**Biological Electives**

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| BIOL 3863 | **General Ecology. 3 Hours.**  Ecological principles and concepts; environmental factors and interactions that determine distribution and abundance of organisms. Prerequisite: 7 hours of biological science.  General Ecology Prerequisite: 7 hours of biological science. | 3 |
| ENSC 4023 | **Water Quality. 3 Hours.**  Physical, chemical, and biological characteristics of natural waters (rain, river, lake, soil, ground, etc.). Discussion of water quality parameters such as pH, alkalinity and acidity, redox, hardness, BOD, TSS, etc. Aquatic processes of pollutants and principles of modeling. Prerequisite:[CHEM 1123](http://catalog.uark.edu/search/?P=CHEM%201123) and [CHEM 1121L](http://catalog.uark.edu/search/?P=CHEM%201121L) and [BIOL 1543](http://catalog.uark.edu/search/?P=BIOL%201543) and [BIOL 15](http://catalog.uark.edu/search/?P=BIOL%201541L) [41L](http://catalog.uark.edu/search/?P=BIOL%201541L). | 3 |
| CSES 2203 | **Soil Science. 3 Hours.**  Origin, classification, and physical, chemical, and biological properties of soils. Lecture 3 hours, discussion 1 hour per week. Corequisite: Drill component. Prerequisite: [MATH 1203](http://catalog.uark.edu/search/?P=MATH%201203) and [CHEM 1103](http://catalog.uark.edu/search/?P=CHEM%201103) or [CHEM 1073](http://catalog.uark.edu/search/?P=CHEM%201073). | 3 |
| CHEM 3613 | **Organic Chemistry II. 3 Hours.**  Basic chemistry of aromatic and carbonyl compounds: properties and reactions. Lecture 3 hours per week. Corequisite: [CHEM 3611L](http://catalog.uark.edu/search/?P=CHEM%203611L) and related course component drill section for [CHEM 3613](http://catalog.uark.edu/search/?P=CHEM%203613). Prerequisite: ([CHEM 3603](http://catalog.uark.edu/search/?P=CHEM%203603) and [CHEM 3601L](http://catalog.uark.edu/search/?P=CHEM%203601L)) or ([CHEM 3603H](http://catalog.uark.edu/search/?P=CHEM%203603H) and [CHEM 3602M](http://catalog.uark.edu/search/?P=CHEM%203602M)) or ([CHEM 3703](http://catalog.uark.edu/search/?P=CHEM%203703) and [CHEM 3702L](http://catalog.uark.edu/search/?P=CHEM%203702L)). | 3 |
| CHEM 3813 | **Elements of Biochemistry. 3 Hours**  **.**One semester survey course of the fundamentals of biochemistry. Structures, properties, and reactions of major classes of biomolecules.  Basics of enzyme catalysis. Overview of metabolism. Credit for  both [CHEM 3813](http://catalog.uark.edu/search/?P=CHEM%203813) and 4813H may not be counted toward a chemistry degree. Lecture 3 hours per week. Prerequisite:  ([CHEM 3613](http://catalog.uark.edu/search/?P=CHEM%203613) and [CHEM 3611L](http://catalog.uark.edu/search/?P=CHEM%203611L)) or ([CHEM 3613H](http://catalog.uark.edu/search/?P=CHEM%203613H) and [CHEM 3612M](http://catalog.uark.edu/search/?P=CHEM%203612M)) or ([CHEM 3713](http://catalog.uark.edu/search/?P=CHEM%203713) and [CHEM 3712L](http://catalog.uark.edu/search/?P=CHEM%203712L)) or ([CHEM 2613](http://catalog.uark.edu/search/?P=CHEM%202613) and [CHEM 2611L](http://catalog.uark.edu/search/?P=CHEM%202611L)). | 3 |
| BIOL 2533 | **Cell Biology. 3 Hours.**  Introduction to cell structure, cell processes, biological polymers, energetics, and diversity. An introduction to biochemistry and cell chemistry. Recommended: ([CHEM 1123](http://catalog.uark.edu/search/?P=CHEM%201123) and [CHEM 1121L](http://catalog.uark.edu/search/?P=CHEM%201121L)) or ([CHEM 1223](http://catalog.uark.edu/search/?P=CHEM%201223) and [CHEM 1221L](http://catalog.uark.edu/search/?P=CHEM%201221L)) or equivalent. Prerequisite: [BIOL 1584](http://catalog.uark.edu/search/?P=BIOL%201584), or [BIOL 1543](http://catalog.uark.edu/search/?P=BIOL%201543) and [BIOL 1541L](http://catalog.uark.edu/search/?P=BIOL%201541L). (Typically offered: Fall and Spring) | 3 |

**Suggested Engineering Electives**

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| [BENG 4123](http://catalog.uark.edu/search/?P=BENG%204123) | **Biosensors & Bioinstrumentation. 3 Hours.**  Principles of biologically based sensing elements and interfacing techniques. Design and analysis methods of biosensing and transducing components in bioinstrumentation. Applications of biosensors and bioinstrumentation in bioprocessing, bioenvironmental, biomechanical and biomedical engineering. Lecture 2 hours, laboratory 3 hours per week. Corequisite: Lab component. Prerequisite: [BIOL 2013](http://catalog.uark.edu/search/?P=BIOL%202013) or [BIOL 2533](http://catalog.uark.edu/search/?P=BIOL%202533) and [BENG 3113](http://catalog.uark.edu/search/?P=BENG%203113). (Typically offered: Spring Odd Years) | 3 |
