

ENVIRONMENTAL SCIENCES (ES)

NOTE: All Environmental Sciences (ES) courses used as prerequisites for other Environmental Sciences courses must be completed with a grade of "C-" or better.

Environmental Sciences (ES) Courses

ES 1003. Survey Topics in Environmental Studies. (3-0) 3 Credit Hours.

A broad-based survey course intended to provide a comprehensive introduction to the multidisciplinary field of environmental studies. This course examines the ecological, social, political, and economic aspects of contemporary environmental issues from an interdisciplinary perspective. May be applied toward the Core Curriculum Component Area Requirement in Social and Behavioral Sciences. Generally offered: Fall and Spring. Course Fee: LRS1 \$46.20; STSI \$21.60.

ES 1111. Environmental Botany Laboratory. (0-3) 1 Credit Hour. (TCCN = BIOL 1111)

Laboratory studies to accompany Environmental Botany Lecture. Selected laboratories pertaining to the structure and function of plants. Generally offered: Fall and Spring. Course Fees: IUS1 \$15; L001 \$20; LRS1 \$15.40; STSI \$7.20.

ES 1113. Environmental Botany. (3-0) 3 Credit Hours. (TCCN = BIOL 1311)

Study of structure and function of plant cells, tissues, and organs. Includes an evolutionary survey and life histories of the following representative groups: algae, fungi, mosses, liverworts, ferns, and seed producing organisms. Plant reproductive and functional interactions with their environment and with humans. May apply toward the Core Curriculum requirement in Life and Physical Sciences. Generally offered: Fall and Spring. Course Fees: IUS1 \$15; LRC1 \$12; LRS1 \$46.20; STSI \$21.60.

ES 1121. Environmental Zoology Laboratory. (0-3) 1 Credit Hour. (TCCN = BIOL 1113)

Laboratory studies to accompany ES 1123 Environmental Zoology Lecture. Selected laboratories pertaining to animal taxonomy, genetics, anatomy, physiology, and ecology. Generally offered: Fall and Spring. Course Fee: IUS1 \$15; L001 \$30; LRS1 \$15.40; STSI \$7.20.

ES 1123. Environmental Zoology. (3-0) 3 Credit Hours. (TCCN = BIOL 1313)

An introduction to basic concepts in biology through the study of the major lineages of invertebrate and vertebrate animals, with emphasis on the structure and function of organ systems in an evolutionary context. Topics covered will include basic cell structure and function, genetics, systematics, evolution, animal groups, and selected body systems. Functional interactions of animals with humans and the environment will also be studied. May apply toward the Core Curriculum requirement in Life and Physical Sciences. Generally offered: Fall and Spring. Course Fee: LRC1 \$12; LRS1 \$46.20; STSI \$21.60; DL01 \$75.

ES 1211. Environmental Geology Laboratory. (0-3) 1 Credit Hour. (TCCN = GEOL 1105)

Laboratory studies to accompany Environmental Geology Lecture. Selected laboratories pertaining to urban and regional land use planning. Generally Offered: Fall and Spring. Course Fees: IUS1 \$15; L001 \$30; LRS1 \$15.40; STFE \$40; STSI \$7.20.

ES 1213. Environmental Geology. (3-0) 3 Credit Hours. (TCCN = GEOL 1305)

The earth as a habitat. Interrelationships between humans and the environment. Geologic factors in urban and regional land use planning. May apply toward the Core Curriculum requirement in Life and Physical Sciences. Generally offered: Fall and Spring. Course Fees: LRC1 \$12; LRS1 \$46.20; STSI \$21.60.

ES 1314. Environmental Statistics. (3-3) 4 Credit Hours. (TCCN = MATH 1442)

Collection, analysis, presentation, and interpretation of environmental data, and probability. Analysis includes descriptive statistics, correlation and regression, confidence intervals and hypothesis testing. Use of appropriate technology, including statistical software. Generally offered: Fall and Spring. Course Fees: IUS1 \$15; LRS1 \$61.60; STSI \$28.80.

ES 2003. Sophomore Research Experience (CURE) I. (1-4) 3 Credit Hours.

Prerequisite: ES 2013, ES 2023, ES 2021, and ES 2031 with a grade of at least a 'C-'; Restricted to students who have completed 30 or more hours. The organizing principles of environmental science are used to train students in modern laboratory or field techniques, bioinformatics, experimental design, and interpretation of results. This is the first semester of a year-long course-based research experience (CURE) in which students complete an original research project and present results to stakeholders outside of the classroom. (Same as BIO 2073. Credit cannot be earned for both BIO 2073 and ES 2033.) Generally offered: Fall. Course Fee: LRS1 \$46.20; STSI \$21.60; L001 \$30.

