Environmental Sciences

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Environmental Sciences
School of Natural Resources
College of Agriculture, Food, and Natural Resources
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Earth's environment provides conditions conducive for life: an oxygenated atmosphere; water resources; and soil as a medium for plant growth. Environmental processes occurring on the planet govern the movement of air, energy, matter, and water. Through the study of Environmental Sciences, students will learn the science and experience the beauty of the outdoor environment. This degree program addresses how human activities can adversely alter some environmental processes and environmental quality, techniques to improve environmental quality, modeling of environmental processes, and practices that minimize human impacts on the environment. The Environmental Sciences degree provides a strong science foundation through general science coursework and specialized studies of the atmosphere, land and soil, water, and environmental outreach and education. The degree combines interests in predicting and understanding weather patterns, monitoring environmental change, conserving and managing soil and biological organisms, assuring healthy streams and adequate water supplies, and improving environmental quality with the shaping of new policies and educating others about the natural environment and environmental issues. Example careers include Atmospheric Scientist, Climatologist, Environmental Specialist, Environmental Technician, Hydrologist, Land Manager, Meteorologist, Soil Scientist, and Water Quality Specialist. Employment may occur in a variety of sectors, including federal, state, county and city government agencies, non-government agencies (NGOs), and private consulting firms.

School of Natural Resources

The School of Natural Resources is one of six divisions in the College of Agriculture, Food and Natural Resources. It is Missouri's and the Midwest's only school with comprehensive academic and research programs focused on biological, physical, and social aspects of natural resources science and management. The School applies an integrated, scientific approach to develop sustainable solutions to environmental challenges and to train the next generation of natural resources and recreation professionals and leaders. This integrated approach results in creative course offerings, enhanced educational opportunities, stimulation of novel research, advanced understanding of natural systems, and expanded knowledge and management of human interactions with the environment. The School is housed in the Anheuser-Busch Natural Resources Building containing state-of-the-art teaching, research and outreach extension facilities.

Patrick Market, Director
The School of Natural Resources
103 Anheuser-Busch Natural Resources Building

Sonja Wilhelm Stanis, Associate Director
The School of Natural Resources
124 Anheuser-Busch Natural Resources Building

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SNR@missouri.edu

Faculty

Professor S. H. Anderson**, N. I. Fox**, A. R. Lupo**, P. S. Market**
Research Professor R. P. Udawatta **
Associate Professor K. Nelson*, R. North**
Assistant Professor N. Aloysius**, A. Argerich**, M. Davis**, K. Gibson*, Z. Leasor*, Q. Liu*, R. Rotman**, J. Wood*
Assistant Teaching Professor E. Aldrich
Instructor S. Lord
Professor Emeritus C. J. Gantzer, P. P. Motavalli
Associate Professor Emeritus R. J. Miles, S. E. Mudrick
Extension Associate Professor Emeritus P. E. Guinan
Adjunct Professor C. K. Wikle*
Adjunct Associate Professor N. R. Kitchen**
Adjunct Assistant Professor K. S. Veum*, C. Wright

* Graduate Faculty Member - membership is required to teach graduate-level courses, chair master's thesis committees, and serve on doctoral examination and dissertation committees.
** Doctoral Faculty Member - membership is required to chair doctoral examination or dissertation committees. Graduate faculty membership is a prerequisite for Doctoral faculty membership.

Undergraduate

- BS in Environmental Sciences (http://catalog.missouri.edu/collegeofagriculturefoodandnaturalresources/environmentalsciences/bs-environmental-sciences/)
  - with emphasis in Atmosphere (http://catalog.missouri.edu/collegeofagriculturefoodandnaturalresources/environmentalsciences/bs-environmental-sciences-emphasis-atmosphere/)
  - with emphasis in Land and Soil (http://catalog.missouri.edu/collegeofagriculturefoodandnaturalresources/environmentalsciences/bs-environmental-sciences-emphasis-land-soil/)
  - with emphasis in Outreach and Education (http://catalog.missouri.edu/collegeofagriculturefoodandnaturalresources/environmentalsciences/bs-environmental-sciences-emphasis-outreach-education/)
  - with emphasis in Water (http://catalog.missouri.edu/collegeofagriculturefoodandnaturalresources/environmentalsciences/bs-environmental-sciences-emphasis-water/)
- Minor in Environmental Sciences (http://catalog.missouri.edu/collegeofagriculturefoodandnaturalresources/environmentalsciences/minor-environmental-sciences/)

Graduate

Options for graduate study in SEAS will be offered through the MS in Natural Resources with an emphasis in SEAS (http://catalog.missouri.edu/collegeofagriculturefoodandnaturalresources/naturalresources/ms-natural-resources-emphasis-soil-environmental-atmospheric-sciences/) and the PhD in Natural Resources with an emphasis in SEAS (http://catalog.missouri.edu/collegeofagriculturefoodandnaturalresources/naturalresources/phd-natural-resources-emphasis-soil-environmental-atmospheric-sciences/).