| BENG 450V | **Special Problems. 1-4 Hour.**  Selected problems in biological engineering are pursued in detail. Prerequisite: Senior standing. (Typically offered: Fall, Spring and Summer) May be repeated for up to 4 hours of degree credit. | 3 |
| [BENG 4753L](http://catalog.uark.edu/search/?P=BENG%204753L) | Nanotechnology Laboratory. 3 hours.  Provides students with hands-on experience in several major areas of nanotechnology, including nanoscale imaging, synthesis of nanomaterials, nanostructure assembly and manipulation, device and system integration, and performance evaluation. Students can earn credit for only one of the following courses: [MEEG 4323L](http://catalog.uark.edu/search/?P=MEEG%204323L), [BENG 4753L](http://catalog.uark.edu/search/?P=BENG%204753L), [BMEG 4103L](http://catalog.uark.edu/search/?P=BMEG%204103L), [CHEM 4153L](http://catalog.uark.edu/search/?P=CHEM%204153L), [PHYS 4793L](http://catalog.uark.edu/search/?P=PHYS%204793L). Corequisite: Drill component, junior standing and instructor consent. Prerequisite: [MATH 2564](http://catalog.uark.edu/search/?P=MATH%202564), [PHYS 2074](http://catalog.uark.edu/search/?P=PHYS%202074), and [CHEM 1123](http://catalog.uark.edu/search/?P=CHEM%201123). (Typically offered: Fall) This course is cross-listed with [MEEG 4323L](http://catalog.uark.edu/search/?P=MEEG%204323L), [CHEM 4153L](http://catalog.uark.edu/search/?P=CHEM%204153L), [PHYS 4793L](http://catalog.uark.edu/search/?P=PHYS%204793L). | 3 |
| BENG 4963 | Modeling Environmental Biophysics: 3 hours  Interactions between the biosphere and the atmosphere. Connecting the physical environment of solar energy, wind, soil, and hydrology to the biosphere through plant ecophysiology. Boundary layer meteorology, photosynthesis and boundary layer modeling strategies, and the soil-plant-atmosphere continuum. Instrumentation, measurement and modeling strategies for understanding leaf-, landscape- and regional behaviors; and, the transfer, kinetics, and balance of momentum, energy, water vapor, CO2, and other atmospheric trace gases between the landscape (vegetation and soil) and the atmosphere. Applications in sustainable agriculture, irrigation, land and water resources, and modeling plant water use and carbon uptake strategies. Three hours of lecture per week. Prerequisite: [MATH 2564](http://catalog.uark.edu/search/?P=MATH%202564) and ([BENG 4933](http://catalog.uark.edu/search/?P=BENG%204933) or [CVEG 3223](http://catalog.uark.edu/search/?P=CVEG%203223)). (Typically offered: Spring Even Years) | 3 |
| CSCE 2004 | **Programming Foundations I. 4 Hours.**  Introductory programming course for students majoring in computer science or computer engineering. Software development process: problem specification, program design, implementation, testing and documentation. Programming topics: data representation, conditional and iterative statements, functions, arrays, strings, file I/O and classes. Using C++ in a UNIX environment. Corequisite: Lab component. Prerequisite: [MATH 2445](http://catalog.uark.edu/search/?P=MATH%202445) or [MATH 2554](http://catalog.uark.edu/search/?P=MATH%202554) or [MATH 2554C](http://catalog.uark.edu/search/?P=MATH%202554C) with a grade of C or better, a College of Engineering (ENGR) student, a Computer Science Minor (CSCE-M), or a math major (MATHBS or MATHBA). (Typically offered: Fall and Spring) | 4 |
| [CVEG 2053](http://catalog.uark.edu/search/?P=CVEG%202053) | **Surveying Systems. 3 Hours.**  Coordinate geometry, measurements, and total integrated surveying systems; total stations, electronic data collection, and reduction; error analysis; applications to civil engineering and surveying practice. Corequisite: [CVEG 2051L](http://catalog.uark.edu/search/?P=CVEG%202051L). Prerequisite: [MATH 2554](http://catalog.uark.edu/search/?P=MATH%202554) or [MATH 2445](http://catalog.uark.edu/search/?P=MATH%202445). (Typically offered: Fall and Spring) | 3 |
| [CVEG 3243](http://catalog.uark.edu/search/?P=CVEG%203243) | **Environmental Engineering. 3 Hours.**  Introduction to theories and fundamentals of physical, chemical, and biological processes with emphasis on water supply and wastewater collection, transportation, and treatment. Lecture 2 hours, laboratory 3 hours per week. Corequisite: Lab component. Prerequisite: [MATH 2584](http://catalog.uark.edu/search/?P=MATH%202584) and [CHEM 1103](http://catalog.uark.edu/search/?P=CHEM%201103). (Typically offered: Fall and Spring) | 3 |
| CVEG 4203 | **Environmental Regulations and Permits. 3 Hours.**  Topics include federal and state environmental regulations, the permitting process, permit requirements and related issues. Prerequisite: [CVEG 3243](http://catalog.uark.edu/search/?P=CVEG%203243) and senior standing. (Typically offered: Fall) | 3 |