ES 2013. Introduction to Environmental Science I. (3-0) 3 Credit Hours. (TCCN = ENVR 1301)

An introduction to environmental science, including scientific principles, concepts, and methods needed to understand the interactions of the biotic (living) components in the natural world. Topics covered include environmental and scientific literacy, ecology, evolution and biodiversity, human populations and environmental health, and resource management and environmental policies. Core Curriculum skills, including critical thinking, quantitative skills, teamwork, and communication, are emphasized. (TCCN = ENVR 1301). May apply toward the Core Curriculum requirement in Life and Physical Sciences. Generally offered: Fall, Spring. Course Fee: DL01 \$75; LRC1 \$12; LRS1 \$46.20; STSI \$21.60.

ES 2021. Introduction to Environmental Science I Laboratory. (0-3) 1 Credit Hour. (TCCN = ENVR 1101)

Prerequisite: Concurrent enrollment in ES 2013 is recommended. Qualitative and quantitative methods in the study of biotic environmental systems. Generally offered: Fall, Spring. Course Fees: IUS1 \$15; L001 \$30; LRS1 \$15.40; STSI \$7.20.

ES 2023. Introduction to Environmental Science II. (3-0) 3 Credit Hours. (TCCN = ENVR 1302)

An introduction to environmental science, including scientific principles, concepts, and methods needed to understand the interactions of the abiotic (non-living) components of the natural world. Topics covered include waste and water resources, land and food resources, conventional energy and alternatives, and air quality and climate change. Core Curriculum skills, including critical thinking, quantitative skills, teamwork, and communication, are emphasized. (TCCN = ENVR 1302). May apply toward the Core Curriculum requirement in Life and Physical Sciences. Generally offered: Fall, Spring. Course Fee: LRC1 \$12; LRS1 \$46.20; STSI \$21.60; DL01 \$75.

ES 2031. Introduction to Environmental Science II Laboratory. (0-3) 1 Credit Hour. (TCCN = ENVR 1102)

Prerequisite: Concurrent enrollment in ES 2023 is recommended.

Qualitative and quantitative methods in the study of abiotic environmental systems. Generally offered: Fall, Spring. Course Fees: IUS1 \$15; L001 \$30; LRS1 \$15.40; STSI \$7.20.

ES 2113. Fundamentals of Geographic Information Systems (GIS). (3-0) 3 Credit Hours.

This course will be a basic introduction to the concepts and techniques of utilizing a Geographic Information System (GIS) to study and model environmental issues. This course will be taught hands-on using Windows-based industry-standard software. The goal of this course is that by the time of completion, students will have the competency of entry-level position skills. The theory and skills will include but are not limited to map-making best practices, data management, editing layers, features, databases, basic geoprocessing, GPS theory, and other GIS components. (Same as GEO 2113. Credit cannot be earned for both ES 2113 and GEO 2113.) Course Fee: IUS1 \$15; LRS1 \$46.20; STSI \$21.60.

ES 3003. Sophomore Research Experience (CURE II). (1-6) 3 Credit Hours.

Prerequisite: ES 2003 with a grade of at least a 'C-'. The organizing principles of environmental science are used to train students in modern laboratory or field techniques, bioinformatics, experimental design, and interpretation of results. This is the second semester of a year-long course-based research experience (CURE) in which students complete an original research project and present results to stakeholders outside of the classroom. (Same as BIO 3053. Credit can be earned for both ES 3003 and BIO 3053.) Generally offered: Spring. This course has Differential Tuition.

ES 3033. Ecology. (3-0) 3 Credit Hours.

Prerequisite: ES 1113 and ES 1123, or equivalents. Examination of the interactions of biotic and abiotic systems, including interactions of plants, animals, and the environment. (Same as BIO 3283. Credit cannot be earned for both ES 3033 and BIO 3283.) Generally offered: Fall, Spring. This course has Differential Tuition.

ES 3042. Ecology Laboratory. (0-6) 2 Credit Hours.

Prerequisite: ES 2021 and ES 2031, or equivalents; concurrent enrollment in ES 3033 is recommended. A laboratory and field-oriented course emphasizing modern ecological techniques, including examining plant and animal populations and measuring selected chemical and physical parameters. (Same as BIO 3292. Credit cannot be earned for both ES 3042 and BIO 3292.) Generally offered: Fall, Spring. This course has Differential Tuition. Course Fee: IUS1 \$15; L001 \$30; STFE \$40.

ES 3053. Environmental Remediation. (3-0) 3 Credit Hours.

