

# Earth and Environmental Systems

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Website: [sewanee.edu/academics/forestry-geology/](http://sewanee.edu/academics/forestry-geology/)

Forestry, geology, watershed analysis, and environmental study are the emphases of the Department of Earth and Environmental Systems. Students analyze the physical, biological, hydrological, and chemical components of natural landscapes, and they also address the economic, social, and political aspects of environmental issues as part of their study. The department stresses work both within and outside the classroom, and trains students to integrate their field observations with theoretical concepts and analytical data.

The department offers four majors, three minors, and a certificate of curricular study.

## Majors

- Environment and sustainability: The study of environmental policies and sustainability issues from a variety of perspectives.
- Forestry: A study of forest ecosystems and the environmental components and processes (biological, physical, and chemical) that affect them.
- Geology: A study of processes affecting the earth — geological, hydrological, and chemical.
- Natural resources and the environment: An interdisciplinary environmental major that integrates coursework in forest ecosystems and geology with other environmental coursework.

All majors in the Department of Earth and Environmental Systems emphasize an interdisciplinary study of the natural world, the interrelationships between geological, hydrological, and forest ecological processes, and the connections among issues such as climate change, land use, sustainable development, pollution, human health, and food systems. The forests and geological exposures on the University Domain and its environs, along with the stream drainages that comprise local watersheds, are the focus of both lab and field study. Other sites in the Appalachians, Rocky Mountains, Colorado Plateau region, and St. Catherine's barrier island are also studied in specific courses. Students in all majors develop skills appropriate to the study of natural systems. These include skills in computer use/analysis (database, word processing, and/or G.I.S. software), field identifications, laboratory analysis, and mapping and spatial analysis of variables in the field. Graduating seniors must demonstrate a broad knowledge of environmental issues (local, regional, and global) and must be competent in both oral and written communication skills. As part of this goal, all juniors in the department complete an oral presentations course or colloquium, and all seniors complete a collaborative and interdisciplinary senior field research project.

Students interested in majoring in environment and sustainability, forestry, geology, or natural resources and the environment have choices in required coursework, and they are advised to consult with a member of the department early in their college career to plan a sequence of courses appropriate to their interests and objectives.

## Minors

- Environmental studies: A study of environmental policy and sustainability issues from a variety of perspectives.
- Forestry: A study of forest ecosystems and the environmental components and processes (biological, physical, and chemical) that affect them.
- Geology: A study of processes affecting the earth — geological, hydrological, and chemical.

## Watershed Science Certificate

The watershed science certificate is designed for students interested in gaining a better understanding of the interactions among physical, chemical, and biological factors that affect our watersheds and wetlands. Students pursuing the certificate take a range of courses focusing on water resources and watershed science, their work culminating in the watershed science capstone course.

## Faculty

Professors: Knoll, Kuers, Potter, K. Smith (Chair), Torreano

Associate Professor: Sherwood

Assistant Professors: Fielding, Fornash, Keen, Neely, Watson

## Majors

## Majors

- Environment and Sustainability (<http://e-catalog.sewanee.edu/archives/2018-2019/arts-sciences/departments-interdisciplinary-programs/earth-environmental-systems/environment-sustainability-major>)

- Forestry (<http://e-catalog.sewanee.edu/archives/2018-2019/arts-sciences/departments-interdisciplinary-programs/earth-environmental-systems/forestry-major>)
- Geology (<http://e-catalog.sewanee.edu/archives/2018-2019/arts-sciences/departments-interdisciplinary-programs/earth-environmental-systems/geology-major>)
- Natural Resources and the Environment (<http://e-catalog.sewanee.edu/archives/2018-2019/arts-sciences/departments-interdisciplinary-programs/earth-environmental-systems/natural-resources-environment-major>)

## Minors

### Minors

- Environmental Studies (<http://e-catalog.sewanee.edu/archives/2018-2019/arts-sciences/departments-interdisciplinary-programs/earth-environmental-systems/environmental-studies-minor>)
- Forestry (<http://e-catalog.sewanee.edu/archives/2018-2019/arts-sciences/departments-interdisciplinary-programs/earth-environmental-systems/forestry-minor>)
- Geology (<http://e-catalog.sewanee.edu/archives/2018-2019/arts-sciences/departments-interdisciplinary-programs/earth-environmental-systems/geology-minor>)