| [CVEG 4243](http://catalog.uark.edu/search/?P=CVEG%204243) | **Environmental Engineering Design. 3 Hours.**  Application of physical, biological, and chemical operations and processes to the design of water supply and wastewater treatment systems. Prerequisite: [CVEG 3243](http://catalog.uark.edu/search/?P=CVEG%203243) and [INEG 2413](http://catalog.uark.edu/search/?P=INEG%202413). (Typically offered: Fall and Spring) | 3 |
| CVEG 4273 | **Open Channel Flow. 3 Hours.**  Open Channel Flow includes advanced open channel hydraulics, flow measurement techniques, a hydrology review, culvert and storm drainage design, natural channel classification (fluvial geomorphology) and rehabilitation, computer methods and environmental issues. Prerequisite: [CVEG 3213](http://catalog.uark.edu/search/?P=CVEG%203213) and [CVEG 3223](http://catalog.uark.edu/search/?P=CVEG%203223). (Typically offered: Spring) | 3 |
| [CVEG 4263](http://catalog.uark.edu/search/?P=CVEG%204263) | Air Pollution Control (Sp)  (Prerequisite: [CVEG 3213](http://catalog.uark.edu/search/?P=CVEG%203213) or [MEEG 3503](http://catalog.uark.edu/search/?P=MEEG%203503).) Air Pollution Control. 3 Hours.  Fundamentals of air pollution causes, effects, and measurements; as well as, control methods with application to current industrial problems. Prerequisite: [CVEG 3213](http://catalog.uark.edu/search/?P=CVEG%203213) or [MEEG 3503](http://catalog.uark.edu/search/?P=MEEG%203503). (Typically offered: Spring) | 3 |
| [INEG 2313](http://catalog.uark.edu/search/?P=INEG%202313) | **Applied Probability and Statistics for Engineers I. 3 Hours.**  Applications to engineering problems of probability theory, discrete and continuous random variables, descriptive statistics, single-population point and interval estimation, single-population hypothesis testing, goodness-of-fit testing, and contingency table testing. INEG and DTSC students only. Corequisite: Drill component. Prerequisite: [MATH 2564](http://catalog.uark.edu/search/?P=MATH%202564) and INEG or DTSC students only. (Typically offered: Fall and Spring) | 3 |
| [INEG 2413](http://catalog.uark.edu/search/?P=INEG%202413) | **Engineering Economic Analysis. 3 Hours.**  Economic aspects of engineering, including current economic problems and the treatment of estimates when evaluating alternative courses of action. Methods of selection and replacement of equipment and break-even points of operation; desirability of new processes or projects where asset life, rate of return on investment, and first, fixed, differential, marginal, and sunk costs must be considered. Corequisite: Drill component. Prerequisite: [MATH 2445](http://catalog.uark.edu/search/?P=MATH%202445) or [MATH 2514](http://catalog.uark.edu/search/?P=MATH%202514) or [MATH 2554](http://catalog.uark.edu/search/?P=MATH%202554). (Typically offered: Fall and Spring) | 3 |
| INEG 4423 | **Advanced Engineering Economy. 3 Hours.**  Preparation of feasibility studies, including cost estimation, risk and uncertainty, sensitivity analysis and decision making. Effects of taxes, depreciation and financing costs on cash flows. Prerequisite: [INEG 2313](http://catalog.uark.edu/search/?P=INEG%202313) and [INEG 2413](http://catalog.uark.edu/search/?P=INEG%202413). (Typically offered: Irregular) | 3 |
| [MEEG 4453](http://catalog.uark.edu/search/?P=MEEG%204453) | **Industrial Waste and Energy Management. 3 Hours.**  Applications of thermodynamics, heat transfer, fluid mechanics, and electric machinery to the analysis of waste streams and energy consumption for industrial facilities. Current techniques and technologies for waste minimization and energy conservation including energy-consuming systems and processes, utility rate analysis, economic analysis and auditing are taught. Prerequisite: [MEEG 4413](http://catalog.uark.edu/search/?P=MEEG%204413). (Typically offered: Irregular) | 3 |
| [MEEG 4473](http://catalog.uark.edu/search/?P=MEEG%204473) | **Indoor Environmental Control. 3 Hours.**  Gives student a thorough understanding of the fundamental theory of air conditioning design for commercial buildings, including calculating heating and cooling loads along with the proper selection and sizing of air conditioning equipment. Prerequisite: [MEEG 4413](http://catalog.uark.edu/search/?P=MEEG%204413). (Typically offered: Irregular) | 3 |

Suggested Technical Electives