Prerequisites: CHE 1083, CHE 1093, ES 2013, and ES 2023, or equivalents. This course will focus on the fundamentals associated with environmental remediation in relation to the overall environmental quality and protection. Topics covered include contaminant fate and transport; physical, chemical, and biological processes/characteristics of the air, soil, and water; remediation/restoration methods; environmental monitoring; environmental assessments; environmental regulations; and water/wastewater treatment. (Formerly ES 3054. Credit cannot be earned for both ES 3053 and ES 3054.) Generally offered: Spring. This course has Differential Tuition.

ES 3073. Environmental Rhetoric and Technical Communication. (3-0) 3 Credit Hours.

Prerequisite: ENG 2413. Restricted to students who have completed 60 or more hours. This course focuses on rhetoric, ecology, and technical/scientific communication in order to develop interdisciplinary, team-based, and applied research projects. This advanced professional writing and rhetoric course will examine ecological communications as an archetypal example of specialized technical communication. (Same as BIO 3073. Credit cannot be earned for both ES 3073 and BIO 3073.) Generally offered: Fall, Spring. This course has Differential Tuition.

ES 3103. Environmental Microbiology. (2-3) 3 Credit Hours.

Prerequisite: CHE 1083, CHE 1093, ES 2013, and ES 2023, or equivalents; or consent of instructor. This course will survey environmental microbiology and emphasize microbial interactions in terrestrial and aquatic environments as well as the fate of microbial pathogens. Topics covered include microbial environments, detection of bacteria and their activities in the environment, microbial biogeochemical cycling, bioremediation of organic and inorganic pollutants, and water quality. (Formerly ES 3104. Credit can only be earned for one of the following: ES 3103, ES 3104, or BIO 3713.) Generally offered: Fall. This course has Differential Tuition.

ES 3113. Ichthyology. (2-3) 3 Credit Hours.

Prerequisite: ES 1113 and ES 1123, or equivalents. Study of fishes, and includes a wide range of topics, including taxonomy, systematics, biogeography, anatomy and physiology, and behavior and ecology. This course will focus on form and function, behavior, life history, ecology, and key taxonomic characteristics of most orders of fishes. Field trips may be required. Same as BIO 3113, credit cannot be earned for both BIO 3113 and ES 3113. Generally offered: Spring. This course has Differential Tuition. Course Fee: STFE \$40; L001 \$15.

ES 3121. Introduction to Soils Laboratory. (0-3) 1 Credit Hour.

Prerequisites: CHE 1083 and CHE 1093, or equivalents. Laboratory exercise and field trips designed to develop student competency in soil description, analysis, and assessment. Generally offered: Fall and Spring. This course has Differential Tuition. Course Fee: IUS1 \$15; L001 \$30.

ES 3123. Introduction to Soils. (3-0) 3 Credit Hours.

Prerequisites: CHE 1083 and CHE 1093, or equivalents. A study of soil properties and processes and relationships to land use, plant growth, environmental quality, and society. Generally offered: Fall and Spring. This course has Differential Tuition.

ES 3133. Oceanography. (3-0) 3 Credit Hours.

Prerequisite: ES 1213 or equivalent. Description of the oceans. Emphasis on relations of biology, chemistry, geology, and physics in marine environments. Examination of relationships and interactions at macro and micro scales in the ocean. Field trips may be required. (Same as GEO 3163. Credit cannot be earned for both ES 3133 and GEO 3163.) Generally Offered: Spring of even years. This course has Differential Tuition.

ES 3141. Watershed Processes Laboratory. (0-3) 1 Credit Hour.

Prerequisite: ES 2013, ES 2023, ES 1213, and ES 2113, or equivalents. Laboratory exercises and field trips to local waterways designed to practice application of concepts, including watershed assessment and watershed management. Generally offered: Fall and Spring. This course has Differential Tuition. Course Fee: IUS1 \$15; L001 \$30; STFE \$40.

ES 3143. Watershed Processes. (3-0) 3 Credit Hours.

Prerequisite: ES 2013, ES 2023, ES 1213, and ES 2113, or equivalents. This course focuses on watershed processes concepts and application of concepts, including aquatic ecosystem management and restoration. Generally offered: Fall and Spring. This course has Differential Tuition.

ES 3153. Environmental Chemistry. (3-0) 3 Credit Hours.

Prerequisite: CHE 1083, CHE 1093, ES 2013, and ES 2023, or equivalents. This course explores the chemistry of the environment, the chemistry underlying environmental problems, and solutions to environmental problems. Emphasis is placed on thermodynamics and kinetics of reaction cycles; sources, sinks, and transport of chemical species; and quantitation of chemical species. Examples are selected from the chemistry of natural and contaminated air, water, and soil. (Same as CE 4613. Credit cannot be earned for both ES 3153 and CE 4613.) Generally offered: Spring. This course has Differential Tuition. Course Fee: LRS1 \$46.20; STSI \$21.60.

