

Geology (GEOL)

The Department of Geosciences offers the Bachelor of Science degree in geology and the Bachelor of Science degree in earth science (<http://catalog.uark.edu/undergraduatecatalog/collegesandschools/jwilliamfulbrightcollegeofartsandsciences/earthsciences/>). It is emphasized that students wishing to become practicing professional geologists should hold the Bachelor of Science degree in geology at a minimum. It is further recognized that practicing professional geologists typically hold a Master of Science degree. The education of students pursuing the Bachelor of Science in earth science degree should reflect general education in the liberal arts with emphasis in geology.

The goal of the program leading to the Bachelor of Science degree in geology is to provide students with a broad spectrum of the various subdisciplines of geology, while at the same time honoring an emphasis in the traditional areas of mineralogy, igneous, metamorphic and sedimentary petrology, structural geology and stratigraphic principles. This curriculum will prepare students to enter graduate programs without deficiencies at the University of Arkansas or other established programs.

Along with the normal degree program, the department offers a B.S. in geology with a concentration in geophysics.

For requirements for the M.S. degree in geology, see the Graduate School Catalog (<http://catalog.uark.edu/graduatecatalog/programsofstudy/geosciencesdepartmentofgeos/>).

B.S. in Geology

Requirements for a Major in Geology leading to the B.S. Degree:

In addition to the state minimum core (<http://catalog.uark.edu/undergraduatecatalog/gened/stateminimum/>) and the Fulbright College of Arts and Sciences Graduation Requirements (<http://catalog.uark.edu/undergraduatecatalog/collegesandschools/jwilliamfulbrightcollegeofartsandsciences/>), the following course requirements must be met. **Bolded** courses from the list below may be applied to portions of the University Core requirements.

State Minimum Core	35
CHEM 14103 University Chemistry I (ACTS Equivalency = CHEM 1414 Lecture) and University Chemistry I Laboratory (ACTS Equivalency = CHEM 1414 Lab)	4
CHEM 14203 University Chemistry II (ACTS Equivalency = CHEM 1424 Lecture) and University Chemistry II Laboratory (ACTS Equivalency = CHEM 1424 Lab)	4
MATH 24004 Calculus I (ACTS Equivalency = MATH 2405)	4
MATH 25004 Calculus II	4
Select one physics sequence from the following:	8
PHYS 20103 College Physics I (ACTS Equivalency = PHYS & PHYS 20101 2014 Lecture) and College Physics I Laboratory (ACTS Equivalency = PHYS 2014 Lab)	
PHYS 20203 College Physics II (ACTS Equivalency = PHYS & PHYS 20101 2024 Lecture) and College Physics I Laboratory (ACTS Equivalency = PHYS 2014 Lab)	

or

PHYS 20304 University Physics I (ACTS Equivalency = PHYS 2034)	
PHYS 20404 University Physics II (ACTS Equivalency = PHYS 2044 Lecture)	
World language up to the Elementary II level	6
A science elective 30000-level or higher as approved by advisor	3
A minimum of 45 credit hours of geology courses to include:	45
GEOL 11103 Physical Geology (ACTS Equivalency = GEOL & GEOL 11101 1114 Lecture) and Physical Geology Laboratory (ACTS Equivalency = GEOL 1114 Lab)	
GEOS 23103 Mineralogy	
GEOS 34103 Sedimentary Geology	
GEOS 35104 Structural Geology	
GEOS 38703 Quantitative Methods in Earth Science	
GEOS 40503 Geomorphology	
GEOS 40603 Principles of Geochemistry or GEOS 44306 physics	
GEOS 42203 Stratigraphy and Sedimentation or GEOS 43106 Igneous and Metamorphic Petrology	
GEOS 46806 Geology Field Camp	
GEOS 49204 Earth System History	
Nine credit hours of geology courses chosen from GEOS electives 30000-level or higher	
General Electives	7-18
Total Hours	120

Writing Requirement: A scholarly writing assignment will be included in all geoscience courses numbered 2000 and above. Those papers submitted in geoscience courses 3000 and above will fulfill the Fulbright College writing requirement. The college writing requirement may also be met by the completion of an honors thesis.

Geology B.S. Nine-Semester Degree Program

State minimum core requirements may vary by individual, based on placement and previous credit granted. Once all core requirements are met, students may substitute with general electives. Students should consult with their academic advisor.

This program requires a summer field camp after the junior year.

First Year	Units		
	Fall	Spring	Summer
ENGL 10103 Composition I (ACTS Equivalency = ENGL 1013)	3		
MATH 24004 Calculus I (ACTS Equivalency = MATH 2405)	4		
GEOL 11103 Physical Geology (ACTS Equivalency = GEOL 1114 Lecture) & GEOL 11101 Physical Geology Laboratory (ACTS Equivalency = GEOL 1114 Lab)	4		

CHEM 14103 University Chemistry I (ACTS Equivalency = CHEM 1414 Lecture) & CHEM 14101 University Chemistry I Laboratory (ACTS Equivalency = CHEM 1414 Lab)	4		
ENGL 10203 Composition II (ACTS Equivalency = ENGL 1023)		3	
MATH 25004 Calculus II		4	
CHEM 14203 University Chemistry II (ACTS Equivalency = CHEM 1424 Lecture) & CHEM 14201 University Chemistry II Laboratory (ACTS Equivalency = CHEM 1424 Lab)		4	
U.S. History State Minimum Core		3	
General Electives		1	
Year Total:	15	15	

