and Junior or above status

CHEM 431 PHYSICAL CHEMISTRY3 Credits

Fundamental principles of thermodynamics, kinetics, and quantum mechanics as related to chemical concepts.

CHEM 431L PHYSICAL CHEMISTRY LABORATORY1 Credit

Physical Chemistry laboratory.

CHEM 433 ENVIRONMENTAL CHEMISTRY3 Credits

Chemical processes that influence the environment, including processes which affect the quality and use of land, water, and atmosphere. Focuses on topics of current concern.

CHEM 433L ENVIRONMENTAL CHEMISTRY LABORATORY1 Credit

Laboratory experience in environmental chemical analysis.

CHEM 444 PHYSICAL CHEMISTRY3 Credits

Fundamental principles of thermodynamics, kinetics, and quantum mechanics as related to chemical concepts.

CHEM 444L PHYSICAL CHEMISTRY LABORATORY1 Credit

Laboratory experience.

CHEM 464 PHYSICAL CHEMISTRY II3 Credits

Fundamental principles of kinetics, and quantum mechanics as related to chemical concepts.

Geoscience

GEOS 110 CAREERS IN SCIENCE1 Credit

Introduction for Physical Sciences majors to career options. Students will conduct independent research of selected firms or agencies. A required field trip to a major metropolitan area will provide knowledge opportunities and challenges of the technical job market.

GEOS 129 PHYSICAL SCIENCE FOR ELEMENTARY AND MIDDLE GRADES TEACHER3 Credits

A laboratory oriented course intended to strengthen the physical science background of the elementary and middle grades teacher.

Essential Studies: SLO #6

Prerequisites: Sophomore or above status

GEOS 130 EARTH SCIENCE3 Credits

Introductory survey of the four earth sciences; geology, oceanography, meteorology, and astronomy. Designed to help non-scientists gain a greater appreciation of the global physical environment, and to understand interactions of society with that environment. One or more field trips may be required.

Essential Studies: SLO #6

Notes: Credit cannot be applied toward an earth science subject endorsement, physical science major, or any geoscience minor.

GEOS 135 PHYSICAL SCIENCE3 Credits

An integrated course in physical sciences including astronomy, earth science, geology, physics and chemistry.

Essential Studies: SLO #6

GEOS 137 ENVIRONMENTAL GEOLOGY3 Credits

Considers effects of human interaction with the physical environment, both in terms of natural phenomena such as earthquakes and floods, which effect human lives, and resource use, in which humans change their environment. One or more field trips will be required.

Essential Studies: SLO #6

GEOS 200 INDEPENDENT STUDY OR RESEARCH1-3 Credits

Study or research in an area of special interest.

Add Consent: Department Consent

Notes: The number of credit hours is determined by the topic and the amount of work required.

Requirements: Approval of instructor, School Dean, and Academic Vice President.

GEOS 210 PLANETARY GEOLOGY3 Credits

Planetary Geology consists of three, (one) hour lectures per week.

The course provides a process oriented examination of the geological features associated with the planets of the Solar System, their satellites, and the Sun. and an examination of "Earth-like" planets and moons.

Essential Studies: SLO #6

GEOS 230 NATURAL HAZARDS AND DISASTERS3 Credits

The cause and effects of natural disasters can be understood using an Earth system science approach. Science and technology are limited in their ability to predict disasters. Recognizing these limitations, students will explore the roles of individuals in broader societal issues relating to disaster preparedness, damage and cost mitigation as they relate to natural hazards.

Essential Studies: SLO #6

GEOS 231 PHYSICAL GEOLOGY3 Credits

Introduction to the fundamentals and language of physical geology, to aid in understanding the solid Earth, its origin, constituents, and surficial features, and the appreciation of the dynamic nature of our planet.

Essential Studies: SLO #6

Co-requisites: GEOS 231L

GEOS 231L PHYSICAL GEOLOGY LABORATORY1 Credit

Laboratory exercises will introduce the tools geologists use to interpret Earth processes: minerals and rocks, maps, and aerial photographs. One or more field trips will be offered.

Essential Studies: SLO #6

Co-requisites: GEOS 231

GEOS 233 ASTRONOMY2 Credits

A descriptive study of the solar system, stars, and galactic systems, including theories of the origin of the universe and the solar system.

Essential Studies: SLO #6

GEOS 233L ASTRONOMY LABORATORY1 Credit

Laboratory experience in astronomy. Held in the evening either outdoors or in the planetarium.

Essential Studies: SLO #6

GEOS 234 EARTH SYSTEM HISTORY3 Credits

Highlights changes through time in the Earth system, including the solid Earth, the oceans and water on land, evolution of the atmosphere, and evolution of life as seen through the fossil record. The systems approach seeks out and analyzes interactions between these different components.