ES 3163. Ornithology. (2-3) 3 Credit Hours.

Prerequisite: ES 2013 and ES 2023, or equivalents. A course covering various aspects of the biology of birds, including anatomy, physiology, systematics, evolution, behavior, ecology, and biogeography. Field trips may be required. (Same as BIO 4063. Credit cannot be earned for both ES 3163 and BIO 4063.) Generally offered: Spring of even years. This course has Differential Tuition. Course Fee: STFE \$40; L001 \$10.

ES 3173. Mammalogy. (3-3) 3 Credit Hours.

Prerequisite: ES 1113 and ES 1123 with a grade of at least a C-. A course covering various aspects of the biology of mammals, including anatomy, physiology, systematics, evolution, behavior, ecology, and biogeography. Field trips may be required. (Same as BIO 3293. Credit cannot be earned for both ES 3173 and BIO 3293.) Generally offered: Fall of odd years. This course has Differential Tuition. Course Fee: STFE \$40; L001 \$10.

ES 3183. Entomology. (2-3) 3 Credit Hours.

Prerequisite: ES 1113 and ES 1123 with a grade of at least a C-. A course covering various aspects of the biology of insects, including systematics, anatomy, physiology, evolution, behavior, ecology, and biogeography. (Same as BIO 3303. Credit cannot be earned for both BIO 3303 and ES 3183.) Generally offered: Spring even years. Field trips may be required. This course has Differential Tuition. Course Fee: L001 \$10; STFE \$40.

ES 3193. Herpetology. (2-3) 3 Credit Hours.

Prerequisite: ES 1113 and ES 1123 with a grade of at least a C-. A course covering various aspects of the biology of amphibians and reptiles, including anatomy, physiology, systematics, evolution, behavior, ecology, and biogeography. Field trips may be required. (Same as BIO 3353. Credit cannot be earned for both ES 3193 and BIO 3353.) Generally offered: Fall of odd years. This course has Differential Tuition. Course Fee: L001 \$10; STFE \$10.

ES 3203. Environmental Law. (3-0) 3 Credit Hours.

Present-day environmental enabling acts and regulations will be covered, with emphasis on federal acts, such as the National Environmental Policy Act, Clean Water Act, Resource Conservation and Recovery Act, and associated regulations. Generally offered: Fall and Spring. This course has Differential Tuition.

ES 3213. Wildflower Identification. (1-6) 3 Credit Hours.

Prerequisite: Junior or senior status; a minimum of 60 semester credit hours. A study of the spring forbs emphasizing identification of the more common wildflowers of Texas. Family characteristics, flower anatomy, plant morphology, and plant-collecting techniques will be included. Lecture, laboratory, and fieldwork will be included in the course. (Same as BIO 3273. Credit cannot be earned for both ES 3213 and BIO 3273.) Generally offered: Spring. This course has Differential Tuition. Course Fee: STFE \$40.

ES 3223. Woody Plant Identification. (1-6) 3 Credit Hours.

Prerequisite: Junior or senior status; a minimum of 60 semester credit hours. A study of the woody plants emphasizing identification of the more common woody plants of Texas. Family characteristics, flower anatomy, plant morphology, and plant-collecting techniques will be included. Lecture, laboratory, and fieldwork will be included in the course. (Same as BIO 3263. Credit cannot be earned for both ES 3223 and BIO 3263.) Generally offered: Fall. This course has Differential Tuition. Course Fee: STFE \$40.

ES 3233. Survey of Insects. (3-0) 3 Credit Hours.

Prerequisite: ES 2013 and ES 2023 with a grade of at least a C-, and junior or senior status. Insect systematics, including major orders and families. (Same as BIO 3233. Credit cannot be earned for both BIO 3233 and ES 3233.) Generally offered: Spring even years. This course has Differential Tuition.

ES 3253. R Coding in Environmental Science and Ecology. (3-0) 3 Credit Hours.

Prerequisite: ES 2113. Restricted to students who have completed 60 or more hours. This course will teach the management of environmental and ecological data using Program R. The focus will be on the structure and linguistics of data in R and how to integrate R into a data science workflow. (Same as BIO 3253. Credit cannot be earned for both ES 3253 and BIO 3253.) Generally offered: Spring even years. This course has Differential Tuition.

ES 3303. Sustainable Development. (3-0) 3 Credit Hours.

Prerequisite: ES 2013 and ES 2023. Restricted to students who have completed 60 or more hours. This course will focus on addressing the challenges of sustainability and development with actionable knowledge for innovating solutions to the world's most pressing problems like climate change, poverty and inequality, and biodiversity loss and ecosystem degradation. Generally offered: Spring even years. This course has Differential Tuition.