Second Year		Units	
	Fall	Spring	Summer
GEOS 23103 Mineralogy	3		
Select one of the following:	4		
PHYS 20304 University Physics I (ACTS Equivalency = PHYS 2034) or PHYS 20103/20101 College Physics I (ACTS Equivalency = PHYS 2014 Lecture)			
Social Sciences State Minimum Core	3		
Fine Arts State Minimum Core	3		
World language at the Elementary I level	3		
GEOS 34103 Sedimentary Geology		3	
Select one of the following:		4	
PHYS 20404 University Physics II (ACTS Equivalency = PHYS 2044 Lecture) or PHYS 20203/20201 College Physics II (ACTS Equivalency = PHYS 2024 Lecture)			
GEOS 38703 Quantitative Methods in Earth Science		3	
Social Sciences State Minimum Core		3	
World language at the Elementary II level		3	
Year Total:	16	16	

Third Year		Units	
	Fall	Spring	Summer
GEOS 42203 Stratigraphy and Sedimentation or GEOS 43303 Igneous and Metamorphic Petrology	3		
GEOS elective 30000-level or higher	3		
Social Sciences State Minimum Core	3		
General Electives	6		

GEOS 35104 Structural Geology	4		
GEOS 40503 Geomorphology	3		
Humanities State Minimum Core	3		
General Electives	5		
GEOS 46806 Geology Field Camp			6
Year Total:	15	15	6

Fourth Year		Units	
	Fall	Spring	Summer
GEOS 40603 Principles of Geochemistry or GEOS 44303 Geophysics	3		
GEOS electives 30000-level or higher	3		
Science elective 30000-level or higher	3		
General Electives	6		
GEOS 49204 Earth System History		4	
GEOS electives 30000-level or higher		3	
Year Total:	15	7	

Total Units in Sequence: 120

Requirements for B.S. in Geology With Geosciences Concentration

The following credit hour requirements must be met ([see Degree Completion Program Policy](#) for additional information). In addition, the Fulbright College Writing Requirement will be satisfied by completing the scholarly writing assignments in any GEOS course numbered 3000-level or higher, or by completion of an honors thesis.

State minimum core (<http://catalog.uark.edu/undergraduatecatalog/gened/statemimum/>) requirements may vary by individual, based on placement and previous course credit earned. Once all core requirements are met, students may substitute with general electives in consultation with their academic adviser.

State Minimum Core	35
CHEM 14103 University Chemistry I (ACTS Equivalency = CHEM 1414 Lecture) & CHEM 14101 University Chemistry I Laboratory (ACTS Equivalency = CHEM 1414 Lab)	4
CHEM 14203 University Chemistry II (ACTS Equivalency = CHEM 1424 Lecture) & CHEM 14201 University Chemistry II Laboratory (ACTS Equivalency = CHEM 1424 Lab)	4
PHYS 20304 University Physics I (ACTS Equivalency = PHYS 2034)	4
PHYS 20404 University Physics II (ACTS Equivalency = PHYS 2044 Lecture)	4
PHYS 20504 University Physics III	4
MATH 24004 Calculus I (ACTS Equivalency = MATH 2405)	4
MATH 25004 Calculus II	4
MATH 26004 Calculus III	4
MATH 25804 Elementary Differential Equations	4
46 credit hours in geosciences (GEOS) and physics (PHYS) courses from the following:	45

GEOL 11103 Physical Geology (ACTS Equivalency = GEOL & GEOL 11101 1114 Lecture) and Physical Geology Laboratory (ACTS Equivalency = GEOL 1114 Lab)	
GEOS 23103 Mineralogy	
GEOS 34103 Sedimentary Geology	
GEOS 35104 Structural Geology	
GEOS 40503 Geomorphology	
GEOS 42203 Stratigraphy and Sedimentation	
GEOS 44303 Geophysics	
GEOS 49204 Earth System History	
GEOS 46806 Geology Field Camp	
PHYS 31103 Analytical Mechanics	
PHYS 34503 Electromagnetic Theory I	
PHYS 36103 Modern Physics	
PHYS 40703 Introduction to Quantum Mechanics	
PHYS 49901 Physics Senior Seminar	
General Electives	4
Total Hours	120

Writing Requirement: A scholarly writing assignment will be included in all geoscience courses numbered 2000 and above. Those papers submitted in geoscience courses 3000 and above will fulfill the Fulbright College writing requirement. The college writing requirement may also be met by the completion of an honors thesis.

Eight-Semester Degree Plan for a Bachelor of Science in Geology with a Concentration in Geophysics

Students enrolling in the eight-semester degree plan should review the Eight-Semester Degree Completion Policy (<http://catalog.uark.edu/undergraduatecatalog/academicregulations/eightsemesterdegreecompletionpolicy/>).

State minimum core requirements may vary by individual, based on placement and previous credit granted. Once all core requirements are met, students may substitute with general electives in consultation with their academic advisor.

First Year	Units		
	Fall	Spring	Summer
ENGL 10103 Composition I (ACTS Equivalency = ENGL 1013) (Satisfies General Education Outcome 1.1) ¹	3		
MATH 24004 Calculus I (ACTS Equivalency = MATH 2405) (Satisfies General Education Outcome 2.1) ¹	4		
PHYS 20304 University Physics I (ACTS Equivalency = PHYS 2034) (Satisfies General Education Outcome 3.4) ¹	4		
CHEM 14103 University Chemistry I (ACTS Equivalency = CHEM 1414 Lecture) & CHEM 14101 University Chemistry I Laboratory (ACTS Equivalency = CHEM 1414 Lab)	4		

ENGL 10203 Composition II (ACTS Equivalency = ENGL 1023) (Satisfies General Education Outcome 1.1) ¹	3	
PHYS 20404 University Physics II (ACTS Equivalency = PHYS 2044 Lecture)	4	
MATH 25004 Calculus II	4	
GEOL 11103 Physical Geology (ACTS Equivalency = GEOL 1114 Lecture) & GEOL 11101 Physical Geology Laboratory (ACTS Equivalency = GEOL 1114 Lab)	4	
Year Total:	15	15