Focus areas in soil science, environmental science or atmospheric science are available through these options. Details on both degree programs, including recommended preparation, admission criteria, required application materials, degree requirements and financial aid, are provided in the graduate tab of the Natural Resources section (http://catalog.missouri.edu/collegeofagriculturefoodandnaturalresources/naturalresources/#graduatetext) of the catalog under the College of Agriculture, Food and Natural Resources.

ENV_SC 1100: Introduction to Environmental Science
Environmental Science integrates physical, chemical, and biological processes to quantitatively examine changes in ecosystems, highlighting human impacts. This course introduces environmental issues and provides students with opportunities to discover their role in the environment. Students will learn the physical and social causes of environmental problems, their impacts, and strategies to mitigate these issues.

Credit Hours: 3

ENV_SC 1100H: Introduction to Environmental Science - Honors
Environmental Science integrates physical, chemical, and biological processes to quantitatively examine changes in ecosystems, highlighting human impacts. This course introduces environmental issues and provides students with opportunities to discover their role in the environment. Students will learn the physical and social causes of environmental problems, their impacts, and strategies to mitigate these issues.

Credit Hours: 3
Prerequisites: Honors eligibility required

ENV_SC 2001: Topics in Environmental Science - General
Organized study of selected topics. Subjects and credit may vary from semester to semester.

Credit Hour: 1-99

ENV_SC 2600: Sustainability Foundations: An Introduction to Sustainability
(same as BIOL_EN 2600). This course introduces fundamental concepts of sustainability from sustainable development to sustainability science. It focuses on human-environment systems, the characteristics of these systems, and patterns of change. Course materials interrogate taken-for-granted assumptions that shape human relationships with the natural world. You will learn to identify common dynamics leading to social and environmental problems with the aim of identifying alternative actions (solutions) for transitioning towards sustainability. Sustainability integrates the social and biophysical sciences; and implementing solutions requires the integration of the social justice, the arts, and humanities. Through a variety of interdisciplinary perspectives and frameworks, you will learn about current sustainability research and be able to develop an understanding of what sustainability means to you and your field of study. Graded on A-F basis only.

Credit Hours: 3

ENV_SC 2600H: Sustainability Foundations: An Introduction to Sustainability - Honors
(same as BIOL_EN 2600). This course introduces fundamental concepts of sustainability from sustainable development to sustainability science. It focuses on human-environment systems, the characteristics of these systems, and patterns of change. Course materials interrogate taken-for-granted assumptions that shape human relationships with the natural world. You will learn to identify common dynamics leading to social and environmental problems with the aim of identifying alternative actions (solutions) for transitioning towards sustainability. Sustainability integrates the social and biophysical sciences; and implementing solutions requires the integration of the social justice, the arts, and humanities. Through a variety of interdisciplinary perspectives and frameworks, you will learn about current sustainability research and be able to develop an understanding of what sustainability means to you and your field of study. Graded on A-F basis only.

Credit Hours: 3

ENV_SC 3085: Problems in Environmental Science
Special individualized projects or readings in environmental science.

Credit Hour: 1-99

ENV_SC 3250: Pollutant Fate and Transport
(same as CV_ENG 3250). Introduction to concepts governing pollutant fate and transport in the environment, including pollutant interactions within and migration through environmental systems, as well as analytical techniques and tools necessary to quantify conditions and movement.

Credit Hours: 3
Prerequisites: ENV_SC 1100 or SOIL 2100 or CV_ENG 3200; and CHEM 1320

ENV_SC 3290: Soils and the Environment
(same as SOIL 3290). Addresses the role of soils and soil properties on environmental pollution and management. Emphasis will be placed on carbon, nitrogen, phosphorus, and sulfur transformations and transport in natural and disturbed ecosystems and soil management practices and technology to prevent or remediate environmental pollution.

