

# 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/>)

## 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 focusing on the topics of matter and measurement, structure of atoms and use of the periodic table, chemical bonding and molecules, reaction stoichiometry, and energy.

**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

First of a two semester sequence of courses in General Chemistry for science majors. Detailed study of matter and measurement, structure of atoms molecules and ions, stoichiometric relationships, electronic structure of atoms, chemical periodicity, chemical bonding, thermochemistry, and properties of gases, liquids and solids.

**Prerequisites:** High school chemistry or CHEM 121 and high school algebra or 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.

### CHEM 131L COLLEGE CHEMISTRY I LABORATORY1 Credit

Laboratory experience in basic chemical concepts, including concentrations, reaction mechanisms, stoichiometric relationships, molecular structure, properties of gases, liquids, and solids, and spectroscopy.

**Co-requisites:** CHEM 131

### CHEM 132 COLLEGE CHEMISTRY II3 Credits

Second of a two semester sequence of courses in General Chemistry for science majors, with a focus on the topics of solution chemistry, chemical kinetics, principles and applications of equilibrium, chemical thermodynamics and electrochemistry.

**Prerequisites:** CHEM 131 and CHEM 131L

**Co-requisites:** CHEM 132L

### CHEM 132L COLLEGE CHEMISTRY II LABORATORY1 Credit

Laboratory experience focusing on studies of principles and applications of chemical kinetics, equilibrium, acid-base chemistry, thermodynamics and electrochemistry.

**Co-requisites:** CHEM 132

### CHEM 140 SURVEY OF CHEMISTRY3 Credits

Survey of chemistry principles and applications for science majors requiring a one semester freshman chemistry course. Topics covered include: matter and measurement, atoms ions and molecules, periodicity, chemical bonding, reaction stoichiometry, energy, phases of matter, solution chemistry, chemical kinetics, equilibrium, and electrochemistry.

**Prerequisites:** High school chemistry or CHEM 121 and high school algebra or 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.

**Add Consent:** Instructor Consent

**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.

**Essential Studies:** SLO #12

**Prerequisites:** CHEM 132, 132L, and sophomore or above status

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

**CHEM 313 QUANTITATIVE, ORGANIC, AND BIOLOGICAL CHEMISTRY FOR EDUCATORS3 Credits**

This course will examine basic principles in quantitative, organic, and biochemistry with the aim of learning how to teach these subjects in a high school classroom. Lesson planning, activity development, scientific literacy, critical thinking skills, and active learning will be incorporated in the class.

**Prerequisites:** CHEM 131, 131L and CHEM 132, 132L

**Co-requisites:** CHEM 313L

**CHEM 313L QUANTITATIVE, ORGANIC, AND BIOLOGICAL CHEMISTRY FOR EDUCATORS LABORATORY1 Credit**

The lab will be a mixture of inquiry-based lessons and direct instruction labs. Students will receive hands-on experience that guide them through concepts taught in lecture. Inquire-based learning labs will allow students to develop their own experiments that are safe to teach in a high school classroom.

**Prerequisites:** CHEM 131, 131L and 132, 132L

**Co-requisites:** CHEM 313

**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 333 ORGANIC CHEMISTRY I3 Credits**

An introduction to the structure, nomenclature, stereochemistry, properties, synthesis, and reactions of aliphatic and aromatic carbon 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.

**Co-requisites:** CHEM 333

**CHEM 334 ORGANIC CHEMISTRY II3 Credits**

A continuation of Organic Chemistry I. Topics will include a systematic study of organic reactions by functional group, reaction mechanisms, and organic synthetic methods.

**Prerequisites:** CHEM 333, 333L and sophomore or above status

**Co-requisites:** CHEM 334L

**CHEM 334L ORGANIC CHEMISTRY II LABORATORY1 Credit**

An introduction to laboratory techniques and procedures of synthetic organic chemistry including analysis of organic compounds by infrared spectroscopy, mass spectrometry, and nuclear magnetic resonance spectroscopy.

**Prerequisites:** CHEM 333, 333L and sophomore or above status

**Co-requisites:** CHEM 334

**CHEM 335 BIOCHEMISTRY I3 Credits**

Introductory course covering the components and reactions of living matter. Topics include structure and function of major macromolecules including carbohydrates, lipids, proteins, and nucleic acids. The basics of enzyme functions and regulation will be studied. A brief introduction to metabolic pathways will be included.