Second Year	Units		
	Fall	Spring	Summer
PHYS 20504 University Physics III	4		
MATH 25804 Elementary Differential Equations	4		
CHEM 14203 University Chemistry II (ACTS Equivalency = CHEM 1424 Lecture) & CHEM 14201 University Chemistry II Laboratory (ACTS Equivalency = CHEM 1424 Lab)	4		
GEOS 23103 Mineralogy	3		
PHYS 36103 Modern Physics		3	
MATH 26004 Calculus III		4	
GEOS 34103 Sedimentary Geology		3	
State Minimum Core—Fine Arts (Satisfies General Education Outcome 3.1) ¹		3	
State Minimum Core—U.S. History or Government (Satisfies General Education Outcome 4.2) ¹		3	
Year Total:	15	16	

Third Year	Units		
	Fall	Spring	Summer
PHYS 31103 Analytical Mechanics	3		
GEOS 42203 Stratigraphy and Sedimentation	3		
State Minimum Core—Social Science (Satisfies General Education Outcome 3.3) ¹	6		
State Minimum Core—Humanities (Satisfies General Education Outcomes 3.2 and 4.1) ¹	3		
GEOS 35104 Structural Geology		4	
GEOS 40503 Geomorphology		3	
State Minimum Core—Social Science		3	
General Electives (Choose one course that satisfies General Education Learning Outcome 5.1) ¹		5	
GEOS 46806 Geology Field Camp			6
Year Total:	15	15	6

Fourth Year	Units		
	Fall	Spring	Summer
PHYS 40703 Introduction to Quantum Mechanics	3		
GEOS 44303 Geophysics	3		
State Minimum Core—Social Science	3		
General Electives	6		
PHYS 34503 Electromagnetic Theory I		3	
PHYS 49901 Physics Senior Seminar		1	
GEOS 49204 Earth System History (Satisfies General Education Outcomes 1.2 and 6.1) ¹		4	
Year Total:	15	8	
Total Units in Sequence:	120		

¹ Students must complete the State Minimum Core (<https://nam11.safelinks.protection.outlook.com/?url=http%3A%2F%2Fcatalog.uark.edu%2Fundergradcatalog%2Fgeneral%2Fstateminimum%2F&data=04%7C01%7Ccc003%40uark.edu%7C92f936f375f845bf930708d8e3ec5fa1%7C79c742c4e61c4fa5be89a3cb566a80d1%7C0%7C0%7C637509951644018253%7CUnknown%7CTWFpbGZsb3d8eyJWljoiMC4wLjAwMDAilCJQljoiv2luMzIiLCJBtil6k1haWwlcjxw%3D&reserved=0>) and the requirements of their major(s) as outlined in the Catalog of Studies. These courses also fulfill many, if not all, of the General Education Requirements (<https://nam11.safelinks.protection.outlook.com/?url=http%3A%2F%2Fcatalog.uark.edu%2Fundergradcatalog%2Fgeneral%2Fgeneral%2F&data=04%7C01%7Ccc003%40uark.edu%7C92f936f375f845bf930708d8e3ec5fa1%7C79c742c4e61c4fa5be89a3cb566a80d1%7C0%7C0%7C637509951644018253%7CUnknown%7CTWFpbGZsb3d8eyJWljoiMC4wLjAwMDAilCJQljoiv2luMzIiLCJBtil6k1haWwlcjxw%3D&reserved=0>). Please visit these pages in the links provided and consult with your academic advisor when making course selections to fulfill these requirements.

Minor in Geology

Requirements for a Minor in Geology: A minor in geology shall be awarded upon completion of the following course work:

GEOL 11103 & GEOL 11101	Physical Geology (ACTS Equivalency = GEOL 1114 Lecture) and Physical Geology Laboratory (ACTS Equivalency = GEOL 1114 Lab)	4
GEOL 11203 & GEOL 11201	Earth Science (ACTS Equivalency = GEOL 1124 Lecture) and Earth Science Laboratory (ACTS Equivalency = GEOL 1124 Lab)	4
GEOS 23103	Mineralogy	3
Two GEOS Courses at the 3000-level		6
One GEOS Course at the 4000-level		3
Total Hours		20

Students are advised to consult with a geology faculty member to develop the course work program that best complements their major area of study.

Requirements for Departmental Honors in Geology: The Departmental Honors Program in Geology provides upper-division undergraduate students with an opportunity to formally participate in geologic research activities. Honors candidates carry out independent study and research under the guidance of the geology faculty. Outstanding student achievement will be recognized by awarding the distinction “Geology Scholar *Cum Laude*” at graduation. Higher degree distinctions may be awarded to truly outstanding students based upon the whole of their academic program and quality of honors research.

Honors candidates in geology must do the following:

1. Satisfy departmental and college requirements for a bachelor’s degree with honors,
2. Become a candidate no later than the second semester of their junior year,
3. Enroll in six hours of honors research GEOS 390H1, GEOS 391H1, GEOS 497H2, GEOS 498H2,
4. Take 12 hours in Honors Studies, which may include 6 hours of thesis,
5. Complete junior and senior honors courses GEOS 390H1, GEOS 391H1, GEOS 497H2, GEOS 498H2, and
6. Achieve a cumulative grade-point average of 3.30 in geology courses.

Teacher Licensure Requirements:

Students interested in pursuing a minor in STEM Education (<http://catalog.uark.edu/undergradcatalog/collegesandschools/collegeofeducationandhealthprofessions/stemeducation/#minorinstemeducationtext>) or a minor in STEM Education with Secondary Teacher Licensure in mathematics, biology, chemistry, physics, or computer science at the undergraduate level should consult with their assigned academic adviser or find more information at <http://stem.uark.edu/> (<http://stem.uark.edu/>). Another option to obtain secondary teacher licensure is to complete the one-year Master of Arts in Teaching (http://catalog.uark.edu/graduatecatalog/programs_of_study/teachereducation/).