## Certificate

The Watershed Science Certificate of Curricular Study is designed for students interested in gaining a better understanding of the interactions among the physical, chemical, and biological factors that affect our watersheds and wetlands. Students pursuing the certificate take a range of courses that focus on water resources and watershed science. In addition to hydrology, students take at least one half-course in applied watershed science, and choose additional watershed science courses from a list that contains offerings in a variety of disciplines, including biology, chemistry, forestry, geology, and environmental studies. Each student completes the certificate with the watershed science capstone course, a multidisciplinary, project-oriented course in which students address issues related to two or more of the following topic areas: the interaction of biological processes and watershed function, chemical processes in streams and watersheds, the relationship between forested landscapes and hydrologic systems, or geological processes in terrestrial aquatic systems. The capstone project may be a semester project created solely for the capstone, or may begin as a watershed-related summer internship project that is further developed by the student during an academic semester.

Students who obtain the certificate will be better prepared to pursue graduate training in watershed science and other hydrologic disciplines, or to begin careers associated with watershed science and management.

Students deciding to pursue the certificate should contact one of the faculty members of the Watershed Certificate Organizing Committee to develop his or her study plan. The Organizing Committee is also available to help a student identify his or her area of emphasis and primary faculty supervisor for the ESCI 430; together the student and primary supervisor identify the second discipline and arrange to work with a faculty member in that area.

## Requirements for the Certificate in Watershed Science

The certificate of curricular study requires successful completion of the following:

Code	Title	Semester Hours
<b>Course Requirements</b>		
ESCI 430	Watershed Science Capstone	4
FORS/GEOL 314	Hydrology (Lab)	4
Select one of the following:		2
ESCI 444	Independent Study (approved by the Organizing Committee)	
FORS 260	Forest Watershed Measurements	
GEOL 315	Watershed Contaminant Hydrology	
Select twelve hours from the following: <sup>1</sup>		12
BIOL 210	Ecology (Lab)	
BIOL 237	Freshwater Biology (Lab)	
ENST 217	Fundamentals of GIS	
ENST 235	Freshwater Conservation	
ENST 310	Comparative Watershed Studies	
ENST 311	Comparative Watershed Studies Field Course	
ENST 317	Advanced Applications of GIS	

ESCI 240	Island Ecology (Lab)
FORS 215	Fisheries Ecology and Management (Lab)
FORS 262	Forest and Watershed Restoration (Lab)
FORS 270	Water Resource Policy and Law
FORS 303	Soils (Lab)
FORS 305	Forest Ecology (Lab)
GEOL 303	Soils (Lab)
GEOL 411	Geochemistry of Natural Waters
Total Semester Hours	
22	

<sup>1</sup> Credit for only one GIS course may apply to the certificate

## Off-Campus Study

### Island Ecology Program

The island ecology program is an interdisciplinary summer field school in the sciences. Following a seminar during the Easter (spring) semester, students study geological, biological, and broadly ecological topics for five weeks on St. Catherines Island, an undeveloped barrier island off the coast of Georgia. The experience emphasizes the interdependence of these disciplines by exploring how the fragile ecosystem of the island functions. The program is limited to ten Sewanee students but is open to non-science as well as science majors. Four faculty members from two departments teach in the program each spring and summer.

## Courses

### Environmental Sciences Courses

#### ESCI 240 Island Ecology (Lab) (8)

This interdisciplinary field course combines the study of geology, oceanography, marine biology, botany, and wildlife behavior in a single coastal island ecosystem. *Prerequisite: Only open to students who have completed ENST 140 and been admitted to the Island Ecology program.*

#### ESCI 310 Oceanography (4)

A multi-disciplinary exploration of the ocean's diversity of dynamics, habitats, and organisms, with an emphasis on the complex processes that connect them. Foundational principles, methods and technology, and the latest progress in the marine sciences are covered. *Prerequisite: ENST 209.*