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| AGEC 3303 | **Food and Agricultural Marketing. 3 Hours.**  Surveys consumer trends in food markets and the marketing activities of the food and fiber system. Emphasizes marketing concepts for both commodities and differentiated food products. Topics include applied consumer and price theory; marketing management; structure and performance of the food system; and current agricultural marketing topics. Prerequisite: [AGEC 1103](http://catalog.uark.edu/search/?P=AGEC%201103) or [ECON 2023](http://catalog.uark.edu/search/?P=ECON%202023) or [ECON 2143](http://catalog.uark.edu/search/?P=ECON%202143). (Typically offered: Fall, Spring and Summer) | 3 |
| AGEC 3413 | **Principles of Environmental Economics. 3 Hours.**  An introductory, issues-oriented course in the economics of the environment. The course will focus on what is involved in how society makes decisions about environmental quality. The environmental issues important to the State of Arkansas and the United States will be emphasized. Prerequisite: [AGEC 1103](http://catalog.uark.edu/search/?P=AGEC%201103) or [ECON 2023](http://catalog.uark.edu/search/?P=ECON%202023). (Typically offered: Spring) This course is cross-listed with [ENSC 3413](http://catalog.uark.edu/search/?P=ENSC%203413). | 3 |
| [AGEC 3503](http://catalog.uark.edu/search/?P=AGEC%203503) | **Agricultural Law I. 3 Hours.**  Examination of those areas of law especially applicable to agriculture. Fundamentals of contract law, torts law, and property law will accompany discussion of major areas of agricultural law; acquisition and disposal of farmland; farm tenancies; rights and limitations in the use and ownership of farmland; water law; environmental protection; protection of the productivity of agricultural land; and the law of sales and secured transactions in an agricultural context. (Typically offered: Fall) | 3 |
| [AGEC 3523](http://catalog.uark.edu/search/?P=AGEC%203523) | **Environmental and Natural Resources Law. 3 Hours.**  Principles of environmental and natural resources law relevant to agriculture, food and the environmental sciences; legal principles relating to regulation of water, air, hazardous substances, land, wildlife, livestock, and water rights. Principles of civil and criminal liabilities and other developing legal and regulatory issues relating to agriculture and natural resources. (Typically offered: Spring Even Years) | 3 |
| AGEC 4163 | **Agricultural and Rural Development. 3 Hours.**  Examination of agricultural and rural development issues in less developed countries. Alternative agricultural production systems are compared, development theories examined, and consideration given to the planning and implementation of development programs. Prerequisite: [AGEC 1103](http://catalog.uark.edu/search/?P=AGEC%201103) (or [ECON 2023](http://catalog.uark.edu/search/?P=ECON%202023)). (Typically offered: Fall) | 3 |
| ASTM 3153 | **Surveying in Agriculture and Forestry. 3 Hours.**  Techniques and procedures normally used in determining areas and characterizing the topography of agricultural and forest lands. Includes basic concepts of surveying; use and care of level, transit, distance measuring equipment; topographic mapping and public land surveys. (Typically offered: Fall) |  |
| [CSES 3603](http://catalog.uark.edu/search/?P=CSES%203603) | **Metrics for Sustainable Agricultural Systems. 3 Hours.**  Analysis of productive agricultural systems necessary to meet expanding demand worldwide for food, feed, fiber and fuel while preserving critical ecosystem services to avoid future catastrophic failures of the biosphere. Characterization of sustainable systems using well-defined metrics, indicators and indices, including reference to sustainability certifications. Metrics for soil, water, atmosphere and biodiversity. Applications in crop and animal production with scales from field to watershed to eco-region. Examining the process and methodologies of integrating metrics into indices to support sustainable supply chain decisions. Discussion of life cycle analyses and current initiatives toward approaching agricultural systems sustainability. Technical course intended for students in agriculture, biology, business, engineering, and environmental sciences. (Typically offered: Fall) |  |
| BENG 4973 | **Practice in Water Quality Monitoring and Analysis. 3 Hours.**  Application of water quality principles to a real world problem. Team project experience developing quality assurance project plans, designing monitoring systems, selecting chemical analysis methods, estimating loads, performing trend analysis, basic model calibration and validation, and technical report writing and oral presentations. Working with various clientele to analyze water quality data in the context of evaluating real-world problems and issues. Technical course intended for students in engineering, environmental sciences, agriculture and biology. Three hours of lecture per week. Prerequisite: [CVEG 3213](http://catalog.uark.edu/search/?P=CVEG%203213) or instructor's consent to allow interdisciplinary student teams. (Typically offered: Spring Odd Years) | 3 |