Geology Courses

GEOL 11101. Physical Geology Laboratory (ACTS Equivalency = GEOL 1114 Lab). 1 Hour.

Laboratory exercises concerning the identification of rocks and minerals, use of aerial photographs and topographic maps, and several field trips. Pre- or Corequisite: GEOL 11103. (Typically offered: Fall, Spring and Summer)

GEOL 11103. Physical Geology (ACTS Equivalency = GEOL 1114 Lecture). 3 Hours.

Survey of geological processes and products, and their relationships to landforms, natural resources, living environments and human beings. Corequisite: GEOL 11101. (Typically offered: Fall, Spring and Summer)

GEOL 111H1. Honors Physical Geology Laboratory. 1 Hour.

Survey of geological processes and products and their relationships to landforms, natural resources, living environments, and human beings. Lecture 3 hours, laboratory 2 hours per week. Corequisite: GEOL 111H3. (Typically offered: Fall) This course is equivalent to GEOL 11101.

GEOL 111H3. Honors Physical Geology. 3 Hours.

Survey of geological processes and products and their relationships to landforms, natural resources, living environments, and human beings. Lecture 3 hours, laboratory 2 hours per week. Corequisite: GEOL 111H1. (Typically offered: Irregular)

This course is equivalent to GEOL 11103.

GEOL 11201. Earth Science Laboratory (ACTS Equivalency = GEOL 1124 Lab). 1 Hour.

Laboratory exercises concerning human interactions with the physical environment including the study of earthquakes, volcanoes, flooding, erosion, mass wasting, water supply and contamination, and waste disposal. (Typically offered: Fall and Spring)

GEOL 11203. Earth Science (ACTS Equivalency = GEOL 1124 Lecture). 3 Hours.

The application of earth science principles and knowledge of problems created by human occupancy and exploitation of the physical environment. (Typically offered: Fall and Spring)

Geosciences Courses

GEOS 11504. Introduction to Geology for Science Majors. 4 Hours.

Survey of geological processes and materials and their relationships to landforms, natural resources, environments, and human beings. Students will understand the principles of physical geology, Earth's internal structure, plate tectonics, and geologic time. Students may not receive degree credit for both GEOL 11103/GEOL 11101 and GEOS 11504. Corequisite: Lab component. Prerequisite: Freshman or sophomore standing, or by instructor consent. (Typically offered: Fall)

GEOS 23103. Mineralogy. 3 Hours.

General principles of mineralogy, study and identification of common minerals, igneous & metamorphic rocks using hand samples. Prerequisite: (GEOL 11103 or GEOS 11504) and CHEM 14103. Corequisite: Lab component. (Typically offered: Fall)

GEOS 28103. Digital Earth. 3 Hours.

This course introduces the fundamental concepts and practical geospatial techniques of the digital earth initiative. Students will learn how digital geographical information is produced (also referred to as geospatial data) and utilized in a variety of economic, environmental, and scientific applications. The class will concentrate on how digital geospatial data are produced, integrated and applied in daily life and will review a variety of environmental and socioeconomic applications. (Typically offered: Fall)

GEOS 281H3. Honors Digital Earth. 3 Hours.

This course introduces the fundamental concepts and practical geospatial techniques of the digital earth initiative. Students will learn how digital geographical information is produced (also referred to as geospatial data) and utilized in a variety of economic, environmental, and scientific applications. The class will concentrate on how digital geospatial data are produced, integrated and applied in daily life and will review a variety of environmental and socioeconomic applications. Prerequisite: Honors standing. (Typically offered: Fall)

This course is equivalent to GEOS 28103.

GEOS 30103. Foundations of Geospatial Data Analysis. 3 Hours.

Basic mathematical tools applied in geospatial technology, including trigonometry in mapping, linear algebra in remote sensing, optimization in spatial decision support, and graph theory in routing. Course develops the framework for spatial data analysis and decision support. Students may receive credit for the course through testing. Prerequisite: GEOS 35403. (Typically offered: Fall and Spring)

GEOS 30203. Introduction to Cartography. 3 Hours.

Students learn basic principles of map design, cartographic theory and field surveying to produce a variety of computer-generated maps. An introductory course designed for students in a variety of different disciplines using AutoCad software and various new technologies. Field trips may be required. (Typically offered: Fall)

GEOS 30403. Sustaining Earth. 3 Hours.

Theory and growth of conservation and sustainability, the wise use of the major natural resources of the United States. This course meets the requirement in conservation and sustainability for teachers. Prerequisite: Junior standing. (Typically offered: Fall)

GEOS 304H3. Honors Sustaining Earth. 3 Hours.

Theory and growth of conservation and the wise use of the major natural resources of the United States. This course meets the requirement in conservation for teachers. Prerequisite: Junior standing. (Typically offered: Fall)
This course is equivalent to GEOS 30403.

GEOS 30603. Geology of Arkansas. 3 Hours.

A survey of the distribution, genesis, and age of the rocks, fossils, structures, landforms and geological processes of Arkansas. Equivalent to two hours of lecture per week. Field trips required. Prerequisite: (GEOL 11103 or GEOL 111H3 or GEOS 11504). (Typically offered: Spring)

GEOS 30903. Speleology. 3 Hours.

An introduction to caving techniques and the science of caves. Covers basic caving equipment, safety, and cave conservation. Cave science (speleology) is covered at an introductory level across a range of disciplines. Field trips required. (Typically offered: Irregular)

GEOS 31003. Geospatial Technologies Computational Toolkit. 3 Hours.