#### ESCI 430 Watershed Science Capstone (4)

Capstone course for students pursuing the watershed science certificate. A multidisciplinary, project-oriented course in which students address issues related to two or more of the following topic areas: the interaction of biological processes and watershed function, chemical processes in streams and watershed, the relation between forested landscapes and hydrologic systems, or geological processes in terrestrial aquatic systems. *Open only to seniors pursuing curricular certificates in watershed science.*

#### ESCI 444 Independent Study (2 or 4)

A supervised field or laboratory investigation of an interdisciplinary topic in environmental science. This course may be repeated for credit when the topic differs. *Prerequisite: Instructor prerequisite override required.*

#### ESCI 450 Readings in Environmental Sciences (2)

A course exploring and integrating themes in current and historical literature in archaeology, earth sciences, forestry, geography, spatial analysis, and watershed sciences. Open only to seniors pursuing majors in forestry, geology, or natural resources and the environment. *Open only to seniors pursuing majors in forestry, geology, or natural resources and the environment.*

### Environmental Studies Courses

#### ENST 100 Walking the Land (4)

A field-oriented geology and writing course, conducted on the Cumberland Plateau and surrounding provinces. The emphasis will be on observation of geological features, particularly geomorphology, and how these relate to other natural parts of the landscape. Historical aspects of human use of the land will also be emphasized. Extensive walking and hiking. Field journals will be part of the writing-intensive approach.

#### ENST 101 Introduction to Environmental Studies (4)

An interdisciplinary introduction to Environmental Studies through the examination of the scientific and social aspects of environmental issues. Field components of the course focus on the University Domain and the surrounding area. This course is required for all students who major or minor in environmental studies and should be taken before the junior year. *Open only to first-year students, sophomores, and juniors.*

**ENST 140 Readings in Island Ecology (2)**

Supervised readings and discussion in geology, hydrology, invertebrate zoology, marine zoology, maritime plant communities, and wildlife behavior as preparation for participation in the interdisciplinary summer Island Ecology program. *Prerequisite: Only open to students admitted to the Island Ecology program.*

**ENST 150 Introduction to "Nature" Writing (4)**

Students conduct experiments in nonfiction writing and critique, informed by study of the local environment and notable contemporary essays that discuss how "nature" is understood and represented. Class activities focus on literary craft, peer critique, and revision of written work. Field study provides both substance and inspiration for student writing. *Open only to new first-year students and sophomores.*

**ENST 201 Foundations of Food and Agriculture (4)**

Integrating local, regional, and global perspectives, this course outlines the history of agriculture, introduces the development of food systems and policy, and reviews the environmental impact of food production. Among topics addressed are the history of agricultural expansion in the US, the development of agriculture and food policies, interaction among agricultural markets at home as well as abroad, and sustainable agriculture. Classroom activities emphasize the involvement of multiple constituencies in identifying and articulating agricultural issues. Field opportunities include garden activities and local trips aimed at relating broader issues to how livelihoods are pursued on the Cumberland Plateau.

**ENST 205 Environmental Writing in Digital Media (4)**

An examination of the interaction between the digital revolution in writing and the environmental crisis. Readings and analysis of contemporary environmental writing in digital media are complemented by student writing and peer critique. Instruction includes both classroom and online work, with a focus on experiential investigation and critique of writing on digital platforms. *Prerequisite: ENST 101.*

**ENST 209 Ecosystems of the Ocean (4)**

As an introduction to the geologic, physical, chemical, and biological processes of the world's ocean, this course emphasizes its complex relationships with human cultures. Students in this course engage with a mix of readings from scientific journals, textbooks, and classic literature while conducting their own scientific reviews to pursue questions at the frontiers of ocean sciences.

**ENST 211 Sustainability and Global Environmental Change Seminar (2)**

This seminar-style course exposes students to literature on a variety of issues related to climate change and other examples of our dynamic global environment including natural resource use and natural hazards. *Prerequisite: Only open to students who have been admitted to the Global Environmental Change Field Studies Program.*

**ENST 212 Sustainability and Global Environmental Change Field Studies (2)**

This course is an interdisciplinary field immersion into a selected location that provides tangible experience of the concepts introduced in ENST 211. Students travel throughout the field site, exploring real-world examples of sustainability efforts in the context of our changing global environment. Concepts of sustainability, climate change, natural resource use, and natural hazards will be explored in the field context. Field sites may change from year to year. *Prerequisite: Only open to students who have been admitted to the Global Environmental Change Field Studies Program.*

**ENST 217 Fundamentals of GIS (4)**

An introduction to the basic concepts and applications of geographic information systems (GIS). Topics include geographic data acquisition, data management, cartography, and methods of geospatial analysis. Laboratory exercises and projects focus on applications of GIS in understanding and managing the environment. Laboratory course.