| BIOL 2323 | **General Genetics. 3 Hours.**  Surveys of Mendelian, molecular, and population mechanisms of inheritance and gene expression in prokaryotes and eukaryotes. Lecture 3 hours per week. Prerequisite: ([BIOL 1584](http://catalog.uark.edu/search/?P=BIOL%201584) or [BIOL 1543](http://catalog.uark.edu/search/?P=BIOL%201543) and [BIOL 1541L](http://catalog.uark.edu/search/?P=BIOL%201541L)) and ([CHEM 1103](http://catalog.uark.edu/search/?P=CHEM%201103) or [CHEM 1203](http://catalog.uark.edu/search/?P=CHEM%201203)) and ([MATH 1203](http://catalog.uark.edu/search/?P=MATH%201203) or higher or [STAT 2823](http://catalog.uark.edu/search/?P=STAT%202823) or [STAT 2303](http://catalog.uark.edu/search/?P=STAT%202303) or equivalent). (Typically offered: Fall and Spring) | 3 |
| [BIOL 2533](http://catalog.uark.edu/search/?P=BIOL%202533) | **Cell Biology. 3 Hours.**  Introduction to cell structure, cell processes, biological polymers, energetics, and diversity. An introduction to biochemistry and cell chemistry. Recommended: ([CHEM 1123](http://catalog.uark.edu/search/?P=CHEM%201123) and [CHEM 1121L](http://catalog.uark.edu/search/?P=CHEM%201121L)) or ([CHEM 1223](http://catalog.uark.edu/search/?P=CHEM%201223) and [CHEM 1221L](http://catalog.uark.edu/search/?P=CHEM%201221L)) or equivalent. Prerequisite: [BIOL 1584](http://catalog.uark.edu/search/?P=BIOL%201584), or [BIOL 1543](http://catalog.uark.edu/search/?P=BIOL%201543) and [BIOL 1541L](http://catalog.uark.edu/search/?P=BIOL%201541L). (Typically offered: Fall and Spring) | 3 |
| BIOL 4333 | **Biotechnology in Agriculture. 3 Hours.**  Discussion of the techniques, applications, and issues of biotechnology as it is being used in modern agriculture. Coverage includes the basics of molecular biology, production of transgenic plants and animals, and new applications in the agricultural, food, and medical marketplace. Lecture and discussion, 3 hours per week. (Typically offered: Fall) This course is cross-listed with [PLPA 4333](http://catalog.uark.edu/search/?P=PLPA%204333).**.** | 3 |
| [BIOL 4734](http://catalog.uark.edu/search/?P=BIOL%204734) | **Wildlife Management Techniques. 4 Hours.**  To familiarize students with techniques used in the management of wildlife populations. Students will be exposed to field methods, approaches to data analysis, experimental design, and how to write a scientific paper. Management applications will be emphasized. Lecture 3 hours, laboratory 3 hours per week. Corequisite: Lab component. Prerequisite: [BIOL 3863](http://catalog.uark.edu/search/?P=BIOL%203863). (Typically offered: Irregular) | 4 |
| [CHEM 3613](http://catalog.uark.edu/search/?P=CHEM%203613) | **Organic Chemistry II. 3 Hours.**  Basic chemistry of aromatic and carbonyl compounds: properties and reactions. Lecture 3 hours per week. Corequisite: [CHEM 3611L](http://catalog.uark.edu/search/?P=CHEM%203611L) and related course component drill section for [CHEM 3613](http://catalog.uark.edu/search/?P=CHEM%203613). Prerequisite: ([CHEM 3603](http://catalog.uark.edu/search/?P=CHEM%203603) and [CHEM 3601L](http://catalog.uark.edu/search/?P=CHEM%203601L)) or ([CHEM 3603H](http://catalog.uark.edu/search/?P=CHEM%203603H) and [CHEM 3602M](http://catalog.uark.edu/search/?P=CHEM%203602M)) or ([CHEM 3703](http://catalog.uark.edu/search/?P=CHEM%203703) and [CHEM 3702L](http://catalog.uark.edu/search/?P=CHEM%203702L)). (Typically offered: Spring and Summer) | 3 |
| [CHEM 3813](http://catalog.uark.edu/search/?P=CHEM%203813) | **Elements of Biochemistry. 3 Hours.**  One semester survey course of the fundamentals of biochemistry. Structures, properties, and reactions of major classes of biomolecules. Basics of enzyme catalysis. Overview of metabolism. Credit for both [CHEM 3813](http://catalog.uark.edu/search/?P=CHEM%203813) and [CHEM 4813H](http://catalog.uark.edu/search/?P=CHEM%204813H) may not be counted toward a chemistry degree. Lecture 3 hours per week. Prerequisite: ([CHEM 3613](http://catalog.uark.edu/search/?P=CHEM%203613) and [CHEM 3611L](http://catalog.uark.edu/search/?P=CHEM%203611L)) or ([CHEM 3613H](http://catalog.uark.edu/search/?P=CHEM%203613H) and [CHEM 3612M](http://catalog.uark.edu/search/?P=CHEM%203612M)) or ([CHEM 3713](http://catalog.uark.edu/search/?P=CHEM%203713) and [CHEM 3712L](http://catalog.uark.edu/search/?P=CHEM%203712L)) or ([CHEM 2613](http://catalog.uark.edu/search/?P=CHEM%202613) and [CHEM 2611L](http://catalog.uark.edu/search/?P=CHEM%202611L)). (Typically offered: Fall, Spring and Summer) | 3 |