Basic computational tools and processes applied in geospatial software, related computer hardware components, systems and applications software, and spatial database fundamentals. Python, including SciPy and NumPy, geospatial implementations will be emphasized. No programming experience is required. Students may receive credit for the course through testing. Prerequisite: GEOS 35403. (Typically offered: Fall and Spring)

GEOS 32103. Principles of Remote Sensing. 3 Hours.

Fundamental concepts of remote sensing of the environment. Optical, infrared, microwave, LIDAR, and in situ sensor systems are introduced. Remote sensing of vegetation, water, urban landscapes, soils, minerals, and geomorphology is discussed. The course includes laboratory exercises in GIS software and field spectroscopy. (Typically offered: Fall)

GEOS 33303. Oceanography. 3 Hours.

The sea, its landforms; its winds and currents as related to the atmosphere, world climates, and world trade; its basin as avenues for continental drift; its waters as habitat for plant and animal life; its marine and submarine resources as presently and potentially useful to man. Offered as physical science. Prerequisite: Junior standing. (Typically offered: Fall)

GEOS 34103. Sedimentary Geology. 3 Hours.

An introductory study of sedimentary rocks from the standpoint of classification, field and laboratory description, genesis, and preservation. Lecture 2 hours, laboratory 2 hours per week. Corequisite: Lab component. Prerequisite: GEOS 23103. (Typically offered: Spring)

GEOS 35104. Structural Geology. 4 Hours.

Survey of deformational features and their geological significance in the crust of the earth. Lecture 3 hours per week. Corequisite: Lab component. Prerequisite: GEOL 11103 or GEOS 11504. (Typically offered: Spring)

GEOS 35403. Geospatial Applications and Information Science. 3 Hours.

An introduction to the methods and theory underlying the full range of geographic information science and collateral areas - including GNSS, remote sensing, cadastral, spatial demographics and others. (Typically offered: Fall and Spring)
This course is cross-listed with ANTH 35403.

GEOS 35503. Spatial Analysis Using ArcGIS. 3 Hours.

Applications of analysis of spatial data using ArcGIS tools in map design, on-line mapping, creating geodatabases, accessing geospatial data, geo-processing, digitizing, geocoding, spatial analysis including basic spatial statistics, analysis of spatial distributions and patterning and 3D application using ArcGIS 3D Analyst. (Typically offered: Fall and Spring)

GEOS 35603. Geospatial Data Mining. 3 Hours.

Basic tools for analyzing, summarizing and visualizing geospatial data. Exploratory data and spatial data analysis, probability distributions and application, single and multivariate analysis and hypothesis testing, and spatial smoothing and interpolation. Emphasis will be on problem solving in geospatial settings using the R statistical language. Prerequisite: GEOS 35403 and (GEOS 30103 or MATH 24004 or MATH 22003 or DASC 25904) and (GEOS 31003 or DASC 11004 or DASC 21103). (Typically offered: Fall and Spring)

GEOS 35903. Introduction to Geodatabases. 3 Hours.

Fundamental concepts and applications of geospatial databases. Schema development and spatial data models for geodata. Spatial and attribute query and optimization, properties and structures of relational and object-oriented geodatabases. Spatial extensions of SQL, spatial indexing, measurement, and geometry. Prerequisite: GEOS 35403 and (GEOS 30103 or MATH 24004 or MATH 22003 or DASC 25904) and (GEOS 31003 or DASC 11004 or DASC 21103). (Typically offered: Fall and Spring)

GEOS 3600V. Undergraduate Special Problems. 1-6 Hour.

Library, laboratory, or field research in different phases of geology. (Typically offered: Fall, Spring and Summer) May be repeated for up to 6 hours of degree credit.

GEOS 36703. Environmental Field Methods. 3 Hours.

An off campus field-based professional course emphasizing the observation and interpretation of environmental and Earth system processes with a focus on applying physical and chemical field measurement techniques. Prerequisite: GEOS 11504 or GEOL 11103. (Typically offered: Summer)

GEOS 37303. Geospatial Data Science in Public Health. 3 Hours.

Introduction to geospatial data science, including geographic information systems (GIS) and related technologies, with an emphasis on their practical applications in the fields of public health, global health, healthcare analytics, healthcare administration, and other health-related fields. (Typically offered: Fall)

GEOS 38703. Quantitative Methods in Earth Science. 3 Hours.

Foundations of quantitative thinking, data analysis and visualization, mathematical modeling, and scientific programming, with applications in the Earth Sciences. Interpretation of scientific data and communication of results. Corequisite: Lab component. Pre- or corequisite: MATH 22003 or MATH 24004. (Typically offered: Fall)

GEOS 390H1. Junior Honors Course. 1 Hour.

Special honors research in geology. One hour credit each semester. Prerequisite: Junior standing. (Typically offered: Fall, Spring and Summer)

GEOS 391H1. Junior Honors Course II. 1 Hour.

Special honors research in geology. One hour credit each semester. Prerequisite: Junior standing. (Typically offered: Fall, Spring and Summer)

GEOS 399HV. Honors Course. 1-6 Hour.

Honors course. Prerequisite: Junior standing. (Typically offered: Irregular) May be repeated for up to 6 hours of degree credit.

GEOS 40303. Hydrogeology. 3 Hours.

Occurrence, movement, and interaction of water with geologic and cultural features. Lecture 3 hours per week. Corequisite: Lab component. Prerequisite: MATH 22003 or MATH 24004. (Typically offered: Spring)

GEOS 40403. Geography of the Middle East. 3 Hours.

Physical and cultural landscapes, natural and cultural resources, art and architecture, land use, political history, OPEC, and current problems of North Africa and the Middle East region west of Afghanistan are discussed. Class participation, discussions, slides and films, and student presentations will round out the class. Prerequisite: Junior standing. (Typically offered: Fall)

GEOS 404H3. Honors Geography of the Middle East. 3 Hours.