**ENST 235 Freshwater Conservation (4)**

A survey of existing and emerging threats to wetland ecosystems and the consequences for animal and human populations. This course discusses causes, consequences, and solutions for issues of international and local concern based on an understanding of freshwater ecology and function. Also considers multiple perspectives on water use and attempts to reconcile these differences so as to identify and publicize potential conservation solutions. *Prerequisite: BIOL 130 or ENST 101 or FORS 121.*

**ENST 250 Environmental and Biological Non-Fiction (4)**

An examination of contemporary intersections among literature, journalism, biological science, and the study of the environment, supplemented by readings of nineteenth- and twentieth-century antecedents. Assignments allow students to develop their own writing abilities in these areas. Consideration is also given to the relationships among non-fiction, fiction, and other forms of creative expression.

**ENST 263 Photography for Environmental and Social Impact (4)**

This course explores the ways in which environmental and social issues influence the economic, political, and cultural aspects of communities. Through interdisciplinary approaches with photography, students consider how an understanding of environmental and social relationships can lead to resilient, innovative communities and to community-based action. *Prerequisite or Corequisite: ART 263 or ART 363.*

**ENST 285 The Development of Aldo Leopold's Land Ethic (4)**

This course traces the development of Aldo Leopold's famous essay "The Land Ethic" through his 40-year career at the beginning of the ecology and conservation movements. Early writings by this noted conservationist are analyzed from the perspectives of environmental history and natural resource management and policy. Leopold essays from a broad spectrum of time (1915-1949) are discussed. Topics include ecosystem management, wildlife conservation and utilization; outdoor recreation, public lands, and wilderness; and agriculture as a land use. To contextualize Leopold's historical voice, perspectives on modern issues are contrasted with perspectives contemporary to Leopold. *Not open to new first-year students.*

**ENST 304 Community Development and Place in Rural Appalachia (4)**

Focusing on the rural counties of the Cumberland Plateau near Sewanee, this course explores environmental, cultural, historical, and political narratives that define the people and places of rural Appalachia. Economic and community development are examined not only through the literature on these topics but also through hands-on, applied learning in partnership with local communities, organizations, institutions, and leaders.

**ENST 305 Ecological Integrity in Agriculture (4)**

This course develops a critique of problems and solutions relating to agricultural technology, policy, and practice with a specific focus on ecology and ecological integrity. The course begins with a brief survey of agricultural history, through the era of modern food systems, with emphasis on the development of industrial agriculture. After evaluating the environmental impact of modern agriculture, the course addresses the foundations of sustainability, with specific reference to the ecology of sustainable agriculture. Field opportunities are provided for students to interact with local producers on their farms and to engage directly the ecological processes involved in food production on the Domain. *Prerequisite: BIOL 130.*

**ENST 306 Ecosystem Services (4)**

This course explores the myriad benefits that people derive from nature from an interdisciplinary perspective drawing on the natural and social sciences. In this course, students learn about the theory and measurement of ecosystem services through the peer-reviewed literature. Students will apply theory and skills in ecosystem service quantification to an engagement project with a community partner. *Prerequisite: BIOL 130 or ENST 101 or ECON 101 or PHIL 230.*

**ENST 310 Comparative Watershed Studies (2)**

The course compares watersheds of the Cumberland Plateau to those of the Kraichgau region of southwestern Germany. Emphasis is on the hydrology, geology, forest cover, and history of human use of select watersheds and how these factors have defined the present natural and cultural landscapes. *Prerequisite: GEOL 121.*

**ENST 311 Comparative Watershed Studies Field Course (2)**

A two-week field course in the Kraichgau region of southwestern Germany. The course is hiking-based and requires students to keep a detailed notebook. *Prerequisite: ENST 310.*