| [CSES 2203](http://catalog.uark.edu/search/?P=CSES%202203) | **Soil Science. 3 Hours.**  Origin, classification, and physical, chemical, and biological properties of soils. Lecture 3 hours, discussion 1 hour per week. Corequisite: Drill component.Prerequisite: [MATH 1203](http://catalog.uark.edu/search/?P=MATH%201203) or higher (to include [MATH 1213](http://catalog.uark.edu/search/?P=MATH%201213), [MATH 1284C](http://catalog.uark.edu/search/?P=MATH%201284C), [MATH 1514](http://catalog.uark.edu/search/?P=MATH%201514), [MATH 2213](http://catalog.uark.edu/search/?P=MATH%202213), [MATH 2043](http://catalog.uark.edu/search/?P=MATH%202043), [MATH 2053](http://catalog.uark.edu/search/?P=MATH%202053), [MATH 2445](http://catalog.uark.edu/search/?P=MATH%202445), [MATH 2514](http://catalog.uark.edu/search/?P=MATH%202514), [MATH 2554](http://catalog.uark.edu/search/?P=MATH%202554), [MATH 2564](http://catalog.uark.edu/search/?P=MATH%202564), or [MATH 2574](http://catalog.uark.edu/search/?P=MATH%202574)) and [CHEM 1103](http://catalog.uark.edu/search/?P=CHEM%201103) or [CHEM 1073](http://catalog.uark.edu/search/?P=CHEM%201073). (Typically offered: Fall and Spring) | 3 |
| [CSES 3214](http://catalog.uark.edu/search/?P=CSES%203214) | **Soil Resources and Nutrient Cycles. 4 Hours.**  Integration of the fundamental concepts of the biological, chemical, and physical properties of soil systems and their roles in managing soil resources. Lecture 3 hours, laboratory 3 hours per week. Pre- or Corequisite: [BIOL 2013](http://catalog.uark.edu/search/?P=BIOL%202013) and [BIOL 2011L](http://catalog.uark.edu/search/?P=BIOL%202011L). Corequisite: Lab component. Prerequisite: [CSES 2203](http://catalog.uark.edu/search/?P=CSES%202203). (Typically offered: Spring Odd Years) | 4 |
| [CSES 4303](http://catalog.uark.edu/search/?P=CSES%204303) | **Bioenergy Feedstock Production. 3 Hours.**  Overview of production and characteristics of cultivated crops, perennial grasses, and woody species as feedstocks for bioenergy. Fundamentals of plant growth factors, culture, harvest and storage, quality and improvement, and introduction to environmental impact, modeling, and resource utilization. Prerequisite: [MATH 1203](http://catalog.uark.edu/search/?P=MATH%201203) and [BIOL 1543](http://catalog.uark.edu/search/?P=BIOL%201543) or [CSES 1203](http://catalog.uark.edu/search/?P=CSES%201203). Courses in introductory chemistry or soil science are preferred. (Typically offered: Spring) | 3 |
| [ENSC 3103](http://catalog.uark.edu/search/?P=ENSC%203103) | **Plants and Environmental Restoration. 3 Hours.**  Selection, establishment, and use of plants to promote soil stabilization, water quality, and wildlife habitat. Principles and practices of managing plants for soil remediation, nutrient and sediment trapping, and restoration of plant communities. Prerequisite: [CSES 1203](http://catalog.uark.edu/search/?P=CSES%201203) or [HORT 2003](http://catalog.uark.edu/search/?P=HORT%202003) or [BIOL 1613](http://catalog.uark.edu/search/?P=BIOL%201613). (Typically offered: Fall Even Years) | 3 |
| [ENSC 3223](http://catalog.uark.edu/search/?P=ENSC%203223) | **Ecosystems Assessment. 3 Hours.**  Application of basic ecological principles to gain an appreciation for ecosystem assessment and management. Lecture 3 hours per week. Prerequisite: [BIOL 1543](http://catalog.uark.edu/search/?P=BIOL%201543). (Typically offered: Fall Even Years) | 3 |
| [ENSC 3263](http://catalog.uark.edu/search/?P=ENSC%203263) | **Soil and Water Conservation. 3 Hours.**  Effect of land use on water quality. Major sources of agricultural nonpoint pollutants. Best management practices used to minimize water quality impacts. Prerequisite: [CSES 2203](http://catalog.uark.edu/search/?P=CSES%202203). (Typically offered: Fall) | 3 |
| [ENSC 3413](http://catalog.uark.edu/search/?P=ENSC%203413) | **Principles of Environmental Economics. 3 Hours.**  An introductory, issues-oriented course in the economics of the environment. What is involved in society making decisions about environmental quality will be studied. Environmental issues important to the State of Arkansas and the United States will be emphasized. Prerequisite: [AGEC 1103](http://catalog.uark.edu/search/?P=AGEC%201103) or [ECON 2023](http://catalog.uark.edu/search/?P=ECON%202023). (Typically offered: Spring)  This course is cross-listed with [AGEC 3413](http://catalog.uark.edu/search/?P=AGEC%203413). | 3 |