Physical and cultural landscapes, natural and cultural resources, art and architecture, land use, political history, OPEC, and current problems of North Africa and the Middle East region west of Afghanistan are discussed. Class participation, discussions, slides and films, and student presentations will round out the class. Prerequisite: Junior standing. (Typically offered: Irregular)
This course is equivalent to GEOS 40403.

GEOS 40503. Geomorphology. 3 Hours.

A quantitative, mechanistic overview of surface processes and landscape evolution. Lecture 2 hours, laboratory 3 hours per week. One to two field trips on weekends (2 day total) are required during the semester. Corequisite: Lab component. Prerequisite: GEOS 38703 or instructor consent. (Typically offered: Spring)

GEOS 40603. Principles of Geochemistry. 3 Hours.

Introduction to fundamental principles of geochemistry from historic development to modern concepts. Prerequisite: CHEM 14201, CHEM 14203 and GEOS 23103. (Typically offered: Fall)

GEOS 40703. Urban Geography. 3 Hours.

Areal patterns of modern urban regions and the focus shaping these patterns. Emphasis is placed on American urban areas and their evolution and functional areas. Field work. Prerequisite: Junior standing. (Typically offered: Spring)

GEOS 40803. Economic Geology. 3 Hours.

Introduction to mineral deposits used as economic resources. Covers basic geology and geochemistry of mineral deposit formations and the formation of major classes of deposits. Examines the relationship between the distribution of ores, oil, gas, coal, and Plate Tectonics. Explores environmental issues associated with the extraction of earth resources. Prerequisite: GEOS 23103. (Typically offered: Irregular)

GEOS 40903. History and Philosophy of Geography. 3 Hours.

This course familiarizes students with the history of geography, the contributions of geographers to scientific thought and theory, and research techniques that are used in geography. Emphasis is given to the integration of statistical and spatial analysis, and their applications in field research. The course includes short field-based projects in and around Northwest Arkansas. (Typically offered: Spring Even Years)

GEOS 4100V. Special Problems in Geosciences. 1-6 Hour.

Designed to meet the needs of students who wish to study one particular geographic topic in some detail. Prerequisite: Junior standing. (Typically offered: Fall) May be repeated for up to 6 hours of degree credit.

GEOS 410HV. Honors Special Problems in Geosciences. 1-6 Hour.

Designed to meet the needs of students who wish to study one particular geographic topic in some detail. Prerequisite: Junior standing. (Typically offered: Fall) May be repeated for up to 6 hours of degree credit.

This course is equivalent to GEOS 4100V.

GEOS 41103. Global Change. 3 Hours.

Examines central issues of global change including natural and human induced climate change, air pollution, deforestation, desertification, wetland loss urbanization, and the biodiversity crisis. The U.S. Global Change Research Program is also examined. (Typically offered: Spring)

GEOS 411H3. Honors Global Change. 3 Hours.

Examines central issues of global change including natural and human induced climate change, air pollution, deforestation, desertification, wetland loss urbanization, and the biodiversity crisis. The U.S. Global Change Research Program is also examined. Prerequisite: Honors candidacy. (Typically offered: Spring)

This course is equivalent to GEOS 41103.

GEOS 41303. Radar Remote Sensing. 3 Hours.

Introduction to radar remote sensing and its applications in geology, geography, archeology, engineering, and agriculture. Focuses on Synthetic Aperture Radar (SAR) and advanced techniques including radar stereo, polarimetry, and interferometry. Covers Interferometric SAR (InSAR) for mapping topography and modeling Earth's surface motions due to earthquakes, volcanic eruptions, landslides, and subsidence. Prerequisite: Junior standing. (Typically offered: Spring)

GEOS 41503. Karst Hydrogeology. 3 Hours.

Assessment of ground water resources in carbonate rock terrains and how they vary with rock properties and climate. Studying the processes that develop karst conduits (caves) and understanding their impact on water quantity and quality. Prerequisite: GEOL 11103, and (MATH 22003 or MATH 24004). (Typically offered: Irregular)

GEOS 42203. Stratigraphy and Sedimentation. 3 Hours.

Introductory investigation of stratigraphic and sedimentologic factors important to the study of sedimentary rocks. Lecture 2 hours, laboratory 3 hours per week. A required weekend, two-day field trip will be conducted during the semester. Corequisite: Lab component. Prerequisite: GEOS 34103. (Typically offered: Fall)

GEOS 42303. Geography of Religion & Sacrality. 3 Hours.

Explores the spatial nature of the World's major faiths and religious institutions, focusing on the distribution and origins of these religions. Examines the religious beliefs, rituals, architecture, demographics, and art in different societies, cultures, and countries. Considers the tenets and practices of what is sacred and/or spiritual, held in common by a group or community. Prerequisite: Junior or senior standing. (Typically offered: Irregular)

GEOS 42403. Political Geography. 3 Hours.

Contemporary world political problems in their geographic context. Development of the principles of political geography with emphasis upon the problems of Eastern Europe, Africa, and Southeast Asia. Prerequisite: Junior standing. (Typically offered: Fall Odd Years)

GEOS 42503. Petroleum Geology. 3 Hours.

Distribution and origin of petroleum. Lecture 2 hours, laboratory 2 hours per week. Corequisite: Lab component. Prerequisite: Geology major and senior standing. (Typically offered: Fall)

GEOS 42603. Geospatial Data Science - Sources and Characteristics. 3 Hours.

Covers the wide range of geospatial data sources and characteristics with emphasis on data science applications through hands-on experience recognizing the unique requirements of major sources. Techniques for the integration of disparate, heterogeneous data sets will be covered. Corequisite: GEOS 35603. Prerequisite: GEOS 35403. (Typically offered: Fall)

GEOS 4300V. Internship in Physical Geography. 3-6 Hour.