**ENST 317 Advanced Applications of GIS (4)**

This course uses spatial analysis methods for environmental analysis and management. Topics include remote sensing and image analysis, surface analysis, spatial statistics, internet mapping, visualization of geographic data, and other advanced GIS methods. *Prerequisite: ENST 217.*

**ENST 320 Environment and Sustainability Colloquium (4)**

This required course for junior environment and sustainability majors addresses some topical themes from an interdisciplinary perspective and with focus on the connections between science and policy. Colloquium themes vary from year to year, and students present relevant research articles and lead discussions with emphasis on developing skill in public speaking. Students also work with course instructors and faculty mentor(s) to propose a research project to be completed as part of their senior environment and sustainability capstone. *Open only to juniors pursuing majors in environment and sustainability. Prerequisite: ENST 101 and completion of the foundational science requirement in major.*

**ENST 325 Environmental Arts and Humanities Seminar (4)**

Required for junior Environmental Arts and Humanities majors, this course introduces students to noteworthy contemporary works in the fields of environmental arts and humanities, with a special emphasis on interdisciplinary sources. Students work on in-depth projects of their own in collaboration with environmental arts and humanities faculty, complete a proposal for their senior capstone project, and engage in substantive peer evaluation and critique. *Open only to juniors pursuing majors in Environmental Arts and Humanities. Open only to juniors pursuing majors in environmental arts and humanities. Prerequisite: ENST 101.*

**ENST 334 Environmental Policy and Law (4)**

This course combines the study of public policy with the study of major environmental problems. Students will explore public policy concepts and the instruments used in environmental regulation. Topics will include air and water quality issues hazardous waste and risk management, natural resources and biological diversity. The course will also discuss the impact of environmental groups and citizen activism on this highly complex area of public policy. *Not open for credit to students who have completed POLS 334. Prerequisite: ENST 101 or ENST 200.*

**ENST 336 Environmental Land-Use Policy (4)**

This course examines the complex systems and values influencing land-use decision-making in both rural and urban settings throughout the U.S. and abroad. Students learn how government agencies and local citizens often conflict in their attitudes and values regarding the costs and benefits of growth and development. Particular attention is paid to forest conversion issues on the South Cumberland Plateau. Students attend local planning sessions and meetings with local officials. *Prerequisite: ENST 101 or ENST 200.*

**ENST 340 Tools for Environmental Policy Analysis (4)**

This course introduces students to quantitative tools applicable to the analysis of environmental policy-including forecasting methods, simulation modeling, and mathematical programming. Probability distributions, risk modeling, and decision-making under uncertainty are also addressed. Students apply such tools to a range of policy analyses and also, where relevant, learn to work with large-scale models developed by others.

**ENST 350 "Nature" Writing (4)**

An exploration of the literature of "nature." Students interrogate ideas of nature and investigate literary responses to these ideas. Readings for the class include works from multiple cultural perspectives, including texts by writers for whom the idea of nature is alien or oppressive.

**ENST 351 Field Studies in "Nature" Writing (4)**

Students conduct experiments in writing and critique, informed by contemplative engagement with the community of life on the University's land. *Prerequisite: ENST 350.*

**ENST 400 Environmental Arts and Humanities Capstone (4)**

A capstone experience for Environmental Arts and Humanities majors. An examination of selected environmental issues from a variety of perspectives in the natural and social sciences and humanities. Special emphasis on student research on the Domain and in the region. *Open only to seniors.*

**ENST 421 Environment and Sustainability Capstone (4)**

This course provides a capstone experience for the Environment and Sustainability major. Major components include independent student research projects and an examination of selected environmental issues from a variety of perspectives in the natural and social sciences. *Open only to seniors pursuing majors in environment and sustainability. Prerequisite: ENST 320.*

**ENST 431 Practicum in Religion and Environment (2)**

This course, which calls for involvement in some faith-based or otherwise engaged form of appropriate activity or service, offers students a capstone opportunity to examine their spiritual experiences and religious beliefs in the context of active engagement with environmental issues in a variety of ways. Reflection on the engagement experience, expressed both in written form and through oral presentation, is required. *Open only to juniors or seniors pursuing minors in religion and the environment. Prerequisite: Instructor prerequisite override required.*