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

**Notes:** Concurrent enrollment in CHEM 335L is recommended.

**CHEM 335L BIOCHEMISTRY LABORATORY1 Credit**

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

**Prerequisites:** CHEM 335

**Co-requisites:** CHEM 335 (can be taken as either a pre-requisite or a co-requisite)

**CHEM 336 BIOCHEMISTRY II3 Credits**

Fundamental concepts of the chemistry of proteins, carbohydrates, lipids, and nucleic acids with emphasis on metabolic pathways of these compounds. The interrelationship of these compounds in living systems will be presented through bioenergetics, reaction pathways, regulatory pathways, and chemical mechanisms.

**Prerequisites:** CHEM 335 and Sophomore or above status

**CHEM 341 QUANTITATIVE ANALYSIS3 Credits**

Detailed study of classical analytical chemistry with topics to include; measurement and uncertainty, statistical analysis of data, basics of chemical equilibrium, activity and systematic treatment of complex equilibrium systems, acid-base equilibrium and buffers, EDTA titrations, gravimetric analysis, combustion analysis, and spectrophotometry.

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

**Co-requisites:** CHEM 341L

**CHEM 341L QUANTITATIVE ANALYSIS LABORATORY1 Credit**

Laboratory experience designed to improve laboratory skills in the qualitative analysis of matter using gravimetric and volumetric techniques.

**Prerequisites:** Sophomore or above status

**Co-requisites:** CHEM 341

**CHEM 342 INSTRUMENTAL ANALYSIS3 Credits**

Examination of the function and use of chemical instrumentation to analyze samples with emphasis on the use of spectrophotometers (UV/vis, IR, AA, mass spec), chromatographs (HPLC, GC), electrodes and potentiometry, and electrophoretic systems.

**Prerequisites:** CHEM 132, 132L or consent of instructor

**Co-requisites:** CHEM 342L

**CHEM 342L INSTRUMENTAL ANALYSIS LABORATORY1 Credit**

Laboratory experience involving the set-up and use of quantitative instrumentation in support of the topics covered in the lecture section of the course (spectrophotometry, chromatography, pH and Ion Specific electrodes, and electrophoresis).

**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.

**Essential Studies:** SLO #12

**Prerequisites:** CHEM 310 and 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.

**Essential Studies:** SLO #12

**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.

**Add Consent:** Instructor Consent

**CHEM 430 INORGANIC CHEMISTRY3 Credits**

Advanced principles of inorganic chemistry. Structure, bonding, properties, and reactions of inorganic compounds with emphasis on the relationships and trends that are embodied in the periodic table of the elements.

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

**CHEM 433 ENVIRONMENTAL CHEMISTRY3 Credits**

Study of the chemical processes that influence the environment, including processes which affect the quality and use of land, water, and atmosphere, as well as influence of anthropogenic effects on them. Focuses on topics of current concern.

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

**CHEM 433L ENVIRONMENTAL CHEMISTRY LABORATORY1 Credit**

Laboratory experience in environmental chemical analysis of environmental samples.

**Prerequisites:** CHEM 433 (can be taken as either a pre-requisite or a co-requisite)

**CHEM 444 PHYSICAL CHEMISTRY3 Credits**

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

**Prerequisites:** CHEM 132 and CHEM 132L

**Co-requisites:** CHEM 444L

**CHEM 444L PHYSICAL CHEMISTRY LABORATORY1 Credit**

Laboratory experience in thermodynamics and kinetics.

**Co-requisites:** CHEM 444

**CHEM 464 PHYSICAL CHEMISTRY II3 Credits**

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

**Prerequisites:** CHEM 444 and CHEM 444L

## 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

**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 132 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 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 138 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

**Co-requisites:** GEOS 138L

**GEOS 138L ASTRONOMY LABORATORY1 Credit**

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

**Essential Studies:** SLO #6

**Co-requisites:** GEOS 138

**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 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 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 245 FIELD SAMPLING TECHNIQUES3 Credits**

Practical field skills applicable to geological and environmental studies developed through field exercises in the Pine Ridge Region or the home region of the student. Results presented in both oral and written formats. Students will learn to convey their knowledge to a variety of audiences, including professional colleagues, government agencies, and the general public.

**Prerequisites:** GEOS 137 or GEOS 234, GEOS 234L and GEOS 231, GEOS 231L

**Co-requisites:** GEOS 245L

**GEOS 245L FIELD SAMPLING TECHNIQUES LABORATORY1 Credit**

During the laboratory, the practical field skills discussed in Field Sampling Techniques lecture will be applied to field exercises in the Pine Ridge Region or the home region of the student.

**Co-requisites:** GEOS 245

**GEOS 246 GEOLOGY FIELD CAMP I3 Credits**

The online part of this course introduces workplace health, safety, environmental impacts and regulations, professionalism and ethics, and quality assurance/quality control in data collection. The field portion will build observation and interpretation skills and introduce technical aspects of field mapping, stratigraphic interpretation and structural analysis. Students will prepare field notes, maps, stratigraphic charts, cross sections, and reports while interacting with geological problems in the Great Plains and Rocky Mountains.