Credit Hours: 3
Prerequisites: SOIL 2100, ENGLSH 1000. Recommended 3 hours of CHEM courses

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ENV_SC 3290W: Soils and the Environment - Writing Intensive
(same as SOIL 3290W). Addresses the role of soils and soil properties on environmental pollution and management. Emphasis will be placed on carbon, nitrogen, phosphorus, and sulfur transformations and transport

in natural and disturbed ecosystems and soil management practices and technology to prevent or remediate environmental pollution.

Credit Hours: 3
Prerequisites: SOIL 2100, ENGLSH 1000. Recommended 3 hours of CHEM courses

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ENV_SC 3315: Practices in Sustainability and Regenerative Agriculture
The goal of this course is to learn how to advance resilient and sustainable food systems through science-based evidence and applied principles of sustainability and regenerative agriculture. This course involves participatory action research wherein students will actively evaluate case farms during the semester. Learning experiences and resources in the course will equip students with the tools to think critically and address problems associated with the transition towards a more sustainable agriculture. The course will be organized around local and global issues of regenerative farms and farmers. Through regular reflections, you will make personal connections between diverse issues in the food system. These issues are grounded in scientific principles but require you to practice negotiating moral and ethical dilemmas embedded in agricultural management practices. Graded on A-F basis only.

Credit Hours: 3
Prerequisites: Junior Standing
Recommended: ABM 2215, PLNT_SCI 2110, SOIL 2100, AN_SCI 1164/AN_SCI 1165, OR AN_SCI 1174/AN_SCI 1175

ENV_SC 3330: Environmental Land Use Management
An introduction to environmentally sustainable use and management of land.

Credit Hours: 3

ENV_SC 3400: Water Quality and Natural Resources Management
(same as NAT_R 3400). Introduction to broad aspects of water quality science, management, and policy. Topics include aquatic ecology, eutrophication, lake and coastal management, water supply and treatment, watershed management with respect to agriculture and urban development, and toxicology. Graded on A-F basis only.

Credit Hours: 3
Recommended: CHEM 1320 and ENV_SC 1100 or NAT_R 1070

ENV_SC 3500: Pollutant Fate and Transport
This course introduces students to concepts governing pollutant fate and transport in the environment, and it provides students with the quantitative tools necessary to estimate the fate and transport of pollutants in the environment.

Credit Hours: 3
Prerequisites: ENV_SC 1100 or SOIL 2100, and CHEM 1320

ENV_SC 4001: Topics in Environmental Science - General
Organized study of selected topics in environmental science.

Credit Hour: 1-99

ENV_SC 4024: Foundations of Environmental Education
(same as NAT_R 4024; cross-leveled with NAT_R 7024)This course provides a theoretical foundation to environmental education (EE). The purpose of this course is to develop the knowledge and skills for developing quality, age-appropriate EE for students in both formal and non-formal education setting. The emphasis is on EE curriculum materials, resources, and programs that can be used with students in settings at classrooms, nature centers, museums, and parks. This course involves training in the Missouri Department of Conservation Discover Nature School educational materials, and in observing and teaching EE lessons in a local nature center. Graded on A-F basis only.

Credit Hours: 3
Prerequisites: ENV_SC 1100 or Instructor's consent
Recommended: BIO_SC 1010 or NAT_R 1070 or NAT_R 2160

ENV_SC 4051: Environmental Art
(same as ART_VS 4051; cross-leveled with ART_VS 7051). This course explores environmental art as it emerged in contemporary art practice in the 1960's and 70's to the ways in which artists work within and engage the environment in diverse art forms today from site-responsive sculpture to eco-activism. Course content will be delivered through short presentations, video viewings, readings and practicum exercises that will build the foundation knowledge leading to the creation an on-site environmental art project students will work on over the course of the semester. Graded on A-F basis only.

Credit Hours: 3

ENV_SC 4085: Problems in Environmental Science
Special individualized research projects or readings in environmental science.

Credit Hour: 1-99

ENV_SC 4100: Lake Ecology
(same as NAT_R 4100; cross-leveled with ENV_SC 7100, NAT_R 7100). Ecology of inland waters with emphasis on productivity. Graded on A-F basis only.