Supervised experience in municipal, county, state or private natural resource management agency, or any other such organization approved by instructor. (Typically offered: Fall, Spring and Summer)

GEOS 43303. Igneous and Metamorphic Petrology. 3 Hours.

Elementary to advanced study of the origin and evolution of igneous and metamorphic rocks in a variety of plate tectonics settings. Lecture 2 hours, Laboratory 2 hours per week. Corequisite: Lab component. Prerequisite: GEOS 23103. (Typically offered: Spring)

GEOS 43503. Meteorology. 3 Hours.

Examination of the atmospheric processes that result in multifarious weather systems. Offered as physical science. Prerequisite: Junior standing. (Typically offered: Fall)

GEOS 43603. Climatology. 3 Hours.

Fundamentals of topical climatology followed by a study of regional climatology. Offered as physical science. Prerequisite: GEOL 11203 or GEOS 43503. (Typically offered: Spring)

GEOS 4370V. Geology Field Trip. 1-2 Hour.

Camping field trip to areas of geologic interest, usually conducted during Spring Break. (Typically offered: Spring) May be repeated for up to 4 hours of degree credit.

GEOS 43803. Hazard & Disaster Assessment, Mitigation, Risk & Policy. 3 Hours.

Comprehensive introduction to interdisciplinary approaches to natural and environmental hazards and risk. Hazards and disaster assessment, mitigation, and policy are the focus of the class. Prerequisite: Junior or senior standing. (Typically offered: Spring) May be repeated for up to 6 hours of degree credit.

GEOS 438H3. Honors Hazard & Disaster Assessment, Mitigation, Risk & Policy. 3 Hours.

Comprehensive introduction to interdisciplinary approaches to natural and environmental hazards and risk. Hazards and disaster assessment, mitigation, and policy are the focus of the class. Prerequisite: Junior or senior standing. (Typically offered: Spring)

This course is equivalent to GEOS 43803.

GEOS 43903. American Public Lands & Policy. 3 Hours.

The course examines the role of American federal public lands in 19th-21st century geography, history, policy, and art. It investigates the growth of conservation, preservation, and management movements in the US by looking at America's national parks, forests, dams, wildlife refuges, wilderness areas, managed and agricultural lands. Prerequisite: Junior or senior standing. (Typically offered: Irregular)

GEOS 439H3. Honors American Public Lands & Policy. 3 Hours.

The course examines the role of American federal public lands in 19th-21st century geography, history, policy, and art. It investigates the growth of conservation, preservation, and management movements in the US by looking at America's national parks, forests, dams, wildlife refuges, wilderness areas, managed and agricultural lands. Prerequisite: Honors standing and Junior or senior standing. (Typically offered: Irregular)

This course is equivalent to GEOS 43903.

GEOS 44303. Geophysics. 3 Hours.

Derivation from physical principles, of the geophysical methods for mapping the Earth. Computational methods of converting gravity, magnetic, radiometric, electrical, and seismic data into geologic information. Lecture 3 hours, laboratory 2 hours per week. Corequisite: Lab component. Prerequisite: MATH 25004 and PHYS 20203 and PHYS 20201 and GEOS 35104. (Typically offered: Irregular)

GEOS 44703. Applied Climatology. 3 Hours.

Applied climatology involves the use of climatic data to solve a variety of social, economic and environmental problems, such as for clients in agriculture, water and energy management. The basic purpose of applied climatology is to help society, at all scales and levels, to achieve a better adjustment to the climatic environment. (Typically offered: Fall)

GEOS 447H3. Honors Applied Climatology. 3 Hours.

Applied climatology involves the use of climatic data to solve a variety of social, economic and environmental problems, such as for clients in agriculture, water and energy management. The basic purpose of applied climatology is to help society, at all scales and levels, to achieve a better adjustment to the climatic environment. Prerequisite: Honors standing. (Typically offered: Fall)

This course is equivalent to GEOS 44703.

GEOS 44903. Geography of Political Violence. 3 Hours.

This seminar focuses on the rise of civil conflict in the post-World War II world. We are particularly interested in understanding the institutional challenges facing countries that experience such conflict. The class will develop a contextually-informed understanding of the international system and how it is shaped by civil war. Prerequisite: Junior or senior standing. (Typically offered: Fall Even Years)

This course is cross-listed with INST 410H.

GEOS 449H3. Honors Geography of Political Violence. 3 Hours.

This seminar focuses on the rise of civil conflict in the post-World War II world. We are particularly interested in understanding the institutional challenges facing countries that experience such conflict. The class will develop a contextually-informed understanding of the international system and how it is shaped by civil war. Prerequisite: Junior or senior standing and honors standing. (Typically offered: Fall Even Years)

This course is cross-listed with GEOS 44903, INST 410H.

GEOS 45203. Cartographic Design and Production. 3 Hours.

This course addresses advanced cartographic concepts (i.e. visual hierarchy, aesthetics, image cognition) and production techniques as they relate to computer-assisted mapping. Students produce a variety of maps using Adobe Illustrator (CS 4-6) software to build a map portfolio. Field trips may be required. Prerequisite: GEOS 30203. (Typically offered: Spring)

GEOS 45303. Introduction to Petroleum Geophysics. 3 Hours.

Introduction to seismic wave propagation and petroleum seismology with particular emphasis on seismic events, elastic waves, and seismic survey design. Prerequisite: MATH 25004, (PHYS 20203 or PHYS 20404), and GEOS 35104 or instructor consent. (Typically offered: Fall)

GEOS 453H3. Honors Introduction to Petroleum Geophysics. 3 Hours.

Introduction to seismic wave propagation and petroleum seismology with particular emphasis on seismic events, elastic waves, and seismic survey design. Prerequisite: MATH 25004, (PHYS 20203 or PHYS 20404), and GEOS 35104 or instructor consent. (Typically offered: Fall)

This course is equivalent to GEOS 45303.