| [ENSC 3603](http://catalog.uark.edu/search/?P=ENSC%203603) | **GIS for Environmental Science. 3 Hours.**  Provide instruction on the uses of GIS techniques in solving practical environmental and agricultural land use problems. Areas include: 1) an introduction to spatial variability in soils with an emphasis on the application of GIS techniques to map and understand spatial parameters important to different land uses, and 2) development of individual experience in the use of GIS in solving environmental and agricultural problems using an oral and written term project. Prerequisite: [CSES 2203](http://catalog.uark.edu/search/?P=CSES%202203). (Typically offered: Spring Odd Years) | 3 |
| [ENSC 3933](http://catalog.uark.edu/search/?P=ENSC%203933) | **Environmental Ethics. 3 Hours.**  The course addresses ethical questions about nature and the natural environment. Topics of discussion include anthropocentric and biocentric ethics, population control, obligations to future generations, animal rights, moral considerability, Leopold's land ethic, deep ecology, and ecofeminism. Lecture/discussions 3 hours per week. Prerequisite: [ENSC 1003](http://catalog.uark.edu/search/?P=ENSC%201003) or [PHIL 2003](http://catalog.uark.edu/search/?P=PHIL%202003) or [PHIL 2103](http://catalog.uark.edu/search/?P=PHIL%202103). (Typically offered: Spring) This course is cross-listed with [PHIL 3113](http://catalog.uark.edu/search/?P=PHIL%203113). | 3 |
| [ENSC 4023](http://catalog.uark.edu/search/?P=ENSC%204023) | **Water Quality. 3 Hours.**  Physical, chemical, and biological characteristics of natural waters (rain, river, lake, soil, ground, etc.). Discussion of water quality parameters such as pH, alkalinity and acidity, redox, hardness, BOD, TSS, etc. Aquatic processes of pollutants and principles of modeling. Prerequisite: [CHEM 1123](http://catalog.uark.edu/search/?P=CHEM%201123) and [CHEM 1121L](http://catalog.uark.edu/search/?P=CHEM%201121L) and [BIOL 1543](http://catalog.uark.edu/search/?P=BIOL%201543) and [BIOL 1541L](http://catalog.uark.edu/search/?P=BIOL%201541L). (Typically offered: Fall) | 3 |
| [ENSC 4034](http://catalog.uark.edu/search/?P=ENSC%204034) | **Analysis of Environmental Contaminants. 4 Hours.**  Methods of analysis for inorganic and organic contaminants, radionuclides and microorganisms in soil and water. Quality assurance and quality control, sampling protocols, sample handling, instrumentation and data analysis. Lecture 4 hours per week. Pre- or Corequisite: [CHEM 2613](http://catalog.uark.edu/search/?P=CHEM%202613) and [CHEM 2611L](http://catalog.uark.edu/search/?P=CHEM%202611L) or [CHEM 3603](http://catalog.uark.edu/search/?P=CHEM%203603) and [CHEM 3601L](http://catalog.uark.edu/search/?P=CHEM%203601L). (Typically offered: Spring Even Years) | 4 |
| [ENSC 4263](http://catalog.uark.edu/search/?P=ENSC%204263) | **Environmental Soil Science. 3 Hours.**  Study of the behavior of pesticides, toxic organic compounds, metals, nutrients, and pathogenic microorganisms in the soil/plant/water continuum. Lecture 3 hours per week. Pre- or Corequisite: [PHYS 2013](http://catalog.uark.edu/search/?P=PHYS%202013) and [PHYS 2011L](http://catalog.uark.edu/search/?P=PHYS%202011L). Prerequisite: [CSES 3214](http://catalog.uark.edu/search/?P=CSES%203214). (Typically offered: Spring Even Years) | 3 |
| FDSC 4121L | **Food Microbiology Lab. 1 Hour.**  A hands-on laboratory course designed to teach students microbiological techniques and certain enumeration and plating techniques of specific food spoilage and pathogenic bacteria. Pre- or Corequisite: [FDSC 4122](http://catalog.uark.edu/search/?P=FDSC%204122). (Typically offered: Fall) | 1 |
| [FDSC 4122](http://catalog.uark.edu/search/?P=FDSC%204122) | **Food Microbiology. 2 Hours.**  The study of food microbiology including classification/ taxonomy, contamination, preservation and spoilage of different kinds of foods, pathogenic microorganisms, food poisoning, sanitation, control and inspection and beneficial uses of microorganisms. Prerequisite: [BIOL 2013](http://catalog.uark.edu/search/?P=BIOL%202013) and [BIOL 2011L](http://catalog.uark.edu/search/?P=BIOL%202011L) or [BIOL 2533](http://catalog.uark.edu/search/?P=BIOL%202533). (Typically offered: Fall) This course is cross-listed with [BIOL 4122](http://catalog.uark.edu/search/?P=BIOL%204122). | 2 |