ES 3313. Advanced Geographic Information Systems (GIS). (3-0) 3 Credit Hours.

Prerequisite: ES 1314 and ES 2113 or equivalents. This course will expand on student GIS skills from merely 'making maps' to geospatial data analysis and using GIS as a problem-solving tool. Introductory skills such as data management, layer editing, layout creation, and knowledge of map design, projections, and error will be assumed. This course will cover advanced analysis tools focusing on advanced spatial and 3D analysis and other geoprocessing techniques. Generally offered: Fall of odd years. This course has Differential Tuition. Course Fee: IUS1 \$15.

ES 3953. Topics in Environmental Science. (3-0) 3 Credit Hours.

Prerequisite: Consent of instructor. An organized course offering the opportunity for specialized study not normally or not often available as part of the regular course offerings. Field trips may be required. May be repeated for credit when topics vary. Generally offered: Fall and Spring. This course has Differential Tuition.

ES 4023. Aquatic Ecology. (3-0) 3 Credit Hours.

Prerequisite: ES 3033 and ES 3042, or equivalents. A survey of physiological approaches to understanding plant-environment interactions from the functional perspective. (Same as BIO 4303. Credit cannot be earned for both ES 4023 and BIO 4303.) Generally offered: Fall of even years. This course has Differential Tuition. Course Fee: STFE \$40.

ES 4033. Plant Physiological Ecology. (3-0) 3 Credit Hours.

Prerequisite: ES 3033 and ES 3042, or equivalents. A survey of physiological approaches to understanding plant-environment interactions from the functional perspective. (Same as BIO 4313. Credit cannot be earned for both ES 4033 and BIO 4313.) Generally offered: Fall of even years. This course has Differential Tuition.

ES 4073. Social Science Research Methods. (3-0) 3 Credit Hours.

Prerequisite: A minimum of 60 semester credit hours, or consent of instructor. The objective of this course is to introduce social science research methods which are (a) commonly used in biological research (e.g., human dimensions research, public lands management, medical research) and (b) essential for research directly engaging stakeholders and the public (e.g., citizen science or community-based research). The course engages ethical and legal obligations related to human-subjects research. It introduces 5 different data collection methods: surveys, interviews, focus groups, ethnographic and community-based research methods, as well as audiovisual/textual artifact analysis (e.g., photographs, etc.). Assignments emphasize writing skills specific to these methods and provide opportunities to actively engage different data collection methods (e.g., via field observations). This course has Differential Tuition.

ES 4103. Global Change. (3-0) 3 Credit Hours.

Prerequisite: ES 3033 or equivalent. This course will cover the large-scale physical mechanisms by which the climate is regulated through time as well as the probable future changes to global systems. The potential impacts on the abiotic and biotic systems will be discussed and considered. Past, current, and future efforts of local, national, and international entities to mitigate and adapt to future climate change scenarios will also be evaluated and assessed. (Formerly ES 4104. Credit cannot be earned for both ES 4103 and ES 4104.) Generally offered: Fall and Spring. This course has Differential Tuition.

ES 4111. Field Biology Laboratory. (0-3) 1 Credit Hour.

Prerequisite: Junior or senior status: a minimum of 60 semester credit hours, or consent of instructor; concurrent enrollment in ES 4113 and ES 4123 is recommended. A field-oriented course offering the opportunity for practical experience observing, collecting, and identifying Texas plants and animals. (Same as BIO 4241. Credit cannot be earned for both ES 4111 and BIO 4241.) Generally offered in Summer. This course has Differential Tuition. Course Fee: IUS1 \$15.

ES 4113. Field Biology. (3-0) 3 Credit Hours.

Prerequisite: Junior or senior status: a minimum of 60 semester credit hours, or consent of instructor; concurrent enrollment in ES 4111 and ES 4123 is recommended. A multi-week, off-campus, field-oriented course offering the opportunity for practical experience observing, collecting, and identifying plants and animals of the American Southwest. (Same as BIO 4233. Credit cannot be earned for both ES 4113 and BIO 4233.) Special fee to cover transportation and campsite costs. Generally offered: Summer. This course has Differential Tuition. Course Fee: IUS1 \$15; L001 \$30.

ES 4123. Desert Biology. (2-3) 3 Credit Hours.

Prerequisite: Junior or senior status: a minimum of 60 semester credit hours, or consent of instructor; concurrent enrollment in ES 4113 and ES 4111 is recommended. A multi-week, off-campus, field-oriented course focused on the study of the deserts of the world, emphasizing the deserts of the American Southwest. Adaptations of plants and animals and their responses to desert conditions, as well as examinations of desert climatic patterns, geology, and natural history. (Same as BIO 4043. Credit cannot be earned for both ES 4123 and BIO 4043.) Special fee to cover transportation and campsite costs. Generally offered: Summer. This course has Differential Tuition. Course Fee: IUS1 \$15.