GEOS 45503. Introduction to Raster GIS. 3 Hours.

Theory, data structure, algorithms, and techniques behind raster-based geographical information systems. Through laboratory exercises and lectures multidisciplinary applications are examined in database creation, remotely sensed data handling, elevation models, and resource models using boolean, map algebra, and other methods. Prerequisite: GEOS 35403 or ANTH 35403. (Typically offered: Fall)

This course is cross-listed with ANTH 45503.

GEOS 45603. Geology of Our National Parks. 3 Hours.

This course examines the underlying geology responsible for selected parks, and explores the interplay of geology, biology, climate, topography, and humans to evaluate the value of the parks, and to anticipate the problems they will face in the near and long-term. Prerequisite: GEOL 11103 or GEOS 11504. (Typically offered: Fall)

GEOS 45803. Enterprise and Multiuser GIS. 3 Hours.

GIS practice that's typical of collaborative team-based geospatial organizations. Solve real-world problems through end-to-end GIS design and implementation using ArcGIS Enterprise, extensive federal, state, and local repositories, and high quality software documentation. Includes relevant training in geospatial provenance and metadata, and in enterprise and multiuser GIS administration. (Typically offered: Spring)

GEOS 45903. Introduction to Global Positioning Systems and Global Navigation Satellite Systems. 3 Hours.

Fundamentals of navigation, mapping, and high-precision positioning using the Navstar Global Positioning System. Topics include datum definition and transformation, map projections, autonomous and differential positioning using both code and carrier processing, and analysis of errors. Prerequisite: GEOS 35403 or GEOS 55403. (Typically offered: Fall)

GEOS 46503. GIS Analysis and Modeling. 3 Hours.

Unlike conventional GIS courses that focus on studying "where", this course will teach students to address beyond "where" using various GIS analysis and modeling techniques to explore "why" and "how". The course will provide theoretical and methodological reviews of the principles of cartographic modeling and multi-criteria decision-making. (Typically offered: Spring)

GEOS 46603. Low-Temperature Geochemistry of Natural Waters. 3 Hours.

Covers the low-temperature geochemistry of waters and their associated minerals at Earth's surface. Examines the controls on the chemical composition of natural waters and the minerals precipitated from them. Topics covered will include water-rock interactions, pH, redox, the carbonate-water system, clay minerals and exchange, heavy metals, and a brief introduction to stable isotopes and geomicrobiology. Prerequisite: CHEM 14203/CHEM 14201 and (GEOL 11103/GEOL 11101 or GEOS 11504). (Typically offered: Fall)

GEOS 46806. Geology Field Camp. 6 Hours.

A professional course taught off campus emphasizing occurrence, description, mapping, and interpretation of major rock types. May not be taken for graduate credit. Prerequisite: GEOS 34103 and GEOS 35104. (Typically offered: Summer)

GEOS 46903. Environmental Justice. 3 Hours.

This course deals with the ethical, environmental, legal, economic, and social implications of society's treatment of the poor, the disenfranchised, and minorities who live in the less desirable, deteriorating neighborhoods, communities, and niches of our country. The class integrates science with philosophy, politics, economics, policy, and law, drawing on award-winning films, current news, and case studies. (Typically offered: Spring)

GEOS 47803. Geography of Europe. 3 Hours.

Geographic regions of the area with emphasis on their present development. Prerequisite: Junior standing. (Typically offered: Irregular)

GEOS 47903. Geospatial Unmanned Aircraft Systems. 3 Hours.

Geospatial unmanned aircraft systems (UAS) are becoming key technologies in a number of disciplines. This course will introduce safe and legal operation of UAS in aerial photography, multispectral, thermal and LIDAR applications, geodetic control, photogrammetric and computer vision processing, and the creation of accurate 2D and 3D digital information products. Pre- or Corequisite: GEOS 32103 or GEOS 45903 or equivalent. (Typically offered: Fall)

GEOS 48103. Geography of Eurasia. 3 Hours.

Introduction to the culture, society, and politics of Eurasia using the organizing concept of empire from the moment of its consolidation in 1945 to its dissolution in 1991. Focuses on places that have emerged from this order and emphasizes experience and memory at each of these different times and places. Prerequisite: Junior standing. (Typically offered: Spring Even Years)

GEOS 49204. Earth System History. 4 Hours.

Physical and biological events that form the history of the earth from its formation to the beginning of the historical era. Corequisite: Lab component. Prerequisite: Junior Standing. (Typically offered: Spring)

GEOS 49303. Ancient Forest Science and Sustainability. 3 Hours.

Ancient forests preserve beautiful habitat with high ecological integrity. This course will examine the development, spatial distribution, and ongoing destruction of ancient forests worldwide, and how science can contribute to the understanding and sustainable management of these valuable resources. (Typically offered: Spring)

GEOS 497H2. Senior Honors Course I. 2 Hours.

Special honors research in geology. Two hours of credit each semester. Prerequisite: Junior honors. (Typically offered: Fall, Spring and Summer)

GEOS 498H2. Senior Honors Course II. 2 Hours.

Special honors research in geology. Two hours of credit each semester. Prerequisite: Junior honors. (Typically offered: Fall, Spring and Summer)

GEOS 49903. Dynamics of Sediment Transport. 3 Hours.

This is a course focused on how fluids transport sediment and construct stratigraphy. Lectures will develop environmental fluid mechanics and sediment transport from first principles so they can be used to evaluate sedimentological and stratigraphic problems. This framework will be applied to a sedimentological problem using original data and analysis. Pre- or Corequisite: GEOS 42203. Prerequisite: GEOS 34103. (Typically offered: Fall Odd Years)