| [FDSC 4304](http://catalog.uark.edu/search/?P=FDSC%204304) | Food Chemistry (Fa): Corequisite: Lab component.  Prerequisite: [CHEM 1123](http://catalog.uark.edu/search/?P=CHEM%201123) and [CHEM 1121L](http://catalog.uark.edu/search/?P=CHEM%201121L) and [CHEM 2613](http://catalog.uark.edu/search/?P=CHEM%202613) and [CHEM 2611L](http://catalog.uark.edu/search/?P=CHEM%202611L) or ([CHEM 3603](http://catalog.uark.edu/search/?P=CHEM%203603) and [CHEM 3601L](http://catalog.uark.edu/search/?P=CHEM%203601L)). **Food Chemistry. 4 Hours.**  Water, carbohydrates, lipids, proteins, vitamins, and minerals in foods; biochemical and functional properties, enzymes, food additives (emulsifiers, pigments, colors, flavors, preservatives, and sweeteners) and texture as related to properties in food systems and during processing. Lecture 3 hours, laboratory 3 hours per week. Corequisite: Lab component. Prerequisite: [CHEM 1123](http://catalog.uark.edu/search/?P=CHEM%201123) and [CHEM 1121L](http://catalog.uark.edu/search/?P=CHEM%201121L) and [CHEM 2613](http://catalog.uark.edu/search/?P=CHEM%202613) and [CHEM 2611L](http://catalog.uark.edu/search/?P=CHEM%202611L) or ([CHEM 3603](http://catalog.uark.edu/search/?P=CHEM%203603) and [CHEM 3601L](http://catalog.uark.edu/search/?P=CHEM%203601L)). (Typically offered: Fall) | 4 |
| [GEOS 1113](http://catalog.uark.edu/search/?P=GEOS%201113) | **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: [GEOS 1111L](http://catalog.uark.edu/search/?P=GEOS%201111L). (Typically offered: Fall, Spring and Summer) | 3 |
| [GEOS 4033](http://catalog.uark.edu/search/?P=GEOS%204033) | **Hydrogeology. 3 Hours.**  Occurrence, movement, and interaction of water with geologic and cultural features. Lecture 3 hours per week. Corequisite: Lab component. Prerequisite: [MATH 2043](http://catalog.uark.edu/search/?P=MATH%202043) or [MATH 2554](http://catalog.uark.edu/search/?P=MATH%202554), and [GEOS 3514](http://catalog.uark.edu/search/?P=GEOS%203514). (Typically offered: Spring) | 3 |
| [GEOS 4063](http://catalog.uark.edu/search/?P=GEOS%204063) | **Principles of Geochemistry. 3 Hours.**  Introduction to fundamental principles of geochemistry from historic development to modern concepts.Prerequisite: [CHEM 1121L](http://catalog.uark.edu/search/?P=CHEM%201121L), [CHEM 1123](http://catalog.uark.edu/search/?P=CHEM%201123) and [GEOS 2313](http://catalog.uark.edu/search/?P=GEOS%202313). (Typically offered: Fall) | 3 |
| [***GEOS 4413***](http://catalog.uark.edu/search/?P=GEOS%204413) | ***Principles of Remote Sensing (Fa) Prerequisite:*** [***GEOS 3023***](http://catalog.uark.edu/search/?P=GEOS%203023) ***or*** [***GEOS 3543***](http://catalog.uark.edu/search/?P=GEOS%203543)***.*** | 3 |
| [GEOS 4693](http://catalog.uark.edu/search/?P=GEOS%204693) | **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) | 3 |
| PLPA 4123 | **Bacterial Lifestyles. 3 Hours.**  The course will introduce students to bacteria as prokaryotic organisms, different from eukaryotes such as plants and animals. Model microbial systems will be studied in more detail to identify unique strategies that bacteria employ to thrive in their respective environment, whether they are causing diseases or establishing beneficial interactions with animal or plants or coexisting with other microorganisms in diverse ecological environments. The course will also cover special adaptations that bacteria have evolved to adapt to harsh environments and how these adaptations can be harnessed to control pollution. Prerequisite: ([BIOL 2013](http://catalog.uark.edu/search/?P=BIOL%202013) and [BIOL 2011L](http://catalog.uark.edu/search/?P=BIOL%202011L)) or [BIOL 3123](http://catalog.uark.edu/search/?P=BIOL%203123). (Typically offered: Spring Odd Years) This course is cross-listed with [BIOL 4223](http://catalog.uark.edu/search/?P=BIOL%204223). | 3 |
| STAT 3003 | **Statistical Methods. 3 Hours.**  Describing Data, Basic Probability, Random variables, Uniform, Normal and Binomial Distributions, Sampling Distributions, Confidence Intervals, Hypothesis testing, Correlation and Regression, Contingency table, Comparing two populations, ANOVA. Prerequisite: [MATH 2554](http://catalog.uark.edu/search/?P=MATH%202554) or [MATH 2554C](http://catalog.uark.edu/search/?P=MATH%202554C). (Typically offered: Fall and Spring) | 3 |
| [SUST 4103](http://catalog.uark.edu/search/?P=SUST%204103) | **Capstone Experience in Sustainability. 3 Hours.**  A capstone experience focused on service learning, research learning, or internship in sustainability. Student engagement in community service, research, or relevant work on sustainability through a summer internship or equivalent experience provides opportunities for students to apply sustainability theories and principles learned from prior course work toward advancing sustainability across society. Prerequisite: [SUST 1103](http://catalog.uark.edu/search/?P=SUST%201103) and [SUST 2103](http://catalog.uark.edu/search/?P=SUST%202103). (Typically offered: Spring). | 3 |