Credit Hours: 3
Recommended: senior standing or BIO_SC 3650

ENV_SC 4200: Stream Ecology and Hydrology
(cross-leveled with ENV_SC 7200). This senior/grad course in stream ecology will provide students an opportunity to increase their knowledge about the ecology of flowing waters. The course will cover physical and biological elements of fluvial ecosystems, with a focus on mechanisms and processes and the discussion of critical issues associated with the conservation and management of streams and their biota. The course is built around lectures, assigned readings, and class and home activities. Graded on A-F basis only.

Credit Hours: 3
Prerequisites: 60 credit hours, MATH 1100
Recommended: BIO_SC 3650 or FOREST 4320

ENV_SC 4200W: Stream Ecology and Hydrology - Writing Intensive
(cross-leveled with ENV_SC 7200). This senior/grad course in stream ecology will provide students an opportunity to increase their knowledge about the ecology of flowing waters. The course will cover physical and biological elements of fluvial ecosystems, with a focus on mechanisms and processes and the discussion of critical issues associated with the conservation and management of streams and their biota. The course is built around lectures, assigned readings, and class and home activities. Graded on A-F basis only.

Credit Hours: 3
Prerequisites: 60 credit hours, MATH 1100
Recommended: BIO_SC 3650 or FOREST 4320

ENV_SC 4300: Methods in Lake Ecology
(same as NAT_R 4300; cross-leveled with ENV_SC 7300). Methods used for quantitative assessment of water quality and quantity in inland waters. Graded on A-F basis only.

Credit Hours: 2
Recommended: senior standing or BIO_SC 3650 and ENV_SC 4100/ NAT_R 4100 or ENV_SC 3400/NAT_R 3400

ENV_SC 4305: Environmental Soil Physics
(same as SOIL 4305). Study of soil physical properties and processes important in solving environmental problems. Topics include soil solids, water content and energy, and transport of water, solutes, gas and heat.

Credit Hours: 3
Prerequisites: SOIL 2100
Recommended: PHYSCS 1210 or equivalent

ENV_SC 4306: Environmental Soil Physics Laboratory
(same as SOIL 4306). Introduction to the methodology and equipment for measurement of soil physical properties and processes.

Credit Hours: 2
Prerequisites or Corequisites: ENV_SC 4305

ENV_SC 4308: Methods in Stream Ecology
(same as NAT_R 4308; cross-leveled with ENV_SC 7308, NAT_R 7308). Students will be introduced to common techniques to measure streamflow and characterize stream ecosystems from a physical and biological perspective. The course combines lectures with field and lab experiences. Graded on A-F basis only. Recommended Senior standing or BIO_SC 3650 and ENV_SC 4200 or FOREST 4390.

Credit Hours: 2

ENV_SC 4312: Environmental Soil Microbiology
(same as SOIL 4312). Microbiology/ecology of life in the soil ecosystem. Emphasis is placed on the role of microbes in nutrient cycling, microbial pesticide/xenobiotic transformation bioremediation, etc.

Credit Hours: 3
Prerequisites: SOIL 2100
Recommended: general microbiology

ENV_SC 4318: Environmental Soil Chemistry
(same as SOIL 4318 and GEOL 4318). Study of chemical constituents and processes occurring in soils. Topics include soil minerals and weathering processes, organic matter, solution chemistry, oxidation-reduction reactions and adsorption processes.

Credit Hours: 3
Prerequisites: SOIL 2100 or GEOL 2400, CHEM 1320 and CHEM 1330; junior standing or instructor's consent

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ENV_SC 4320: Hydrologic and Water Quality Modeling
(same as NAT_R 4320). Introduction to models for simulating hydrologic and water quality processes. Emphasis is placed on watersheds to provide experience with the use of simulation models for natural resource decision making.

Credit Hours: 3
Prerequisites: ENV_SC 1100 or SOIL 2100

ENV_SC 4396: Agroforestry for Watershed Restoration
Agroforestry for watershed restoration will focus on integrated approaches for improved water quality, soil health, and economic benefits. Students will learn principles and practices, critical analysis and application of agroforesty practices to improve overall environmental quality. May be repeated for credit. Graded on A-F basis only.

Credit Hours: 3
Prerequisites: FOREST 4385 or FOREST 7385

ENV_SC 4400: Environmental Law, Policy, and Justice
(cross-leveled with ENV_SC 7400, AAE 7400). This course will examine the intersection of environmental law, policy, and justice. We will first cover the building blocks of U.S. environmental law, including common law and statutes such as the Clean Air Act and the Clean Water Act. We will then turn to international environmental policy issues such as climate change, marine pollution, and the hazardous waste trade. We will approach these laws and treaties through the lens of equity and environmental justice. The course will use a variety of teaching methods, including lecture and classroom discussion using cold calling and the Socratic Method. We will also have student presentations, guest speakers, a moot court, a negotiation simulation, and a field trip in the Columbia, Missouri area. Graded on A-F basis only.