ES 4133. Natural Resource Policy and Administration. (3-0) 3 Credit Hours.

A course designed to introduce students to the evolution of forest, range, wildlife, and related natural resources policies and administration in the United States. The National Environmental Policy Act (NEPA) and Endangered Species Act will be examined in detail. This course will expand upon ES 3203 (Environmental Law) and provide a historical perspective of natural resource conservation and the federal and state agencies that manage and oversee natural resources in the United States. The last part of this course will focus on non-governmental agencies, stakeholders, public relations, budgeting, and planning. This course is required for some tracks in the Integrative Biology program. Credit cannot be earned for both BIO 4233 and ES 4133. This course has Differential Tuition.

ES 4153. Introduction to Sustainability. (3-0) 3 Credit Hours.

Prerequisites: ES 2023 and junior or senior status: a minimum of 60 semester credit hours, or consent of instructor. This course will examine the major environmental issues and trends happening in modern society from a scientific and practical perspective, including biodiversity, population, food and water resources, climate change, energy, public health, and the overall forecast for the environment for the next several decades. This course has Differential Tuition. Course fee: DL01 \$75.

ES 4163. Renewable Energy. (3-0) 3 Credit Hours.

Prerequisite: ES 2023 and a minimum of 60 semester credit hours, or consent of instructor. This course is an introduction to sustainable energy systems and resources. This class examines the practical and economic potential of the current sustainable energy sources as well as investigates newer technologies on the energy horizon. By the end of this class, students should have an understanding of the fundamentals of thermal solar, photovoltaic, biomass, hydro, wind, wave, tidal, and geothermal energy sources, including their environmental impacts, economics, and future prospects. Generally offered: Fall of even years. This course has Differential Tuition.

ES 4173. Waste Water Treatment. (3-0) 3 Credit Hours.

A course designed to introduce students to the fundamentals of water pollution and wastewater treatment. Students will be introduced to sources of pollution and control measures with a focus on streams, rivers, lakes, and reservoirs. Soil and atmospheric interactions that can affect water resources will also be emphasized. A major focus of the course will be on ground and surface water pollution. Toxicology, risk assessment, remediation, and sampling methods will be discussed. The wastewater treatment process will be introduced. This course has Differential Tuition. Course Fee: IUS1 \$15.

ES 4183. Environmental Toxicology. (3-0) 3 Credit Hours.

Prerequisite: CHE 1083, ES 2013, and ES 2023 or equivalents. Examination of advanced or specialized hazardous or toxic waste treatment methods. Emphasis will be on physical, chemical, and biological processes in treatment and processing of hazardous waste materials. Generally offered: Spring. This course has Differential Tuition.

ES 4193. Planning and Response to Environmental Disasters. (3-0) 3 Credit Hours.

Prerequisite: CHE 1083, CHE 1093, ES 2013, and ES 2023, or equivalents. Mitigation of preparation for, response to, and recovery from environmental disasters. Generally offered: Fall of even years. This course has Differential Tuition.

ES 4203. Environmental Assessment. (3-0) 3 Credit Hours.

Prerequisites: ES 2013 and ES 2023, or equivalents. This course evaluates the framework of an impact assessment and details regarding the environment (air, water, soil), its pollutants (atmospheric, noise, water, solid waste), their impacts (physical, social, economic), relevant regulations, and pollution minimization or management strategies. Students use this information to review and comment on an existing Environmental Impact Statement (EIS). Generally offered: Fall and Spring. This course has Differential Tuition.

ES 4212. Professional Development for Environmental Science Careers. (2-0) 2 Credit Hours.

Prerequisite: A minimum of 60 semester credit hours. This course is a broad-based professionalization course in which students have the opportunity to participate in their own professional development; identify and define their skills and competencies; create a comprehensive resume and/or CV; navigate employment websites and social media; create, present and defend a professional portfolio virtually and in person, and participate in public speaking. (Formerly ES 4211. Credit cannot be earned for both ES 4212 and ES 4211. Formerly titled "Senior Seminar".) This course has Differential Tuition.

ES 4213. Conservation Biology. (3-0) 3 Credit Hours.

Prerequisite: BIO 3283 or ES 3033 or equivalents. Class topics will include identifying and/or explaining biological and ecological principles central to conservation biology; critically evaluating reasons for conserving ecosystems and ecosystem services; explaining how the human dimension (human behavior, economics, land use, and others) affects the conservation of species; evaluating strategies and tools used to conserve species or habitat at risk of extinction or destruction; demonstrating skills in science communication: articulate and communicate a breadth of knowledge of conservation biology, conservation challenges, policies, and programs. (Same as BIO 4033. Credit cannot be earned for both ES 4213 and BIO 4033.) Generally offered: Spring. This course has Differential Tuition.