**ENST 444 Independent Study (2 or 4)**

An opportunity for students to explore a topic of interest in an independent or directed manner. *Prerequisite: Instructor prerequisite override required.*

**Forestry Courses****FORS 121 Introduction to Forestry (Lab) (4)**

An environmental survey course which addresses the important features, processes, and issues of forested landscapes. Topics include major tree species, forest biology and ecology, tree structure and function, silviculture, forest management, forest products, and U.S. forest policy and laws. The focus on North American forests is set within a context of global forest issues. Lab exercises emphasize fieldwork, utilizing the diverse array of local forest types present on the Cumberland Plateau and nearby Appalachian Mountains. Lecture, three hours, laboratory and field trips.

**FORS 204 Forest Wildlife Management (4)**

A survey and analysis of how vertebrate animals affect forest processes, with particular emphasis on forest regeneration on the Cumberland Plateau. This discussion-oriented class will also address the history and current status of U.S. and international wildlife management, and the effects of forest management on game and non-game species. Students will interact with wildlife management professionals in Tennessee and will design and implement a field study to quantify the effects of vertebrate animals on forest growth and development. *Prerequisite: FORS 121 or BIOL 130.*

**FORS 211 Dendrology (Lab) (4)**

This course explores the identification, biology and morphology of woody plants, with emphasis on the major forest species of North America. Primary focus is on the ecophysiological characteristics of species and their roles in forest succession, species distribution across the landscape, and responses to disturbance and environmental stress. Includes field identification of native trees and shrubs of the eastern U.S., with special emphasis on the Cumberland Plateau and the southeast. Lecture, laboratory, and weekend field trips. *Open only to sophomores, juniors, and seniors.*

**FORS 212 Tropical Forest Ecology and Management (4)**

An introduction to the ecology and management of forests and natural resources in the tropical biome. Social and technical aspects of forestry and natural resource management are considered. Topics include tropical forest ecology, techniques of forest and natural resource management, land tenure, the use of plants as pharmaceuticals, agroforestry, trees in traditional management systems, the forest as habitat, and the role of western environmental assistance in tropical countries.

**FORS 215 Fisheries Ecology and Management (Lab) (4)**

An introduction to the theory and practice of fisheries science. Particular emphasis is placed on approaches and techniques for assessing and managing fish populations, habitats, and ecosystems under commercial and recreational harvest; on human dimensions in fisheries management and policy; and on case studies of flawed management approaches throughout history. *Prerequisite: FORS 121 or BIOL 130.*

**FORS 230 Urban Forest Management (4)**

Study of the environmental stresses associated with urban landscapes and their impact on establishing and maintaining trees in urban environments. Topics include the theory and practice of individual tree care; biology of tree response to stress, disease, and nutrient assessment; impacts of trees on urban climate; and urban forest inventory and planning. *Prerequisite: FORS 121.*

**FORS 240 Special Topics (2 or 4)**

A seminar on a topic related to forestry and natural resources. This course may be repeated for credit when the topic differs. *Prerequisite: FORS 121.*

**FORS 250 Forests: Food, Medicine, and More (4)**

An exploration of the wide range of edible, medicinal, and otherwise useful forest products found in forests of western and eastern North America, including the forests of Sewanee. In addition to learning about the biology and distribution of these plants, and about how they are gathered and processed, students discuss the ecological implications of harvesting these interesting plants and fungi. Note: The class involves some eating. *Prerequisite: FORS 121 or BIOL 130.*

**FORS 260 Forest Watershed Measurements (2)**

A field and analysis course in which students learn the techniques of stream and watershed evaluation through active participation in a watershed monitoring project. Activities will focus upon stream and watershed sampling procedures, analytical laboratory techniques, and the synthesis, analysis, and reporting of data. Non-laboratory course. *Prerequisite: FORS 314 or GEOL 314.*

**FORS 262 Forest and Watershed Restoration (Lab) (4)**

A study of the principles and practices employed in forest and watershed restoration across North America. Emphasis placed on the scientific tenets of restoration (ecosystem function and process), field monitoring techniques, the concept of adaptive management, collaboration and conflict resolution, and the development of restoration policy. Laboratory course. *Prerequisite: FORS 121 or GEOL 121 or BIOL 130.*

**FORS 270 Water Resource Policy and Law (4)**

This case-studies based course focuses on the protection and management of water resources and associated biodiversity. Students are introduced to the principal federal and state laws governing the rights and responsibilities of landowners, with emphasis on how such regulation affects management decisions and economic outcomes. The course promotes understanding of the legal/regulatory environment through study of common and statutory law, as well as critical analysis of the outcomes. Case studies involve both international and local problems. Students gain practical experience by applying science-based monitoring guidelines and methods, together with opportunities for community engagement work.