Credit Hours: 3
Recommended: Junior, senior, or graduate student status

ENV_SC 4400W: Environmental Law, Policy, and Justice - Writing Intensive
(cross-leveled with ENV_SC 7400, AAE 7400). This course will examine the intersection of environmental law, policy, and justice. We will first cover the building blocks of U.S. environmental law, including common law and statutes such as the Clean Air Act and the Clean Water Act. We will then turn to international environmental policy issues such as climate change, marine pollution, and the hazardous waste trade. We will approach these laws and treaties through the lens of equity and environmental justice. The course will use a variety of teaching methods, including lecture and classroom discussion using cold calling and the Socratic Method. We will also have student presentations, guest speakers, a moot court, a negotiation simulation, and a field trip in the Columbia, Missouri area. Graded on A-F basis only.

Credit Hours: 3
Recommended: Junior, senior, or graduate student status

ENV_SC 4450: Environmental Hydrology
(same as BIOL_EN 4450; cross-leveled with BIOL_EN 7450, ENV_SC 7450). This course provides an understanding, and the roles of natural processes and anthropogenic factors influencing the occurrence and the movement of water. Students will learn the quantitative basis of hydrology, which will help them to appreciate the scientific approach to understanding the observed phenomena. The material presented will provide sufficient knowledge for students to evaluate hydrologic processes associated with environmental systems and to develop conceptual evaluations that are part of water and natural resource assessments. Learning objectives: 1. Describe basic mechanisms and variables of hydrologic fluxes and states 2. Describe and define different mathematical formulations of hydrologic fluxes and states 3. Understand key components of a watershed model 4. Analyze, synthesize and interpret hydrologic data.

Credit Hours: 3
Prerequisites: MATH 1100 or MATH 1400 or STAT 1300 or consent of the instructor

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ENV_SC 4560: Observing the Earth from Space
(same as BIOL_EN 4560; cross-leveled with BIOL_EN 7560, ENV_SC 7560). This course provides an understanding of the theory and application of earth observing satellite remote sensing as a tool for environmental engineering and science. The topics include the fundamentals of electromagnetic radiation, satellite and sensor technology, integration of satellite and GIS data and digital image analysis. The lectures and homework assignments at the beginning of the course provide the necessary foundation to work with satellite imagery. Students will receive training with advanced image processing software and data acquisition techniques. The course will also cover case studies using remote sensing and image analysis techniques to answer real-world problems. The lectures and homework assignments include applications in forest management, land use change detection, monitoring agricultural activities, water and air quality monitoring, climate studies, and ecology and infectious diseases. The course will cover lectures on advanced remote sensing techniques towards the end of the course. Students will work on their independent projects during the last three weeks, applying remote sensing techniques to satellite images.

Credit Hours: 3
Prerequisites: MATH 1100 or MATH 1400 or STAT 1300 or consent of the instructor

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ENV_SC 4600: Sustainability Science Problem Solving
This course introduces fundamental concepts of sustainability science. It provides a survey of perspectives, frameworks, and competencies to engage in sustainability problem-solving. Students will develop an understanding for integrating critical concepts from economics and business, social and public policy, and environmental science and law to address pressing sustainability challenges. Through student-selected and student-led individual or group projects, principles learned will be used to analyze complex social-ecological problems to design alternative pathways towards sustainability. Graded on A-F basis only.

Credit Hours: 3
Prerequisites or Corequisites: ENV_SC 2600 or BIOL_EN 2600

ENV_SC 4600W: Sustainability Science Problem Solving - Writing Intensive
This course introduces fundamental concepts of sustainability science. It provides a survey of perspectives, frameworks, and competencies to engage in sustainability problem-solving. Students will develop an understanding for integrating critical concepts from economics and business, social and public policy, and environmental science and law to address pressing sustainability challenges. Through student-selected and student-led individual or group projects, principles learned will be used to analyze complex social-ecological problems to design alternative pathways towards sustainability. Graded on A-F basis only.

Credit Hours: 3
Prerequisites or Corequisites: ENV_SC 2600 or BIOL_EN 2600

ENV_SC 4940: Environmental Science Internship
Supervised professional experience with an approved public or private organization. Graded on S/U basis only.