ES 4223. Urban Wildlife Ecology. (3-0) 3 Credit Hours.

Prerequisite: ES 3033 and ES 3042. This course will introduce students to the ecology of wildlife in urban areas. The first section of the course will focus on the fundamental components of urban ecosystems that define urban wildlife ecology and explore urban wildlife ecology in a Coupled Human and Natural Systems (CHANS) framework. The second section of this course will introduce students to the population and community-level responses of wildlife to urbanization. Lastly, the course will discuss the management of wildlife in urban areas. This course has Differential Tuition.

ES 4233. Restoration Ecology. (3-0) 3 Credit Hours.

Prerequisite: ES 3033 or BIO 3283, or equivalents. Applies ecological principles to the restoration of disturbed terrestrial, wetland, and aquatic ecosystems. Includes the restoration of soils and waterways, of flora and fauna, and of natural ecological processes such as plant succession and nutrient cycling. (Same as BIO 4323. Credit cannot be earned for both ES 4233 and BIO 4323.) Generally offered: Spring. This course has Differential Tuition.

ES 4243. Wildlife Ecology. (3-0) 3 Credit Hours.

Prerequisite: ES 3033. Major environmental factors affecting wildlife; structure, and behavior of wildlife populations; regional wildlife communities and their conservation. (Same as BIO 4053. Credit cannot be earned for both ES 4243 and BIO 4053.) Generally offered: Spring even years. This course has Differential Tuition.

ES 4253. Sources, Fate, and Transport of Chemicals in the Environment. (3-0) 3 Credit Hours.

Prerequisites: ES 2013, ES 2023, and MAT 1093, or equivalents. Sources of chemicals in the environment. Processes regulating fate and transport of metals, organics, nutrients, salts, pathogens, and radionuclides in the environment. Generally offered: Fall and Spring. This course has Differential Tuition.

ES 4263. River Ecosystems. (3-0) 3 Credit Hours.

Prerequisite: ES 3033 with a grade of at least a 'C-'. This course examines the physical, chemical, and biological factors that determine biodiversity and the structure and function of aquatic and riparian ecosystems. Key ecological and hydrogeomorphology concepts and their application to environmental concerns are covered. (Same as BIO 4263. Credit cannot be earned for both BIO 4263 and ES 4263.) Generally offered: Spring of even years. This course has Differential Tuition.

ES 4273. Fish Ecology. (3-0) 3 Credit Hours.

Prerequisite: ES 3033 with a grade of at least a 'C-'. A study of the biotic and abiotic factors affecting the diversity and distribution of fishes, with a focus on North American freshwater fishes. This course will include (1) lectures and discussions covering patterns and processes in fish ecology; and (2) a collaborative research project covering computational techniques used in fish ecology. (Same as BIO 4273. Credit cannot be earned for both BIO 4273 and ES 4273.) Generally offered: Fall of even years. This course has Differential Tuition.

ES 4283. Plant-Soil-Microbe Interactions. (3-0) 3 Credit Hours.

Prerequisite: ES 3033 with a grade of at least a 'C-'. Restricted to students who have completed 60 or more hours. This course focuses on the microbial groups which live in soils and among plant species and methodologies used to understand their interaction. (Same as BIO 4283. Credit cannot be earned for both BIO 4283 and ES 4283.) Generally offered: Spring of odd years. This course has Differential Tuition.

ES 4293. Human Dimensions of Wildlife Management. (3-0) 3 Credit Hours.

Prerequisite: ES 1113 and ES 1123 with a grade of at least a C-. This course will introduce students to the role that humans play in the management of wildlife and how people's knowledge, values, and behaviors influence conservation decisions. Students taking this course will develop an understanding of the social, political, and economical drivers of wildlife management and explore ways to engage stakeholders in wildlife management through conservation tools and effective communication that considers human dimensions. An emphasis will be placed on working with private landowners to train students to work in private landscapes where culture, society, politics, and economics often provide the context for management decisions. This is highly relevant in Texas, where private lands comprise around 95% of the state. Generally offered: Spring in even years. This course has Differential Tuition.

ES 4303. Principles of Wildlife Management. (3-0) 3 Credit Hours.

Prerequisite: ES 4243. Ways of conserving desired numbers of animals for the overall best interests of society, be they aesthetic, ecological, economic, commercial, or recreational; includes management of endangered species, exploited species, wildlife communities in nature reserves, and wildlife pests. Generally offered: Spring even years. This course has Differential Tuition.

ES 4503. Introduction to Environmental Risk Assessment. (3-0) 3 Credit Hours.