Essential Studies: SLO #6

Co-requisites: GEOS 234L

GEOS 234L EARTH SYSTEM HISTORY LABORATORY1 Credit

Laboratory exercises will introduce the tools used to understand changes in the Earth system through time. Includes identification of the major fossil groups, and analysis of geologic, oceanographic, atmospheric and paleontologic data.

Essential Studies: SLO #6

Co-requisites: GEOS 234

GEOS 246 GEOLOGY FIELD CAMP I2 Credits

This course offers students opportunities to develop observation and interpretation skills while being introduced to technical aspects of field mapping, stratigraphic interpretation and structural analysis. Participants will prepare maps, stratigraphic charts, geologic cross sections, field notes and reports while interacting with geological problems in several areas in the Great Plains and Rocky Mountains. Time will be divided between travel and working out of a base camp.

Prerequisites: GEOS 231, GEOS 231L, GEOS 234, GEOS 234L, and Junior or above status

Notes: Taught concurrently with GEOS 346 and 446.

Requirements: Additional course fee required.

GEOS 270 TOPICS IN GEOSCIENCE1-3 Credits

Special topics appropriate for lower division credit.

Notes: May be repeated with different emphases for up to six hours of credit.

GEOS 310 CAPSTONE I: RESEARCH SEMINAR1 Credit

The student will choose a topic for research and conduct a literature survey of that topic. Preliminary results and a plan for conducting further independent research on the topic will be presented in oral and written form during the semester.

Prerequisites: Sophomore or above status

Notes: Normally taken during the student's Junior year.

GEOS 320 SUPERVISED STUDY IN LAB AND FIELD METHODS1-2 Credits

Students will prepare, supervise, and evaluate laboratory and field exercises under the direction of faculty members. Designed to give students practical experience teaching in the laboratory and field setting.

Cross-Listed: BIOL/CHEM/GEOS/PHYS320

Prerequisites: Sophomore or above status

GEOS 321 INTRODUCTION TO GPS1 Credit

Principles and applications of global positioning system. Emphasis is on mapping and other uses applied to geoscience field problems. Field trips may be required.

Prerequisites: Sophomore or above status

GEOS 322 INTRODUCTION TO GIS3 Credits

Principles and applications of geographic information systems with emphasis on Arcview* software. Students will address solutions to real-world problems using Geographic Information Systems.

Prerequisites: Sophomore or above status

Notes: Field trips may be required; recommended prerequisite: GEOS 321. * Registered Trademark

GEOS 334 METEOROLOGY3 Credits

The physical behavior of the atmosphere including the causes of weather and the elements of forecasting.

Essential Studies: SLO #6

Prerequisites: Sophomore or above status

GEOS 337 PALEONTOLOGY3 Credits

A systematic survey of invertebrate phyla and vertebrate classes most important in the fossil record.

GEOS 337L PALEONTOLOGY LABORATORY1 Credit

Examination of fossil invertebrates and vertebrates in laboratory and field.

Prerequisites: Sophomore or above status

Co-requisites: GEOS 337

GEOS 338 ROCKS AND MINERALS3 Credits

Introduction to mineralogy, and optical mineralogy in the context of rocks and interpretation of rock-forming environments. Possibly one or more field trips required.

Prerequisites: GEOS 231, GEOS 231L and Sophomore or above status

GEOS 346 GEOLOGY FIELD CAMP II2 Credits

This course offers students opportunities to develop observation and interpretation skills while learning the technical aspects of field mapping, stratigraphic interpretation and structural analysis. Participants will prepare maps, stratigraphic charts, geologic cross sections, field notes and reports while interacting with geological problems in several areas in the Great Plains and Rocky Mountains. Time will be divided between travel and working out of a base camp.

Prerequisites: GEOS 246 and Junior or above status

Notes: Taught concurrently with GEOS 246 and 446.

Requirements: Additional course fee required.

GEOS 390 INTERNSHIP IN GEOSCIENCE1-12 Credits

Provides practical experience as a geoscientist in government, business, or industry. Open to upper division students majoring in the area of geoscience.

Add Consent: Department Consent

Notes: Interested students should contact the Internship and Career Services Office to secure application materials.

Requirements: Application should be made prior to the semester the internship will be started; the amount of credit will be based on the availability of a suitable work position, the qualifications of the applicant, and the work hours.

GEOS 400 INDEPENDENT STUDY OR RESEARCH1-3 Credits

Study or research in a geoscience area of special interest.

Add Consent: Instructor Consent

Notes: The number of credit hours is determined by the topic and the amount of work required. Permission of instructor, School Dean, and Academic Vice President is required.

GEOS 401 CAPSTONE II: SENIOR RESEARCH1 Credit

Independent research projects based on the results presented in GEOS 310. Data collection, analysis, and presentation of scientific papers.

Prerequisites: GEOS 310 and Junior or above status

Notes: Normally taken during the student's Junior or Senior year; may be repeated for a total of up to six hours of credit.

GEOS 410 CAPSTONE III: SENIOR RESEARCH THESIS1 Credit

Research thesis is completed and presented at the Nebraska Academy of Sciences or other regional or national scientific forum approved by the faculty. Required field trip in late April. Normally taken during the student's Senior year.

Prerequisites: GEOS 401 and Junior or above status

GEOS 426A RESEARCH MICROSCOPY1 Credit

Microscopic principles and techniques focusing on the use of microscopes in scientific inquiry and diagnosis. Includes light and optic theory, specimen preparation, image collection and interpretation, and types of research microscopes.

Cross-Listed: BIOL436A/GEOS426A

GEOS 426B INTRODUCTION TO SCIENTIFIC RESEARCH2 Credits

Scientific research methodology, including development of testable hypotheses, research design, data analysis introduction, grant proposal writing, and writing research papers.

Cross-Listed: BIOL436B/GEOS426B

GEOS 430 SPECIAL TOPICS IN GEOSCIENCE1-3 Credits

To meet special needs of Geoscience students.

Notes: May be repeated with different topics and approval of instructor for a total of six credit hours.

GEOS 431 GEOLOGY OF WATER RESOURCES3 Credits

An introduction to the origin and nature of groundwater, its interaction with surface water, geological methods of groundwater exploration, and factors affecting water supply and quality. One or more field trips required.

GEOS 432 STRUCTURAL GEOLOGY3 Credits

Description and analysis of geologic structures and the regional and global tectonic forces that produce them. Possibly one or more field trips required.

Prerequisites: GEOS 231, GEOS 231L, and Junior or above status

GEOS 434 INTRODUCTION TO OCEANOGRAPHY3 Credits

An earth-system approach to study of the oceans. Includes discussion of physical and biological phenomena in the oceans; analyzes interactions among the hydrosphere atmosphere and geosphere; and considers humans as stewards of ocean resources. Field trips may be required.

GEOS 435 FIELD EXPERIENCE IN GEOSCIENCE1-3 Credits

Typically a one to three week workshop. Field excursions to study major geologic features and provinces in North America or elsewhere.

Add Consent: Instructor Consent

GEOS 436 FIELD EXCAVATION AND PROCEDURES1-3 Credits

A summer workshop designed to give the student field experience in the development of paleontological sites.

Prerequisites: Junior or above status

Add Consent: Instructor Consent

GEOS 437 WORLD ENVIRONMENTAL ISSUES3 Credits

Exploration of world environmental problems. Discussion participation setting emphasizes library research, accessing information, critical analysis of media news, and information and global perspective measures. The course culminates in student action plans that may affect environmental change.

Essential Studies: SLO #9

Prerequisites: Junior or above status

GEOS 438 PETROLEUM GEOLOGY3 Credits

The origin, characteristics, occurrence, exploration, and development of/ for petroleum. Possibly one or more field trips.

GEOS 439 SEDIMENTOLOGY AND STRATIGRAPHY3 Credits

The origin and characteristics of sedimentary rocks.

Prerequisites: GEOS 231, GEOS 231L, GEOS 234, GEOS 234L and Junior or above status

Co-requisites: GEOS 439L

GEOS 439L SEDIMENTOLOGY AND STRATIGRAPHY LABORATORY1 Credit

Laboratory and field studies of sediments and sedimentary rocks.

Prerequisites: Junior or above status

Co-requisites: GEOS 439

GEOS 446 GEOLOGY FIELD CAMP III2 Credits

This course offers students opportunities to develop proficiency with observation and interpretation skills and the technical aspects of field mapping, stratigraphic interpretation and structural analysis. Participants will prepare maps, stratigraphic charts, geologic cross sections, field notes and reports while interacting with geological problems in several areas in the Great Plains and Rocky Mountains. Time will be divided between travel and working out of a base camp. Additional course fee required.

Prerequisites: GEOS 346 and Junior or above status

Notes: Taught concurrently with GEOS 246 and 346.

GEOS 471 ADVANCED ASTRONOMY1-3 Credits

A quantitative study of topics introduced in GEOS 233. Includes astrophotography, deep sky viewing, and planetarium.

Prerequisites: GEOS 233/, GEOS 233L, and , GEOS 233L, and Junior or above status