**Prerequisites:** GEOS 231, GEOS 231L, GEOS 234, GEOS 234L

**Notes:** Taught concurrently with GEOS 346.

**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 312 PLANETARY GEOLOGY FOR EDUCATORS3 Credits**

This course will provide an overview of planetary geology, which will include a discussion on the Solar System, our understanding of the physical compositions of other planetary bodies, a look at the Earth and its unique atmosphere, the atmospheres of other planets in our system, and small bodies present in the Solar System. Students will learn about the geological techniques employed to learn about other planets and moons as well as the technology used to investigate space.

**Co-requisites:** GEOS 312L

**GEOS 312L PLANETARY GEOLOGY FOR EDUCATORS LABORATORY1 Credit**

This course will provide an overview of planetary geology, which will include a discussion on the Solar System, our understanding of the physical compositions of other planetary bodies, a look at the Earth and its unique atmosphere, the atmospheres of other planets in our system, and small bodies present in the Solar System. Students will learn about the geological techniques employed to learn about other planets and moons as well as the technology used to investigate space.

**Co-requisites:** GEOS 312

**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 325 ENERGY AND THE ENVIRONMENT3 Credits**

A deep survey of the science and technology behind fossil fuels, nuclear, and renewable energy sources. Participants will research the origins of energy resources and the technologies that put them to use. The class will develop a code of energy ethics.

**Essential Studies:** SLO #9

**Prerequisites:** Junior status and permission of instructor

**Add Consent:** Instructor Consent

**Notes:** Students will produce a personal project documenting achievement of Essential Studies outcome 9. If that outcome is already satisfied, students may petition to get credit for Essential Studies outcome 6.

**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, CHEM 132 and CHEM 132L or CHEM 140 and CHEM 140L, and Sophomore or above status

**GEOS 346 GEOLOGY FIELD CAMP I13 Credits**

The online part of this course teaches mineral and energy exploration, and measuring quantity and quality of resources. The field portion will build observation and interpretation skills and reinforce technical aspects of field mapping, stratigraphic interpretation and structural analysis. Student will prepare field notes, maps, stratigraphic charts, cross sections, and reports while interacting with geological problems in the Great Plains and Rocky Mountains.

**Prerequisites:** GEOS 246 or GEOS 245 and GEOS 245L

**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 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 HYDROGEOLOGY3 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.

**Prerequisites:** Junior or above status

**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 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

**PHYS 151 COLLEGE PHYSICS I3 Credits**

Principles of mechanics, sound, thermodynamics, and fluid mechanics.

**Prerequisites:** MATH 134, MATH 135, MATH 138, MATH 142, MATH 151, or MATH 232

**Co-requisites:** PHYS 151L

**PHYS 151L COLLEGE PHYSICS I LABORATORY1 Credit**

Laboratory exercises in College Physics I.

**Co-requisites:** PHYS 151

**PHYS 152 COLLEGE PHYSICS II3 Credits**

Principles of electricity, magnetism, light, optics and modern physics.

**Prerequisites:** PHYS 151 and PHYS 151L

**Co-requisites:** PHYS 152L

**PHYS 152L COLLEGE PHYS II LABORATORY1 Credit**

Laboratory exercises in College Physics II.

**Co-requisites:** PHYS 152

**PHYS 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.

**PHYS 241 UNIVERSITY PHYSICS I4 Credits**

The principles of mechanics, heat and sound. Differential and integral calculus applied.

**Prerequisites:** MATH 252

**Co-requisites:** PHYS 241L

**PHYS 241L UNIVERSITY PHYSICS I LABORATORY1 Credit**

Laboratory exercises in University Physics I.

**Co-requisites:** PHYS 241L

**PHYS 242 UNIVERSITY PHYSICS II4 Credits**

Principles of magnetism, electricity, and optics. Differential and integral calculus applied.

**Prerequisites:** PHYS 241 and PHYS 241L

**Co-requisites:** PHYS 242L

**PHYS 242L UNIVERSITY PHYS II LABORATORY1 Credit**

Laboratory exercises in University Physics II.

**Co-requisites:** PHYS 242

**PHYS 320 SUPERVISED STUDY IN LAB AND FIELD METHODS1-2 Credits**

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

**Cross-Listed:** BIOL/CHEM/GEOS/PHYS320

**Prerequisites:** Sophomore or above status

**PHYS 471 J INDEPENDENT STUDY OR RESEARCH1-3 Credits**

Study or research in an area of special interest.

**Prerequisites:** Junior or above status

**Add Consent:** Instructor Consent

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

**Requirements:** Permission of instructor and School Dean is required.