**FORS 303 Soils (Lab) (4)**

A study of soils as they relate to land use, bedrock and geomorphology, site quality, and vegetation processes. Emphasizes field interpretation of soils as one component of terrestrial ecosystems. Lecture, three hours; laboratory and field trips. *Prerequisite: FORS 121 or GEOL 121.*

**FORS 305 Forest Ecology (Lab) (4)**

Explores the interrelationships between structure and function of forested ecosystems, approaching the forest community from a physiological perspective. Emphasizes the influence of microclimate, nutrient cycling, and disturbance on community productivity and composition. Lecture, three hours; laboratory and field trips. *Prerequisite: FORS 121 and one forestry course numbered 200 or above.*

**FORS 312 Silviculture (Lab) (4)**

Principles and practices of establishing, tending, and harvesting forest stands on a sustainable basis. Emphasis on ecologically sound techniques of managing forests to meet diverse landowner objectives such as watershed management, wildlife habitat enhancement, recreational use, insect and disease control, and/or timber production. *Prerequisite: FORS 121 and one forestry course numbered 200 or above.*

**FORS 314 Hydrology (Lab) (4)**

Occurrence, movement, quality, and behavior of water in the hydrologic cycle with emphasis on surface and underground water. Includes techniques and problems of measurement and utilization. Lectures, three hours; laboratory and field trips, three hours. *Prerequisite: GEOL 121.*

**FORS 319 Natural Resource Management and Decisions (4)**

A survey of theory and methods used in natural resource management analysis and decision making with an emphasis on forests and some other renewable resources such as wildlife. Students will use resource modeling and decision-making software to address problems in managing multiple resources. Emphasis will be on (1) evaluation of the effects of land characteristics, tax policy, risk, and interest rates on management; (2) choice among policy alternatives proposed by competing groups; and (3) application of concepts of management, policy, economics, and spatial analysis to land management. Practicums will involve analysis of resource data and presentation of preferred strategies. *Prerequisite: ECON 101 and (FORS 121 or BIOL 130).*

**FORS 332 Oral Presentations (2)**

Oral presentations of important topics and published data in forestry, geology, and other environmental sciences. Course goal is to train students through practice to give and critique oral presentations appropriate for scientific or other professional research. Each student gives several presentations and formally critiques other presentations as part of the course. *Open only to juniors or seniors pursuing majors in forestry, geology, or natural resources and the environment. Prerequisite: FORS 121 or GEOL 121.*

**FORS 432 Senior Field Project (4)**

An interdisciplinary field-based study of a selected portion of the university Domain or surrounding area. The primary focus of the study is to conduct a detailed analysis of interrelationships between the project area's geology, forest cover, hydrology, archeology, economics, history, and current use, and to use these parameters to critically evaluate the land-use issues of the area. Students produce a professional-quality written report of their analysis and also orally present their results to department faculty and seniors. *Open only to seniors pursuing majors in forestry, geology, or natural resources and the environment. Prerequisite: FORS 121.*

**FORS 444 Independent Study (2 or 4)**

An opportunity for students to explore a topic of interest in an independent or directed manner. *Prerequisite: Instructor prerequisite override required.*

**Geology Courses****GEOL 121 Physical Geology (Lab) (4)**

A study of the geological features and processes that shape the earth's surface and subsurface. Lectures detail major components of the earth and the dynamic processes that generate them (including rocks, minerals, fossils, mountain belts, ocean basins, tectonic activity, magma formation, and climate change). Environmental issues related to geology (earthquakes, landslides, volcanic activity, groundwater contamination, and coastal and stream erosion) are major topics of discussion. