# Earth Science

The study of Earth Science draws primarily on geology and meteorology with additional attention to the fields of oceanography and life history. The traditional background for Earth Science focuses on mathematics and the quantitative aspects of science. The contemporary study and practice of Earth Science includes the qualitative evaluation and understanding of earth processes.

Both the quantitative and qualitative factors are applied in decision-making processes that range from plans for worldwide concerns, such as global warming, and for natural disasters, such as earthquakes and floods, to evaluation of a building site for a home. Earth Science is also a companion field of study for hydrologists and environmental scientists and for related careers in government, business, and industry.

**Programs**

- Geography, B.S. (Earth Science Emphasis) *major*
- Science Education, B.S. (Earth and Space Science Specialty (Teacher Licensure)) *major*
- Earth Science *minor*

**Career Directions**

Federal/State Agent
Industry/Business Consultant
Park Naturalist
Science Curriculum Coordinator
Also: Graduate Study

**Preparation**

*Recommended High School Courses*
Algebra
Biology
Chemistry
Physics
Trigonometry

## Geography, B.S. *major*
## Earth Science Emphasis

A total of 120 semester credits are needed for the **Geography, Earth Science emphasis B.S.** degree and include the following:

- 40 upper division credits (level 3000/4000)
- 48 required major core credits
- Completion of Core Curriculum credits (Minnesota Transfer Curriculum [MnTC] Goal Areas 1-10) - required for all baccalaureate degrees
- Completion of BSU Focus and Nisidotaading Course Requirements

Dual Degrees
Students wishing to complete two degrees concurrently, (example: Bachelor of Science and Bachelor of Arts) must complete a minimum of an additional 30 credits above the required 120 credits.

Multiple Credentials
Any additional major, minor or certificate in a degree must have at least 6 credits of course work not used to meet the requirements of another major, minor or certificate in the degree.

Required Credits: 48
Required GPA: 2.25

**I REQUIRED CORE COURSES**

Complete the following courses:

- BUAD 2231 Business Statistics I (3 credits)
  *or* PSY 3401 Basic Statistics for Research (4 credits)
  *or* STAT 2610 Applied Statistics (4 credits)
- ENGL 2150 Technical Writing (3 credits)
  *or* ENGL 3150 Writing In The Disciplines (3 credits)
- GEOG 3231 Introduction to Geographic Information Systems (3 credits)
- GEOG 3232 Intermediate Geographic Information Systems (3 credits)
- GEOG 3410 Geography of North America (3 credits)
  *or* GEOG 3800 Regional Geography (1-3 credits)
  *or* GEOG 3810 Geography of Europe (3 credits)
  *or* GEOG 3820 Geography of East, South, and Southeast Asia (3 credits)
  *or* GEOG 3840 Geography of Africa (3 credits)
  *or* GEOG 3850 Geography of the Middle East (3 credits)
  *or* GEOG 3860 Geography of Latin America and the Caribbean (3 credits)
  *or* GEOG 3870 Planning for Sustainable Cities (3 credits)
- GEOG 4265 Spatial Analysis (3 credits)

**II EARTH SCIENCE EMPHASIS**

REQUIRED EMPHASIS CORE

Complete the following courses:

- GEOG 2100 Introduction to Physical Geography (3 credits)
- GEOG 4130 Biogeography (3 credits)
- GEOG 4140 Landscape Ecology (3 credits)
- GEOG 4910 Directed Independent Study (3 credits)
  *or* GEOG 4970 Internship (3 credits)
  *or* GEOG 4990 Thesis (3 credits)
- GEOL 1110 Physical Geology (4 credits)
- GEOL 2110 Crystals, Minerals and Rocks (4 credits)

EARTH SCIENCE ELECTIVES
Select 3 courses from the following, or related upper division courses as approved in advance by advisor:

- BIOL 3120 Soils (4 credits)
  *or* GEOL 3120 Soils (4 credits)
- BIOL 3361 Limnology (4 credits)
- BIOL 3730 Plant Diversity (4 credits)
- BIOL 3840 Wetlands Ecology (3 credits)
- BIOL 4623 Forest Ecology (4 credits)
- ENVR 3040 Environmental Economics (3 credits)
- ENVR 3600 Environmental Justice and Sustainability (3 credits)
- GEOG 3125 Weather and Climate (3 credits)
- GEOG 3630 Conservation Biology (3 credits)
  *or* BIOL 3630 Conservation Biology (3 credits)

- GEOL 1120 Intro to Fossils and History of Planet Earth (4 credits)
- GEOL 3211 Environmental Hydrology (3 credits)
- GEOL 3212 Hydrogeology (3 credits)
- GEOL 3400 Glacial and Pleistocene Geology (3 credits)
- GEOL 3500 Topics in Paleontology (3 credits)
- GEOL 3600 Stratigraphy and Sedimentation (3 credits)
- GEOL 3700 Environmental Geophysics (3 credits)
- GEOL 4300 Global Environmental Change (3 credits)

**III SPATIAL METHODS ELECTIVES**

Select 1 of the following courses:

- GEOG 3226 Cartography (3 credits)
- GEOG 3255 Introduction to Remote Sensing (3 credits)
- GEOG 4190 Qualitative Methods in Geographic Research (3 credits)
- GEOG 4275 Advanced Geographic Information Systems (3 credits)
- STAT 3610 Time Series Analysis (3 credits)

**Program Learning Outcomes | Geography, B.S.**

1. Geographic Understanding: Students will have an understanding of the nature of Geography as an academic discipline, including familiarity with its history and principal sub-fields, concepts are introduced in Geog 1400, and core courses.

2. Thematic Geographic Knowledge: Students will demonstrate understanding of Geography as a spatial science within its various sub-disciplines.

2.1. Competence in the Basic Concepts of Human Geography: Students will show proficiency in this area by meeting specific performance metrics in Geog 2200 and another upper division Human Geography Elective.

2.2. Competence in the Basic Concepts of Physical Geography: Students will show proficiency in this area by meeting performance metrics in Geog 2100 and another upper division Physical Geography Elective.

2.3. Competence in the Basic Concepts of Economic Geography: Students will show proficiency in this area by meeting performance metrics in Geog 2300.

2.4. Competence in the Basic Concepts of Planning: Students will show proficiency in this area by meeting performance metrics in Geog 2400 and another upper division Planning Courses.

3. Understanding the Basic Concepts of Geospatial Analysis: Students will show proficiency in this area by meeting performance metrics all classes requiring both quantitative and qualitative analysis.

3.1. Demonstrate confidence with GIS Software: Demonstrate a competency in selected geographic techniques and/or methods: Relevant Courses: Geog3231, Geog3232, Geog 4275.

3.2. Apply GIS skills in a related Geography Course: Demonstrate the ability to use and integrate GIS into research and project development non-GIS classes.

4. Basic Understanding of Regional Concepts: Students will appreciate how Geography's unique spatial perspective is essential for understanding historical, cultural, and demographic patterns in different world regions. Upper Division Regional courses, Geog3810, 3820, 3830, 3850.

5. Effective Communication: Students will display competency in written expression with respect to clarity, logical expression, and effective argument.

6. General Geographic Research Skills: Students will apply basic research skills, including the ability to {a} critically evaluate the research of others and {b} develop a coherent, thoughtful analysis of these findings. (Typically applies to shorter paper projects, not full term projects for the assessment criteria)

6.1. Competence in Geographic Research: Conceive, develop and produce a term project that involves a précis or abstract, an annotated bibliography and a review of academic literature presented in a coherent, well-developed articulate thesis or independent study project. (Assessments suited to full term projects).

7. Practical Experience - Internship: Students will acquire knowledge and skills sufficient to allow one to pursue advanced study in Geography or find employment in Geography-related fields, including but not limited to those involving urban and regional planning.

## Science Education, B.S. *major*
## Earth and Space Science Specialty (Teacher Licensure)

A total of 120 semester credits are needed for the **Science Education, Earth and Space Science specialty (Teacher Licensure) B.S.** degree and include the following:

- Completion of a minimum of 40 upper division credits (level 3000/4000)
- Completion of all required major credits
- Completion of Core Curriculum credits (Minnesota Transfer Curriculum [MnTC] Goal Areas 1-10 with a minimum of 40 credits) required for all baccalaureate degrees
- Completion of BSU Focus and Nisidotaading Course Requirements

Dual Degrees
Students wishing to complete two degrees concurrently, (example: Bachelor of Science and Bachelor of Arts) must complete a minimum of an additional 30 credits above the required 120 credits.

Multiple Credentials
Any additional major, minor or certificate in a degree must have at least 6 credits of course work not used to meet the requirements of another major, minor or certificate in the degree.

Required Credits: 86
Required GPA: 2.50

**Core Courses for Science Teaching in Grades 5-8**

Complete the following courses:

- BIOL 1400 Cellular Principles (4 credits)
  *or* BIOL 1110 Human Biology (4 credits)
- BIOL 1500 Diversity of Life (4 credits)
  *or* BIOL 1120 General Biology: Evolution And Ecology (3 credits)
- CHEM 2211 Principles of Chemistry I (4 credits)
  *or* CHEM 1111 General Chemistry I (4 credits)
- CHEM 2212 Principles of Chemistry II (4 credits)
  *or* CHEM 1112 General Chemistry II (4 credits)
- GEOL 1110 Physical Geology (4 credits)
- SCI 3100 Integrative Science for Teachers (4 credits)
- SCI 3450 Science Methods For Grades 5-8 (4 credits)
  *or* ED 3410 Secondary Science Methods (4 credits)

**REQUIRED PROFESSIONAL EDUCATION COURSES**

Complete the following courses with a minimum 2.50 GPA:

- ED 3100 Introduction to the Foundations of Public School Education (3

credits)
- ED 3110 Educational Psychology (3 credits)
- ED 3140 Human Relations In Education (3 credits)
- ED 3350 Pedagogy: Planning for Instruction (3 credits)
- ED 3780 Adaptation and Management: Designing the Learning Environment (3 credits)
- ED 4737 Content Area Reading (3 credits)
- ED 4799 The Professional Teacher (1 credit)

Complete the following course:

- HLTH 3400 Health and Drugs in Society (2 credits)

Complete 12 credits of student teaching:

- ED 4830 Student Teaching - Secondary (1-12 credits)

**EARTH AND SPACE SCIENCE SPECIALTY**

Complete the following courses:

- ENVR 2000 Introduction to Environmental Science (3 credits)
- GEOL 1120 Intro to Fossils and History of Planet Earth (4 credits)
- GEOL 2110 Crystals, Minerals and Rocks (4 credits)
- GEOL 3500 Topics in Paleontology (3 credits)
- GEOL 3600 Stratigraphy and Sedimentation (3 credits)
- PHYS 2000 Astronomy (3 credits)

Select 1 of the following courses:

- GEOL 3211 Environmental Hydrology (3 credits)
- ENVR 4050 Geochemistry (3 credits)

Select 1 of the following courses:

- GEOL 4970 Internship (3 credits)
- GEOL 4980 Research (3 credits)

## Earth Science *minor*

The Earth Science minor is designed to support other fields such as geography, biology, and chemistry. The program will complement and enhance many majors, but does not in and by itself lead to a career choice.

Multiple Credentials
Any additional major, minor or certificate in a degree must have at least 6 credits of course work not used to meet the requirements of another major, minor or certificate in the degree.

Required Credits: 23
Required GPA: 2.00

**I REQUIRED COURSES**

COMPLETE THE FOLLOWING COURSES:

- BIOL 3630 Conservation Biology (3 credits)
- GEOL 1110 Physical Geology (4 credits)
- GEOL 1120 Intro to Fossils and History of Planet Earth (4 credits)
- GEOL 3211 Environmental Hydrology (3 credits)
- SCI 2200 Meteorology (3 credits)

**II REQUIRED ELECTIVES**

SELECT 2 OF THE FOLLOWING COURSES:

- GEOL 2110 Crystals, Minerals and Rocks (4 credits)
- GEOL 2730 Introduction to Planetary Science (4 credits)
- GEOL 3212 Hydrogeology (3 credits)
- GEOL 3400 Glacial and Pleistocene Geology (3 credits)
- GEOL 3500 Topics in Paleontology (3 credits)
- GEOL 3600 Stratigraphy and Sedimentation (3 credits)
- GEOL 3700 Environmental Geophysics (3 credits)
- GEOL 3120 Soils (4 credits)
  *or* BIOL 3120 Soils (4 credits)

## Biology Courses

**BIOL 1110 Human Biology (4 credits)**
General introduction to biology, focusing on humans, including topics on cell biology, genetics, molecular biology, form and function of organ systems, and the interaction between humans and their environment. Intended for nonbiology majors. Lecture and laboratory. [Core Curriculum Goal Area 3 (LC)]

**BIOL 1111 Anatomy and Physiology for Allied Health I (4 credits)**
This course is designed as the first semester of a year-long human anatomy and physiology course for allied health students including nursing and community health. The course covers aspects of the structure, function, and development of the human body from the cellular level through an introduction to the nervous system. Both lecture and laboratory are required.

**BIOL 1112 Anatomy and Physiology for Allied Health II (4 credits)**
This course is designed as the second semester of a year-long human anatomy and physiology course for allied health students including nursing and community health. The course covers aspects of the structure, function, and development of the human body from the nervous system through digestion and nutrition. Both lecture and laboratory are required. Prerequisite: BIOL 1111.

**BIOL 1120 General Biology: Evolution And Ecology (3 credits)**
A general introduction to biology with an emphasis on evolution, ecology, and the diversity of life. Intended for nonbiology majors. Includes laboratory simulations and field exercises. [Core Curriculum Goal Area 3 and 10]

**BIOL 1300 Medical Terminology (2 credits)**
A study of anatomical and medical terminology by examining word roots, prefixes, and suffixes. Designed to assist pre-professional and allied health students who desire to increase their usage and understanding of medical terminology. This course does not satisfy any Biology major or minor degree requirements.

**BIOL 1400 Cellular Principles (4 credits)**
Lecture | An introduction to the structure and function of living systems, with an emphasis on basic mechanisms and concepts in biochemistry and in cellular and molecular biology. Intended for biology majors and minors, preprofessional students, and open to any student wishing to fulfill their Core Curriculum requirement. Lecture and laboratory. [Core Curriculum Goal Area(s) 3 (LC)]

**BIOL 1410 Cellular Principles Lab (0 credit)**
Lab | An introduction to the structure and function of living systems, with an emphasis on basic mechanisms and concepts in biochemistry and in cellular and molecular biology. Intended for biology majors and minors, preprofessional students, and open to any student wishing to fulfill their Core Curriculum requirement. Lecture and laboratory. [Core Curriculum Goal Area(s) 3 (LC)] Student must register for BIOL 1400 (Lecture) and BIOL 1410 (Lab).

**BIOL 1500 Diversity of Life (4 credits)**
Lecture | An introduction to living organisms, with an emphasis on the basic mechanisms and concepts in organismal biology, ecology, and evolutionary biology. Topics include taxonomy and classification of the major groups of plants and animals, structure and function, development, and behavior. Intended for biology majors and minors, preprofessional students, and open to any student wishing to fulfill their Core Curriculum requirement. [Core Curriculum Goal Area 3 (LC)] Student must register for BIOL 1500 (Lecture) and BIOL 1510 (Lab).

**BIOL 1510 Diversity of Life Lab (0 credit)**
Lab | An introduction to living organisms, with an emphasis on the basic mechanisms and concepts in organismal biology, ecology, and evolutionary biology. Topics include taxonomy and classification of the major groups of plants and animals, structure and function, development, and behavior. Intended for biology majors and minors, preprofessional students, and open to any student wishing to fulfill their Core Curriculum requirement. [Core Curriculum Goal Area 3 (LC).]

**BIOL 2110 Human Anatomy and Physiology (5 credits)**
The structure, function, and development of the human body. Lecture and laboratory. Prerequisite(s): BIOL 1400 or BIOL 1500.

**BIOL 2339 Ethics of Fish and Wildlife Management (3 credits)**
This class is designed to explore the ethical aspects of various fish and wildlife management related topics in order to better understand how ethical viewpoints at both the social and political levels have influenced natural resource policy throughout history at the local, regional, and global scales. [Core Curriculum Goal Area 9]

**BIOL 2360 Genetics (4 credits)**
Fundamental principles of heredity in plants, animals, and microorganisms. Includes both classical and molecular genetic approaches to studying organisms. Prerequisites: BIOL 1400.

**BIOL 2610 General Ecology (3 credits)**
Introduction to the interrelationships of organisms and their environments, emphasizing the historic development of fundamental principles at the levels of individual, population, community, and ecosystem through examination of theoretical and empirical findings. Prerequisites: BIOL 1110, 1120 or BIOL 1400, 1500 or consent of instructor.

**BIOL 2750 Medical Microbiology (3 credits)**
Introduction to pathogenic microorganisms, the interaction of pathogens and the immune system, transmission of infections, and methods of controlling infections. The laboratory portion of the class covers aseptic technique, pure culture techniques, microscopy, and diagnostic microbiology. This course is intended primarily for Nursing majors. Prerequisites: (BIOL 1110 or BIOL 1111 or BIOL 1400) and (CHEM 1110 or CHEM 1111 or CHEM 2211)

**BIOL 2925 People of the Environment: Biological Perspectives (3 credits)**
Discussion and evaluation of current environmental biology topics, including biodiversity, ecosystems, biological resources, and human impact on the environment. This course fulfills Core Curriculum requirements only and does not satisfy and Biology major or minor degree requirements. [**Core Curriculum Goal Area(s) 10]

**BIOL 3074 Molecular Techniques (2 credits)**
This is a hybrid lecture and lab-based course and is an introduction to several common molecular-based techniques. Students will learn basic pipetting, protein assays, electrophoresis, PCR, and other molecular genetic techniques. Prerequisite(s): BIOL 1400, BIOL 2360, CHEM 2211, CHEM 2212; or consent of instructor.

**BIOL 3075 Cellular Techniques (2 credits)**
This course is the one of two options for completion of techniques core requirement for the BCMB major and for specific Biology majors. Includes an introduction to cell culture, cell imaging, cell-based assays, and stem cell biology. Prerequisite(s): BIOL 3074 or BCMB 3074.

**BIOL 3120 Soils (4 credits)**
Introduction to principles of soil genesis, classification, physical and chemical properties, and biological significance. Lecture and laboratory. Prerequisites: (BIOL 1400 or BIOL 1120) and (GEOL 1110 or BIOL 1500) or consent of instructor. May not be offered every year.

**BIOL 3150 Animal Behavior (3 credits)**
Introduction to the study of the diversity, physiology, ecological context, and evolutionary development of behavior of invertebrate and vertebrate animals. Prerequisite: BIOL 1400 and BIOL 1500, or PSY 1100.

**BIOL 3170 Dendrology (2 credits)**
The main function of a dendrology class is to learn the identification and basic ecology of woody plants (trees, shrubs, woody vines) for a region, along with the basic vocabulary used to describe woody plants. Prerequisite(s): (BIOL 1400, 1500, and 2610) or consent of instructor.

**BIOL 3250 Human Anatomy (4 credits)**
Anatomical structure of the human body, from individual organ systems to the integrated whole. BIOL 1400.

**BIOL 3260 Human Physiology (4 credits)**
Physiological and pathophysiological principles and control mechanisms of organ systems within humans. Lecture and laboratory. Prerequisites: BIOL 1400 and (CHEM 1111 or CHEM 2211); or consent of instructor.

**BIOL 3299 Virology (3 credits)**
This course explores virology, which is the study of viruses that infect all manner of life on earth. We will focus on animal viruses and those that impact human health. Important discoveries from viruses that infect microbes, plants, and non-human animals will be included. Prerequisite(s): One year introductory biology or consent of instructor.

**BIOL 3300 Introduction to Hematology (4 credits)**
Introduction to the principles of blood cell formation, function, and associated disorders. Lecture and Laboratory. Prerequisites: BIOL 1400, CHEM 2211, and CHEM 2212. BIOL 2360 or BIOL 3380 is recommended.

**BIOL 3310 Entomology (3 credits)**
The biology of insects and their importance. Prerequisites: BIOL 1400 and BIOL 1500, or consent of instructor.

**BIOL 3337 Science Communication (3 credits)**
Explores the foundations of scientific thinking and communication and develops practical skills in finding, understanding, and thinking critically about scientific results and consensus. [BSU Focus: Performance and Participation]

**BIOL 3338 Science Communication Lab (1 credit)**
All students in the Biology Baccalaureate Partnership at North Hennepin Community College are expected to co-enroll in this 1 credit face-to-face section on the NHCC campus when taking BIOL 3337 online. The on-campus discussion section will cover supplementary topics and material and is intended to build scientific community and communications skills among the BBP cohort. The lab section will not impact the main course grades. Co-requisite BIOL 3337.

**BIOL 3339 Bioethics (3 credits)**
In this online Bioethics course we will grapple with the many philosophical, ethical, and practical questions created by advances in medicine and biology using a combination of readings, case studies, scientific literature, and popular culture. The course has undergraduate and graduate sections and is intended for students in their Junior year of college or later. Topics include prenatal testing, abortion, assisted suicide, human augmentation/transhumanism, cloning, disability rights, animal rights, genetically modified organisms, and environmental ethics. [Core Curriculum Goal Area(s) 9]

**BIOL 3361 Limnology (4 credits)**
Introduction to the biology, chemistry, geology, and physics of lakes and streams. Lecture, field, and laboratory work. Prerequisites: BIOL 1400, BIOL 1500, BIOL 2610, CHEM 1111 or CHEM 2211, CHEM 1112 or CHEM 2212, or consent of instructor.

**BIOL 3362 Streams and Rivers (4 credits)**
An introduction to the physical characteristics, chemistry, and biology of lotic systems such as streams and rivers. Includes information on morphology, hydrology, and alteration of these natural systems. Includes laboratory simulations and field exercises. Lecture and laboratory. Prerequisites: BIOL 1400 and BIOL 1500, or consent of instructor.

**BIOL 3380 Molecular Genetics (3 credits)**
Study of the structure, replication, repair, expression, regulation, and change of genetic material. Introduction to theory and procedures by which recombinant DNA molecules are formed, cloned, and expressed. Prerequisites: BIOL 1400 and BIOL 2360.

**BIOL 3400 Fish & Wildlife Law and Administration (3 credits)**
This course is for majors in natural resources, biology, and related fields. The lectures throughout the course will cover the history, philosophy, evolution, and application of these laws in the management of fish, wildlife, and other renewable resources for the benefit of the public. The course concludes with contemporary economic, administrative and political aspects of fish and wildlife management. The course fulfills some certification requirements of The Wildlife Society and the American Fisheries Society and is recommended for students planning graduate study or employment in natural resources management. Prerequisite: BIOL 2610.

**BIOL 3420 Human Dimensions of Wildlife and Fisheries Management (3 credits)**
This course is for majors in natural resources, biology, and related fields. The lectures throughout the course will cover the history, philosophy, evolution, and application of human dimensions in wildlife and fisheries management. The course fulfills some certification requirements of The Wildlife Society and the American Fisheries Society and is recommended for students planning graduate study or employment in natural resources management. Prerequisite: BIOL 2610.

**BIOL 3580 Immunology (3 credits)**
The study of disease fighting mechanisms of the innate and adaptive immune systems. Prerequisites: BIOL 2360 and one year of chemistry.

**BIOL 3590 Cell Biology (3 credits)**
Microscopic anatomy and physiological mechanisms of plant and animal cells. Gene control of cellular metabolism, mechanism of energy utilization in cells and pathways of synthesis of molecules. Prerequisites: (BIOL 2360 or BIOL 3380) and (CHEM 2211, CHEM 2212) or consent of instructor.

**BIOL 3610 Principles of Wildlife Management (3 credits)**
Introduction to the field of wildlife management, including the biological principles important to the understanding of wildlife populations and the management strategies implemented by natural resource managers. Prerequisite(s): BIOL 1500 and BIOL 2610.

**BIOL 3630 Conservation Biology (3 credits)**
Principles and theories of conservation biology. Topics include biodiversity, threats to biodiversity, extinctions, management of threatened and endangered species, managing habitats for conservation, and methods to mitigate biodiversity loss. Prerequisites: BIOL 1400 and BIOL 1500, or consent of instructor. Also GEOG 3630.

**BIOL 3710 Microbiology (4 credits)**
Structure, classification, and physiology of bacteria and related microorganisms. Lecture and laboratory. Prerequisites or Corequisites: One year introductory biology and one year introductory chemistry or consent of instructor.

**BIOL 3720 Plant Form and Function (4 credits)**
Structure, function, and development of vascular plants. Interrelationships between anatomical structures and physiological processes and how plants cope with environmental challenges. Lecture and laboratory. Prerequisites: BIOL 1400, 1500 and one year of college chemistry or consent of instructor.

**BIOL 3723 Ecosystem Ecology (3 credits)**
Fundamentals of the study of ecosystems, with emphasis on the integration of abiotic and biotic components in the development of ecosystem processes. Comparisons and interactions between terrestrial, wetland, aquatic, and atmospheric systems across the major biomes. Prerequisite: BIOL 2610.

**BIOL 3730 Plant Diversity (4 credits)**
Classification, phylogeny, collection, field identification, and uses of wild plants. Lecture and laboratory. Prerequisites: BIOL 1400 and BIOL 1500 or consent of instructor.

**BIOL 3830 Aquatic Plants and Algae (4 credits)**
Survey of the morphology, physiology, taxonomy, systematics, and ecology of algae and aquatic vascular plants. Lecture, laboratory, and field study. Prerequisites: BIOL 1400 and BIOL 1500.

**BIOL 3840 Wetlands Ecology (3 credits)**
Survey course develops a basic understanding of the terminology, classification, ecology, values, and conservation of wetlands. Covers wetland systems from around the world, with emphasis on wetlands in North America. Prerequisites: BIOL 1400 and BIOL 1500, or consent of instructor.

**BIOL 3844 Wetlands Ecology Lab (1 credit)**
Laboratory course to supplement BIOL/ENVR 3840 Wetlands Ecology. Intended to strengthen a basic understanding of the terminology, classification, ecology, values, and conservation of wetlands. Prerequisite or Corequisite: BIOL/ENVR 3840 or consent of instructor.

**BIOL 3850 Marine Biology (3 credits)**
Lecture course introducing major concepts and theories. Includes physical and chemical components of the oceans, with special interest paid to the major groups of organisms living in marine systems. Emphasis on the different types of marine systems (coral reefs, mangroves, open water, etc.). Prerequisites: BIOL 1400 and 1500. Might not be offered every year.

**BIOL 4030 Wetland Delineation and Classification (3 credits)**
This training course for the identification, delineation, and classification of wetlands covers the major types of wetlands and their general delineation procedures. Hydrological, soil, and vegetation characteristics will be used to identify and map wetland boundaries. Focuses on current regulations as established by the US Army Corps of Engineers' 1987 Wetland Delineation Manual with additional regulations specific for the state of Minnesota. Satisfies the requirements for basic delineation training as specified by the Corps of Engineers and certification programs in many states. Prerequisites: BIOL 1400, 1500, or consent of instructor.

**BIOL 4200 Freshwater Invertebrates (4 credits)**
Morphology and functional roles of representative freshwater invertebrates and their ecological interrelationships. Lecture and laboratory. Prerequisite: BIOL 1400, BIOL 1500, BIOL 3361, BIOL 3362, and junior status, or consent of instructor.

**BIOL 4210 Parasitology (4 credits)**
The biology of animal parasites, their identification, biochemistry, immunology, and epidemiology. Lecture and laboratory. Prerequisites: BIOL 1400, 1500, or consent of instructor.

**BIOL 4270 Histology (4 credits)**
Microscopic anatomy of vertebrate tissues and organs with functional correlations. Lecture and laboratory. Prerequisites: BIOL 1400 and BIOL 1500, BIOL 3250, and BIOL 3260. Might not be offered every year.

**BIOL 4330 Upland Wildlife Management (3 credits)**
An advanced pre-professional course for majors in natural resources, biology, and related fields. Lectures cover the history, philosophy, evolution, and application of wildlife management with a focus on upland wildlife as a renewable, sustainable natural resource. The course fulfills some professional certification requirements of The Wildlife Society and is recommended for students planning graduate study or employment in natural resources management. Prerequisite: BIOL 3610.

**BIOL 4360 Developmental and Tumor Biology (3 credits)**
Investigation of the mechanisms leading to the development of multicellular animal organisms from a fertilized egg. In contrast, the course also investigates how cells within a multicellular organism can become misregulated, leading to cancer. Prerequisites: BIOL 1400, BIOL 2360.

**BIOL 4447 Genomics (3 credits)**
Genomics is the study of the content, structure, organization, evolution, and conservation of whole genomes. Because of its reliance on precision instrumentation and scale, and the unprecedented volume of data produced, genomics is unusual among biological disciplines in its integration of engineering, statistics, and information science. Genomics also requires the biologist to engage in systems thinking by taking a wide view of the dynamic physical and informational network that comprises a single genome. One must further consider the human genome as itself a component of an even larger network of genomes that make up the holobiont-that's us plus our always-changing resident community of microbial pals. After covering these and other topics, and carrying out a substantial genome annotation project for the lab component of the course, we explore personal genomics, or how all this information and understanding affects our lives as 21st century human beings. Prerequisite: BIOL 2360.

**BIOL 4448 Genomics Lab (2 credits)**
All students in the Biology Baccalaureate Partnership at North Hennepin Community College are expected to co-enroll in this 2 credit face-to-face section on the NHCC campus when taking BIOL4447 online. This lab section consists of a hands-on genome annotation project in collaboration with the national Genomics Education Partnership, as well as practice using other bioinformatics tools and databases. Prerequisites: BIOL2360, co-enrollment with BIOL4447.

**BIOL 4449 Gene Expression (4 credits)**
While mutations in genomic DNA play a major role in human health and disease, the control of gene expression plays the pivotal role in establishing developmental patterning, cellular differentiation, responsiveness to environmental stimuli, and defense against pathogens and invasive genetic elements. Changes in genomic DNA over time are a key driver of evolution, but the control of gene expression is also a major generator of species diversity and a driver of genome structure and function. Chromosomes in eukaryotic nuclei are made up of a combination of DNA and proteins packaged and compacted into a composite called chromatin-in turn, chromatin structure and modification determines whether a gene is "open" for transcription or closed. One of the most efficient and well-characterized systems for studying the relationship between chromatin and gene expression is the so-called position effect variegation (PEV) in the compound eye of Drosophila melanogaster, in which the variable expression of a reporter transgene allows reproducible measurement of gene expression in response to genetic and environmental factors. We will use a combination of classroom and laboratory approaches to understand and complete original research projects using this system. Successful completion of this course satisfies BSU Biology's capstone requirement. Prerequisite: BIOL 2360.

**BIOL 4460 Stem Cells and Regenerative Medicine (3 credits)**
This course is designed as an introduction to stem cell biology and the medical applications of stem cells including in the field of regenerative medicine. Prerequisite(s): BIOL 2360.

**BIOL 4470 Introduction to Vaccinology (4 credits)**
This course will introduce students to the field of vaccinology and aspects of the bioscience industry related to vaccine discovery, production, and testing. Students will learn about the history of vaccines; the production of vaccines in a regulated environment; the benefits and concerns with vaccine use. The course will include a discussion of vaccine types, delivery, efficacy, and safety. Students will learn about the mechanism of action of different vaccines; traditional verses modern vaccine production methods, the process of clinical trials and approval for new vaccines; and discuss ethical concerns related to vaccine use. Prerequisite(s): BIOL 2360.

**BIOL 4510 Ornithology (3 credits)**
Morphology, ecology, behavior, classification, distribution, and evolution of birds. Lecture, laboratory, and field study (early morning field trips and one or two all-day field trips). Prerequisites: BIOL 1500 and BIOL 2610, or consent of instructor.

**BIOL 4520 Mammalogy (3 credits)**
Morphology, ecology, behavior, classification, distribution, and evolution of mammals. Lecture and laboratory. Prerequisite(s): BIOL 1500 and BIOL 2610, or consent of instructor.

**BIOL 4530 Ecology and Management of Large Mammals (3 credits)**
Large mammals are socially and ecologically important components of the landscape and are intensively managed by wildlife agencies and private landowners. The primary focus of the course will be on life-histories, investigative techniques, and management of the major large mammals in Minnesota; white-tailed deer, black bear, wolves, moose, and elk. Biology, management, and research of large mammals from the western United States (i.e., mule deer, cougar, bison, pronghorn antelope, bighorn sheep, brown bear, etc.) will also be discussed. Students will be introduced to current issues concerning the political and social aspects of big game management. Prerequisite(s): BIOL 3610.

**BIOL 4534 Ichthyology (4 credits)**
An overview of morphology, physiology, behavior, taxonomy, systematics, and ecology of fishes. This course emphasizes the evolution of ecological adaptations and the origin and conservation of biodiversity. Lecture, laboratory, and field work. Prerequisites: BIOL 1400 and BIOL 1500, or consent of instructor.

**BIOL 4545 Fisheries Management (4 credits)**
Theory and methods of fisheries management with an emphasis on quantitative methods and ecosystem management. Lecture and extensive field and laboratory work. Prerequisites: BIOL 3361 and BIOL 3362, or consent of instructor.

**BIOL 4620 Evolution (3 credits)**
Patterns and processes of biological evolution. Topics include phylogenies, speciation, extinctions, biogeography, adaptations, sexual selection, and behavior, with an emphasis on vertebrates and invertebrates. Prerequisite: BIOL 2360 or consent of instructor.

**BIOL 4623 Forest Ecology (4 credits)**
Fundamentals of forest ecology, including study of tree growth, tree demography, forest community dynamics, and ecosystem processes. Students also learn to identify forest trees native to the region and basic techniques of forest stand description. Prerequisite: BIOL 2610 or consent of instructor. Might not be offered every year.

**BIOL 4715 Clinical Microbiology (3 credits)**
Clinical techniques used to identify medically important microorganisms will be examined. Correlate the presence of microorganisms to health and disease. Prerequisite(s): BIOL 3710.

**BIOL 4780 Wildlife Management Techniques (5 credits)**
This course emphasizes application of ecological principles, knowledge, and practical field skills to data collection used in the management of wildlife resources and their habitats. Use of literature, development of basic field and laboratory skills, and application of management and research principles are integral. Designed for upper level students who have met prerequisites, and graduate students, who are preparing for professional careers in wildlife conservation, natural sciences, and related areas of natural resources management. The course helps fulfill The Wildlife Society professional certification requirements. Prerequisite: BIOL 3610.

**BIOL 4800 Advanced Project Certification (0 credit)**
A course designed to document a students successful completion of a professional or graduate school entrance exam, with a student placing in at least the 60th percentile. This course is one of the options for completing the capstone project requirement in Biology.

**BIOL 4894 Advanced Research Project I (2 credits)**
This course provides a culminating experience that integrates the knowledge and skills learned in previous courses and applies them to a scholarly activity. Examples of an advanced research project may include an original research project, internship, or shadowing experience with a professional. Prerequisite: Junior status and consent of instructor.

**BIOL 4895 Advanced Research Project II (2 credits)**
This course is a continuation of BIOL 4894 for students who undertake a year-long research project. The course provides a culminating experience that integrates the knowledge and skills learned in previous courses and applies them to a scholarly activity. Examples of an advanced research project may include an original research project, internship, or shadowing experience with a professional. Prerequisite: Junior status and consent of instructor.

**BIOL 4898 Fisheries Research I (2 credits)**
Independent field projects based on the background and interests of the students and the instructor. Designed to give students experience developing original research objectives, designing methods, collecting data, and writing a research manuscript that conveys that research to their peers. Prerequisites: Completion of the Area II required writing course for the B.S. or B.A. Biology major, junior status and consent of instructor.

**BIOL 4899 Fisheries Research II (2 credits)**
This course is a continuation of BIOL 4898. It is designed to give students experience analyzing data, drawing conclusions, completing and preparing a research manuscript for publication, and developing an oral presentation for a professional meeting. Prerequisites: BIOL 4898, Completion of the Area II required writing course for the B.S. or B.A. Biology major, junior status and consent of instructor.

**BIOL 4917 DIS Tchg Assoc | (1-2 credits)**
Directed Independent Study | Teaching Associate

### All-University Courses

The course numbers listed below, not always included in the semester class schedule, may be registered for by consent of the advisor, instructor, or department chair, or may be assigned by the department when warranted. Individual registration requires previous arrangement by the student and the completion of any required form or planning outline as well as any prerequisites.

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## Geography Courses

**GEOG 1224 Introduction to Map Use (3 credits)**
This course is designed for the core curriculum and provides an introduction to common characteristics and social aspects for the use of map media. Topographic maps will be used for physical analysis as well as to discern cultural and economic features of landscapes. Thematic maps, their use and applications will be presented. Includes some study out-of-doors with map and compass. [Core Curriculum Goal Area(s) 5 & BSU Focus: Performance and Participation.]

**GEOG 1400 World Regional Geography (3 credits)**
A survey of physical, cultural, and economic aspects of world regions. An introduction to how constituent parts of the world differ from one another in their associated resources, cultures and economics. Attention is given to the interrelationships, interdependencies, and associations that bind together the diverse communities of the world. [Core Curriculum Goal Areas 7 & 10]

**GEOG 2100 Introduction to Physical Geography (3 credits)**
This course is designed for the core curriculum program and provides an introduction to spatial patterns derived from earth system processes. The course provides a systematic survey of landforms, weather and climate, soils and vegetation. This course utilizes a combination of in class discussion and laboratory-like exercises to investigate these topics. [Core Curriculum Goal Area(s) 3 & 10.]

**GEOG 2200 Introduction to Human Geography (3 credits)**
Emphasizes the study of geographical relationships and interactions of cultural, social, economic, ethnic, and political phenomena. Topical approach to population subgroups, religions, languages, urban and rural settlements, and other attributes of the cultural landscape. [Core Curriculum Goal Area(s) 7 & 8.]

**GEOG 2400 Introduction to Planning (3 credits)**
This course is designed for the core curriculum program and provides information on the background and fundamentals of the community planning process. Includes discussion of contemporary issues in physical, environmental and social planning. Emphasis is on the local and subregional levels. [Core Curriculum Goal Area(s) 5 & 9.]

**GEOG 2925 People of the Environment: Geography Perspective (3 credits)**
An integrative study of the natural, social, value-based, and citizen-action contexts for environmental awareness. The disciplinary component surveys geographic approaches to and institutional settings for environmental problems and decision making, including our spatial behaviors as either sources or recipients of environmental impacts. Interdisciplinary perspectives are evaluated in light of different geographic concepts of spatial distributions, physical geography, and regional planning. [Core Curriculum Goal Area(s) 7 & 10.]

**GEOG 3125 Weather and Climate (3 credits)**
Weather is the study of the atmosphere over short time scales, while climate is the study of long-term weather trends. The study of weather is commonly termed meteorology, which is actually a branch of physics associated with fluid dynamics. Climate is associated with statistical procedures and analyses. This course examines the geographic patterns and processes of global climate and weather, as well as topics such as global climate change, global climate models, and extreme weather events. Students learn about the Earth's atmosphere; energy budgets and astronomical controls on weather processes; oceanic and atmospheric circulation; the basic atmospheric parameters; atmospheric hazards such as tornadoes, hurricanes, hail, and lightning; and global climate change issues. [Core Curriculum Goal Area(s) 3 (LL) & 10]

**GEOG 3226 Cartography (3 credits)**
This course provides a more integrated, practical link between cartographic theory and practice for users of GIS. This course blends theoretical discussion of GIS as a science and GIS as a software application and addresses through lecture and laboratory work map productions for a variety of audiences. A particular focus of this course is on quality communication through maps. Experience with GIS software is essential. Prerequisite: GEOG 3231.

**GEOG 3231 Introduction to Geographic Information Systems (3 credits)**
This course develops a proficiency in basic GIS skills for those new to GIS. The premise of the course revolves around analytical problem solving using spatial data and techniques. The course also focuses on graphic communication of quantitative data including cartographic mapping concepts and data classification. This course concentrates on learning to navigate the current version of ArcGIS software at a beginner's level and developing and creating maps as communication tools. [Core Curriculum Goal Area 4.]

**GEOG 3232 Intermediate Geographic Information Systems (3 credits)**
An intermediate course on the theories and application of GIS for spatial data management and analysis, thematic mapping, environmental modeling. This course expands on the concepts and methods presented in Introduction to GIS and guides students through a more comprehensive overview of principles and techniques used in GIS. Course objectives include (1) enhance and build knowledge of GIS as a system and science, (2) improve skills at GIS analysis, and (3) develop and improve problem solving skills. Prerequisite: GEOG 3231 or consent of instructor.

**GEOG 3255 Introduction to Remote Sensing (3 credits)**
Analysis of a special class of pictures that provide an overhead perspective. These images have unique properties that provide a distinct advantage to assessing spatial changes and patterns of change on the Earths surface. Students develop an understanding and the skills necessary for interpreting air photos, satellite, and remotely sensed images. Prerequisite: GEOG 3231 or consent of instructor.

**GEOG 3400 Economic Geography (3 credits)**
This course helps students understand the world's increasingly complex economic interdependence by examining issues confronting the Global Economy today. This course looks at countries' economic and social well-being, their relationships to other countries and internal and global economic patterns of productivity, wealth and development. The course also has a focus on the use of economic data and analytical methods in order to investigate spatial patterns of economic distribution, difference, and networks of production and consumption. [Core Curriculum Goal Area(s) 5 & 9]

**GEOG 3410 Geography of North America (3 credits)**
A regional analysis of the physical, demographic, economic and cultural characteristics of the nations in North America. [Core Curriculum Goal Area(s) 5 & 7.]

**GEOG 3531 Political Geography (3 credits)**
This course utilizes "World Systems Theory" to investigate 1) theories of State formation and organization; 2) historical processes of imperialism, colonialism, and decolonization; 3) major issues of the emerging political economy; 4) historical and contemporary geopolitics; and 5) the political geography of everyday life.

**GEOG 3532 Political Ecology (3 credits)**
Political ecology utilizes a necessary geographical perspective to understand and analyze the biophysical processes that shape issues otherwise inadequately conceptualized as political, economic or social. This spatial understanding developed by political geographers reveals relationships of the ecological and the political that are simultaneously mutually reinforcing and, often, mutually antagonistic. Prerequisite: GEOG 3531 or consent of instructor.

**GEOG 3550 Site and Resource Analysis in Planning (3 credits)**
This course emphasizes techniques and methods in the location, analysis, evaluation, and design of sites, focusing on identifying use potentials and impact limitations for planning and management. Prerequisite: GEOG 2400 or consent of instructor.

**GEOG 3560 Metropolitan Land Use Planning (3 credits)**
An examination of the identification and inventory methods of land use analysis including the designing of land use models which are compatible with environmental, social, and economic goals. Prerequisites: GEOG 2100, GEOG 2400, or consent of instructor. Prior completion of or concurrent enrollment in either GEOG 3550 or GEOG 3570 is recommended.

**GEOG 3570 Public Lands Planning (3 credits)**
Comparison and evaluation of natural resource management policies and analytical techniques of the U.S. Forest Service, Bureau of Land Management, National Park Service and U.S. Fish and Wildlife Service. Attention is paid to the historical and contemporary land management approaches used to protect, exploit, manage, and/or use public lands in the United States. Especially relevant are jurisdictional issues over public land, federal agencies involved in land management, state and local issues and land management, and contemporary issues associated with land management in the 21st Century. Prerequisites: GEOG 2400 and GEOG 3550, or consent of instructor.

**GEOG 3580 Regional Development Planning (3 credits)**
An examination of methods and processes emphasizing contemporary relationships between planners and governments, the private sector, and nongovernmental organizations regarding relationships between regions nationally and internationally, with special attention to environmental sustainability. Prerequisite(s): GEOG 2400 or consent of instructor.

**GEOG 3630 Conservation Biology (3 credits)**
Principles and theories of conservation biology. Topics include biodiversity, threats to biodiversity, extinctions, management of threatened and endangered species, managing habitats for conservation, and methods to mitigate biodiversity loss. Prerequisites: BIOL 1400 and BIOL 1500, or consent of instructor. Also BIOL 3630.

**GEOG 3800 Regional Geography (1-3 credits)**
A regional and topical analysis of the cultural and physical features of a continent or major region of the earth. May be repeated provided different regions are involved. Note: Recommended for students in international studies, foreign languages, and for prospective teachers in the humanities or social studies.

**GEOG 3810 Geography of Europe (3 credits)**
A regional analysis of Europe emphasizes both the physical and cultural environments across the continent. We explore the regional differentiation of economic and political affairs throughout different regions. Examine the population distributions, natural resources, and the ever-interweaving globalized world. [Core Curriculum Goal Area(s) 5 & 8.]

**GEOG 3820 Geography of East, South, and Southeast Asia (3 credits)**
This course is designed to provide a more in depth look at Asian sub regions of South, East and Southeast Asia. Geographically, we will examine and analyze activities in this part of the world through cultural, demographic, political, economic, urban and geopolitical lenses. [Core Curriculum Goal Area(s) 5 & 8]

**GEOG 3840 Geography of Africa (3 credits)**
Despite persistent bias about it, Africa's cultural complexity, social dynamism, and political/economic struggle have tremendous relevance for the study of global trends at the start of the twenty-first century. The central purpose of this course is to demonstrate that relevance by investigating the cultural, historical, economic, and political dimensions of change in Africa. [Core Curriculum Goal Area(s) 5 & 8]

**GEOG 3850 Geography of the Middle East (3 credits)**
This course is designed to provide a more in depth look at the region we routinely describe as the Middle East. Geographically, we will examine activities in SW Asia and the nations of North Africa. We may extend our discussion to the countries of Afghanistan, the Sudan, South Sudan and Turkey to provide a more comprehensive analysis of a particular topic or subtopic. This is a highly complex region and may be looked at from numerous perspectives. Our objective thus is to examine the region through economic, cultural, environmental, urban and geopolitical lenses. [Core Curriculum Goal Area(s) 5 & 8]

**GEOG 3860 Geography of Latin America and the Caribbean (3 credits)**
This course is designed to provide a more in depth look at the region of Latin America and the Caribbean. We recognize at the outset that this is a broad subject and may be looked at from numerous perspectives. Our objective thus is to examine this geographic region through economic, cultural, environmental, urban and political lenses. [Core Curriculum Goal Area(s) 5 & 8]

**GEOG 3870 Planning for Sustainable Cities (3 credits)**
Using a World Regional Geography approach, this course examines the dynamics of urban development across the globe, with particular reference to sustainable urban design and urban biodiversity. Political, cultural, environmental and economic influences on the city are examined in both the developed and the developing world. [Core Curriculum Goal Area 5]

**GEOG 4130 Biogeography (3 credits)**
This course examines the distribution and diversity of flora and fauna across multiple scales. It will focus on the factors that shape and influence these patterns and investigate the role of disturbance in this process. It will also incorporate both field and lab experiences to further examine the key concepts of biogeography. Prerequisites: GEOG 2100 and GEOG 3231.

**GEOG 4140 Landscape Ecology (3 credits)**
This course examines the connection of pattern and process at the scale of the landscape. Students will utilize several analytical methods to examine and explain how humans, disturbance and natural process work in concert to create landscape-level dynamics and change. The course will also cover how landscape ecology is applied to assist in conservation efforts. Prerequisites: GEOG 2100 and GEOG 3231.

**GEOG 4150 Applications of Machine Learning (3 credits)**
The uses of machine learning, data science and artificial intelligence are everywhere today. Much of the data we create through our daily activities gets processed and used to customize services, offer better health care, or target you for specific advertising. Although there are many benefits of using data in these ways, there can be pitfalls and caution is always warranted when employing these tools. As such this class attempts to teach you the basic foundations of machine learning with particular emphasis to its application in environmental and spatial analysis. To this end, we will use the python development environment and we will emphasize the most commonly used tools including supervised learning algorithms (logistic regression, linear regression, neural networks), unsupervised learning algorithms (k- means, principal component analysis). In addition, we also cover anomaly detection, natural language processing and building recommender systems. A central focus will be building this foundation so students can successfully participate in a Kaggle competition which is a premier venue for testing your machine learning skillset.

**GEOG 4190 Qualitative Methods in Geographic Research (3 credits)**
As a geographic perspective becomes increasingly important in analysis of critical issues at multiple scales from the local to the global, this course demonstrates how research grounded in qualitative methodologies encourages innovative approaches and yields significant insights. Prerequisite: GEOG 2200. While not required, it is highly recommended that GEOG 4210 and GEOG 4265 be taken previously or concurrently.

**GEOG 4210 The History and Development of Geographic Thought (3 credits)**
Development of the discipline of Geography with emphasis on both the historical and recent developments in the field. Includes a critical analysis of writing of representative geographers.

**GEOG 4265 Spatial Analysis (3 credits)**
An examination in the concepts and application of advance spatial statistical methodologies. These include, kriging, spatial autocorrelation, spatial regression models, and cluster analysis. Prerequisites: STAT 2610 or PSY 3401 or BUAD 2231 and GEOG 3231.

**GEOG 4275 Advanced Geographic Information Systems (3 credits)**
This course will give students hands on experience working with advanced geodatabases, the basic automation and scripting of geospatial processes, web mapping, and server side application in GIS. Prerequisites: GEOG 3231 and GEOG 3232.

**GEOG 4910 Directed Independent Study (3 credits)**
Arranged individual study.

**GEOG 4917 DIS Tchg Assoc | (1-2 credits)**
Directed Independent Study | Teaching Associate

**GEOG 4930 Experimental Course (3 credits)**
A course proposed for inclusion in the University curriculum. May not be offered more than two times as an experimental course.

**GEOG 4970 Internship (3 credits)**
Graded Satisfactory/Unsatisfactory only. Student internships may be either full-time or part-time in a public or private agency appropriate to the degree objective. Internships consist of closely supervised periods of service that are arranged in advance of the course registration. Students should consult their advisor concerning prerequisites.

**GEOG 4980 Research (3 credits)**
Research carried out by the student that is based on appropriate methodology and scholarship.

**GEOG 4990 Thesis (3 credits)**
Working individually with a thesis advisor, the student produces a Geography thesis. The thesis must be a scholarly piece of work, based on empirical or archival research of a geographical issue (physical, demographic, economic, cultural, and/or political) of present or future relevance. The end product is a documented essay of at least minimally required length and format that must be approved by the advisor and at least one other member of the Geography Department after a brief oral defense.

### All-University Courses

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## Geology Courses

**GEOL 1110 Physical Geology (4 credits)**
Physical geology is the study of the Earth system, minerals, rocks, the processes that operate upon Earth, the landforms that originate from them. Natural hazards and mineral resources are also studied. The course will demonstrate that the planet is a completely integrated, continually evolving and dynamic system. The course is also aimed to create an awareness of how it affects our life and our responsibility to the planet and its future. Lecture and laboratory. [Core Curriculum Goal Area(s) 3 & 10 (LC)]

**GEOL 1120 Intro to Fossils and History of Planet Earth (4 credits)**
The course focuses on the study of fossils and the application of fundamental geologic principles to decipher Earth's history: understanding Earth materials and processes, fossils identification and classification, geologic time, and the conditions that led to the major events (extinctions, diversifications, and environmental transitions) in the history of life. Lecture and laboratory. [Core Curriculum Goal Area 3 (LC)]

**GEOL 2110 Crystals, Minerals and Rocks (4 credits)**
The course provides understanding of how crystals and crystalline structures are formed, as well as minerals and igneous and metamorphic rocks. It includes learning to use tools and diagnostic tests for identification of minerals in hand samples and in the polarizing microscope and other instruments. The course also includes the study of the genesis, classification, and identification of igneous, and metamorphic rocks. Finally, the potential of a region to produce mineral resources is discussed. Lecture and laboratory. [Core Curriculum Goal Area 3 (LC)]

**GEOL 2730 Introduction to Planetary Science (4 credits)**
An introduction to the solar system and its components. The course includes a discussion of missions, devices, and technologies for its exploration. It also involves the study of star evolution, laws, and principles for movement of celestial objects: planets, satellites, asteroids, comets, and meteorites. Analysis of physical characteristics and geological features of planets and moons of the solar system. Introduction to exoplanets and the search for life. Finally, a discussion of the solar system evolution, Planet Earth's future and human influence is included. Lecture and laboratory. [Core Curriculum Goal Area 3 (LC)]

**GEOL 2925 People of the Environment: Earth Science Perspective (3 credits)**
Application of the Earth Sciences in understanding the causes of, and solutions to, environmental problems. Environmental perspectives on geologic hazards.

**GEOL 3120 Soils (4 credits)**
Introduction to principles of soil genesis, classification, physical and chemical properties, and biological significance. Lecture and laboratory. Prerequisites: (BIOL 1400 or BIOL 1120) and (GEOL 1110 or BIOL 1500) or consent of instructor. May not be offered every year.

**GEOL 3211 Environmental Hydrology (3 credits)**
The course provides a basic understanding of the principles and processes governing the movement of water through the hydrologic cycle, including atmospheric moisture flow, surface runoff, infiltration, and groundwater flow. Environmentally relevant applications based on case studies will be studied. The course include coverage of contemporary global issues related to water resources, sustainable development, and climate change. Prerequisites: GEOL 1110 and MATH 1170 or equivalent, or consent of instructor.

**GEOL 3212 Hydrogeology (3 credits)**
Groundwater flow to wells, aquifer test analysis, groundwater exploration techniques, application of computer models in groundwater studies, hydrogeologic field methods, contaminant hydrogeology, vadoze zone hydrology. Lecture and laboratory. Prerequisites: GEOL 3211 or consent of instructor. May not be offered every year.

**GEOL 3400 Glacial and Pleistocene Geology (3 credits)**
Modern concepts of glaciology and glacial geology. Interpretation of the phenomena and effects on the landscape. Lecture and laboratory. Prerequisite: GEOL 1110 or consent of instructor.

**GEOL 3500 Topics in Paleontology (3 credits)**
Introduction to major groups of organisms that are commonly preserved as fossils. Focus of class may vary between offerings; including invertebrate and vertebrate paleontology, introductory micropaleontology, palynology and pollen analysis. May be repeated as topics change. Lecture and laboratory. Prerequisite: GEOL 1120. (May not be offered every year.)

**GEOL 3600 Stratigraphy and Sedimentation (3 credits)**
Study of sedimentary rocks. Recognition of the physical and biologic factors affecting deposition. Introduction to stratigraphic principles. Lecture and laboratory. Prerequisites: GEOL 1110 or GEOL 1120, and GEOL 2110.

**GEOL 3700 Environmental Geophysics (3 credits)**
Introduction to geophysical processes and geophysical field methods commonly used in environmental evaluation. Interdisciplinary approach to an understanding of the physical environment. Lecture and laboratory. (Might not be offered every year.)

**GEOL 4300 Global Environmental Change (3 credits)**
This class offers an interdisciplinary introduction to the principles of climate, ecosystems, and biogeochemistry needed to understand human impacts on the natural environment. We will also discuss global change prediction and the scientific bases for global change assessments and policy measures. Key topics are the physical climate system and its variability, the carbon cycle and related biogeochemistry and ecosystem processes, land use issues, the interactions among climate, ecosystems, and biogeochemistry, and the impact of global change on societally relevant parameters. Common threads in all of these topics will pervade the whole semester; these include the use of observations and models, the consideration of multiple scales of change (temporal and spatial), the interaction of human behaviors and choices with natural systems, and the linkages among aspects of global change science (may not be offered every year). Prerequisites: ENVR 2000 or GEOG 2100 or Consent of Instructor.

**GEOL 4910 Directed Independent Study (3 credits)**
Arranged individual study.

**GEOL 4917 DIS Tchg Assoc | (1-2 credits)**
Directed Independent Study | Teaching Associate

**GEOL 4970 Internship (3 credits)**
Graded Satisfactory/Unsatisfactory only. Student internships may be either full-time or part-time in a public or private agency appropriate to the degree objective. Internships consist of closely supervised periods of service that are arranged in advance of the course registration. Students should consult their advisor concerning prerequisites.

**GEOL 4980 Research (3 credits)**
Research carried out by the student that is based on appropriate methodology and scholarship.

### All-University Courses

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## Science Courses

**SCI 1110 Exploring Science (4 credits)**
An interdisciplinary course incorporating the areas of biology, chemistry, earth science, and physics. Connections to everyday life and environmental issues will be emphasized. Includes a laboratory component. (LC) [Core Curriculum Goal Area 3 & 10.]

**SCI 2200 Meteorology (3 credits)**
A one-semester survey course, with emphasis on the science of the atmospheric dynamics of weather and climate, precipitation, storms, and forecasting. Includes laboratory simulations and field exercises.

**SCI 2925 People of the Environment: Science Perspective (3 credits)**
The discussions of this section will include the specific relation between air, water, and solid waste pollution and the effect on the environment, including the following: acid rain, smog, global warming, measurement of environmental pollutants, and the role of science in solving pollution problems.

**SCI 2951 Study-Travel Natural Science (1-6 credits)**
Study Travel course in Science.

**SCI 3100 Integrative Science for Teachers (4 credits)**
An interdisciplinary laboratory-based course incorporating the areas of biology, chemistry, earth science, and physics. Focuses on conducting a series of investigations by Science Inquiry and demonstrating the connection between the various disciplines. Prerequisites: 2 courses each in the life sciences and physical sciences.

**SCI 3450 Science Methods For Grades 5-8 (4 credits)**
Strategies for implementation of the Minnesota Graduation Standards in the areas of Science and Inquiry for grades 5-8. Strategies include laboratory activities, discussions, the development of classroom activities, and the adaptation of these strategies for use in the elementary and high school science classroom. Prerequisite: Senior status or consent of instructor.

**SCI 4917 DIS Tchg Assoc | (1-2 credits)**
Directed Independent Study | Teaching Associate

## All-University Courses

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