Credit Hour: 1-99

ENV_SC 4945: Experiential Learning in Industry Internship in Environmental Science
Learning experience combining observation, application, and reflection in a discipline-based industry internship. Course appears on transcript for zero credit and does not count toward full-time enrollment. No tuition or fees are charged. Graded on S/U basis only.

Credit Hours: 0
Prerequisites: instructor's consent

ENV_SC 4950: Undergraduate Research in Environmental Science
Research apprenticeship with a faculty mentor. Students are expected to develop initial concept for the research, design experiments, collect data, and analyze data with faculty input, oversight, and guidance.

Credit Hour: 1-4
Prerequisites: ENV_SC 1100, STAT 1200
Recommended: 9 hours of Environmental Science with at least 3 hours above the 3000-level

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ENV_SC 4955: Experiential Learning in Research in Environmental Science
A supervised learning experience contributing to faculty research. Course appears on transcript for zero credit and does not count toward full-time enrollment. No tuition or fees are charged. Graded on S/U basis only.

Credit Hours: 0
Prerequisites: instructor's consent

ENV_SC 7001: Topics in Environmental Science
Organized study of selected topics in environmental science. Intended for graduate students.

Credit Hour: 1-99

ENV_SC 7100: Lake Ecology
(same as NAT_R 7100; cross-leveled with ENV_SC 4100, NAT_R 4100). Ecology of inland waters with emphasis on productivity. Graded on A-F basis only.

Credit Hours: 3
Recommended: BIO_SC 3650

ENV_SC 7200: Stream Ecology and Hydrology
(cross-leveled with ENV_SC 4200). This senior/grad course in stream ecology will provide students an opportunity to increase their knowledge about the ecology of flowing waters. The course will cover physical and biological elements of fluvial ecosystems, with a focus on mechanisms and processes and the discussion of critical issues associated with the conservation and management of streams and their biota. The course is built around lectures, assigned readings, and class and home activities. Graded on A-F basis only.

Credit Hours: 3
Prerequisites: 60 credit hours, MATH 1100
Recommended: BIO_SC 3650 or FOREST 4320

ENV_SC 7300: Methods in Lake Ecology
(same as NAT_R 7300; cross-leveled with ENV_SC 4300, NAT_R 4300). Methods used for quantitative assessment of water quality and quantity in inland waters. Graded on A-F basis only.

Credit Hours: 2
Recommended: senior standing or BIO_SC 3650. ENV_SC 4100 or NAT_R 4100 or NAT_R 3400

ENV_SC 7305: Environmental Soil Physics
(same as SOIL 7305). Study of soil physical properties and processes important in solving environmental problems. Topics include soil solids, water content and energy, and transport of water, solutes, gas and heat.

Credit Hours: 3
Prerequisites: SOIL 2100, PHYSCS 1210 or equivalent

ENV_SC 7306: Environmental Soil Physics Laboratory
(same as SOIL 7306). Introduction to the methodology and equipment for measurement of soil physical properties and properties and processes.

Credit Hours: 2
Prerequisites or Corequisites: SOIL 4305

ENV_SC 7308: Methods in Stream Ecology
(same as NAT_R 7308; cross-leveled with ENV_SC 4308, NAT_R 4308). Students will be introduced to common techniques to measure streamflow and characterize stream ecosystems from a physical and biological perspective. The course combines lectures with field and lab experiences. Graded on A-F basis only.

Credit Hours: 2
Recommended: BIO_SC 3650 and ENV_SC 4200/ENV_SC 7200 or FOREST 4390/FOREST 7390

ENV_SC 7312: Environmental Soil Microbiology
(same as SOIL 7312). Microbiology/ecology of life in the soil ecosystem. Emphasis is placed on the role of microbes in nutrient cycling, microbial pesticide/xenobiotic degradation and bioremediateion, soil quality and pathogen regulation in the environment. Nitrogen fixation, mycorrhizal processes are discussed.

Credit Hours: 3

ENV_SC 7318: Environmental Soil Chemistry
(same as SOIL 7318 and GEOL 7318). Study of chemical constituents and processes occurring in soils. Topics include soil minerals, and weathering processes, organic matter, solution chemistry, oxidation-reduction reactions and adsorption processes.