Prerequisite: ES 4183 with a grade of "C-" or better. This course will offer hands-on training in the primary areas of risk assessment (i.e., hazard identification, dose-response assessment, exposure assessment, and risk characterization). Generally offered: Fall of odd years. This course has Differential Tuition.

ES 4513. Advanced Environmental Risk Assessment. (3-0) 3 Credit Hours.

Prerequisite: ES 4503 with a grade of at least a 'C-'. This course will offer hands-on training in the advanced areas of risk assessment (i.e., hazard identification, dose-response assessment, exposure assessment, and risk characterization). Generally offered: Spring of even years. This course has Differential Tuition.

ES 4911. Independent Study. (0-0) 1 Credit Hour.

Prerequisites: Permission in writing (form available) from the instructor, the student's advisor, the Department Chair, and Dean of the College in which the course is offered. Independent reading, research, discussion, and/or writing under the direction of a faculty member. May be repeated for credit, but not more than 6 semester credit hours, regardless of discipline, will apply to a bachelor's degree. Generally offered: Fall, Spring, Summer. This course has Differential Tuition.

ES 4912. Independent Study. (0-0) 2 Credit Hours.

Prerequisites: Permission in writing (form available) from the instructor, the student's advisor, the Department Chair, and Dean of the College in which the course is offered. Independent reading, research, discussion, and/or writing under the direction of a faculty member. May be repeated for credit, but not more than 6 semester credit hours, regardless of discipline, will apply to a bachelor's degree. Generally offered: Fall, Spring, Summer. This course has Differential Tuition.

ES 4913. Independent Study. (0-0) 3 Credit Hours.

Prerequisites: Permission in writing (form available) from the instructor, the student's advisor, the Department Chair, and Dean of the College in which the course is offered. Independent reading, research, discussion, and/or writing under the direction of a faculty member. May be repeated for credit, but not more than 6 semester credit hours, regardless of discipline, will apply to a bachelor's degree. Generally offered: Fall, Spring, and Summer. This course has Differential Tuition.

ES 4953. Special Studies in Environmental Science. (3-0) 3 Credit Hours.

Prerequisite: Consent of instructor. An organized course offering the opportunity for specialized study not normally or not often available as part of the regular course offerings. Special Studies may be repeated for credit when the topics vary, but not more than 6 semester credit hours, regardless of discipline, will apply to a bachelor's degree. Generally offered: variable. This course has Differential Tuition. Course Fee: DL01 \$75.

ES 4963. Internship. (0-0) 3 Credit Hours.

Prerequisite: Consent of the Undergraduate Advisor of Record. An opportunity for students to work in a setting that permits them to apply what they have learned in the formal instruction part of the program. Generally offered: Fall, Spring, Summer. This course has Differential Tuition.

ES 4991. Directed Research. (0-0) 1 Credit Hour.

Prerequisite: Approval from the instructor, the Department Chair, and the Associate Dean of Undergraduate Studies in the College for which this course is offered; form available on the College of Sciences website. Supervised research mentored by a faculty member engaged in active research within the student's designated area of concentration. The directed research course may involve either a laboratory or a theoretical problem. Students may produce a thesis in addition to active research. This course can also be used for students pursuing the COS Undergraduate Thesis Option. May be repeated for credit, but no more than 6 hours, regardless of discipline, in combination with ES 4911-3 (Independent Study), will apply to the Bachelor's degree. This course has Differential Tuition.

ES 4992. Directed Research. (0-0) 2 Credit Hours.

Prerequisite: Approval from the instructor, the Department Chair, and the Associate Dean of Undergraduate Studies in the College for which this course is offered; form available on the College of Sciences website. Supervised research mentored by a faculty member engaged in active research within the student's designated area of concentration. The directed research course may involve either a laboratory or a theoretical problem. Students may produce a thesis in addition to active research. This course can also be used for students pursuing the COS Undergraduate Thesis Option. May be repeated for credit, but not more than 6 hours, regardless of discipline, in combination with ES 4911-3 (Independent Study), which will apply to the Bachelor's degree. This course has Differential Tuition.

ES 4993. Directed Research. (0-0) 3 Credit Hours.

Prerequisite: Approval from the instructor, the Department Chair, and the Associate Dean of Undergraduate Studies in the College for which this course is offered; form available on the College of Sciences website. Supervised research mentored by a faculty member engaged in active research within the student's designated area of concentration. The directed research course may involve either a laboratory or a theoretical problem. Students may produce a thesis in addition to active research. This course can also be used for students pursuing the COS Undergraduate Thesis Option. May be repeated for credit, but not more than 6 hours, regardless of discipline, in combination with ES 4913-3 (Independent Study), will apply to the Bachelor's degree. This course has Differential Tuition.