Credit Hours: 3
Prerequisites: SOIL 2100 or GEOL 2400, CHEM 1320 and CHEM 1330

ENV_SC 7320: Hydrologic and Water Quality Modeling
(same as NAT_R 7320). Introduction to models for simulating hydrologic and water quality processes. Emphasis is placed on watersheds to provide experience with the use of simulation models for natural resource decision making.

Credit Hours: 3
Prerequisites: ENV_SC 1100 or SOIL 2100 or equivalent

ENV_SC 7396: Agroforestry for Watershed Restoration
Agroforestry for watershed restoration will focus on integrated approaches for improved water quality, soil health, and economic benefits. Students will learn principles and practices, critical analysis and application of agroforesty practices to improve overall environmental quality. May be repeated for credit. Graded on A-F basis only.

Credit Hours: 3
Prerequisites: FOREST 4385 or FOREST 7385 or permission of instructor

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ENV_SC 7400: Environmental Law, Policy, and Justice
(same as with AAE 7400; cross-leveled with ENV_SC 4400). This course will examine the intersection of environmental law, policy, and justice. We will first cover the building blocks of U.S. environmental law, including common law and statutes such as the Clean Air Act and the Clean Water Act. We will then turn to international environmental policy issues such as climate change, marine pollution, and the hazardous waste trade. We will approach these laws and treaties through the lens of equity and environmental justice. The course will use a variety of teaching methods, including lecture and classroom discussion using cold calling and the Socratic Method. We will also have student presentations, guest speakers, a moot court, a negotiation simulation, and a field trip in the Columbia, Missouri area. Graded on A-F basis only.

Credit Hours: 3

ENV_SC 7450: Environmental Hydrology
(same as BIOL_EN 7450; cross-leveled with ENV_SC 4450). This course provides an understanding, and the roles of natural processes and anthropogenic factors influencing the occurrence and the movement of water. Students will learn the quantitative basis of hydrology, which will help them to appreciate the scientific approach to understanding the observed phenomena. The material presented will provide sufficient knowledge for students to evaluate hydrologic processes associated with environmental systems and to develop conceptual evaluations that are part of water and natural resource assessments. Learning objectives: 1. Describe basic mechanisms and variables of hydrologic fluxes and states 2. Describe and define different mathematical formulations of hydrologic fluxes and states 3. Understand key components of a watershed model 4. Analyze, synthesize and interpret hydrologic data.

Credit Hours: 3
Prerequisites: MATH 1100 or MATH 1400 or STAT 1300 or consent of the instructor

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ENV_SC 7560: Observing the Earth from Space
(same as BIOL_EN 7560; cross-leveled with ENV_SC 4560, BIOL_EN 4560). This course provides an understanding of the theory and application of earth observing satellite remote sensing as a tool for environmental engineering and science. The topics include the fundamentals of electromagnetic radiation, satellite and sensor technology, integration of satellite and GIS data and digital image analysis. The lectures and homework assignments at the beginning of the course provide the necessary foundation to work with satellite imagery. Students will receive training with advanced image processing software and data acquisition techniques. The course will also cover case studies using remote sensing and image analysis techniques to answer real-world problems. The lectures and homework assignments include applications in forest management, land use change detection, monitoring agricultural activities, water and air quality monitoring, climate studies, and ecology and infectious diseases. The course will cover lectures on advanced remote sensing techniques towards the end of the course. Students will work on their independent projects during the last three weeks, applying remote sensing techniques to satellite images.

Credit Hours: 3
Prerequisites: MATH 1100 or MATH 1400 or STAT 1300 or consent of the instructor

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ENV_SC 8001: Topics in Environmental Science
Organized study of selected topics in environmental science. Intended for graduate students.

Credit Hour: 1-99

ENV_SC 8090: Masters Research in Environmental Science
Original investigations in environmental science for presentation in a thesis. Graded on S/U basis only.

Credit Hour: 1-10

ENV_SC 8300: Journal Club in Water Resources
This Journal Club is a forum to gain practice reading scientific literature and asking analytical questions. The Club is student-driven. Each student will pick an article for individual presentation and group discussion. The articles will cover a variety of water resources topics based on student interests.

Credit Hour: 1

ENV_SC 8400: Solute Transport in the Vadose Zone
(same as SOIL 8400). Transport of water and solutes in geomedia with emphasis on development of the equations of flow. Evaluation of analytical and numeral solutions to equations describing transport phenomena.

Credit Hours: 3
Prerequisites: ENV_SC 7305 or SOIL 7305
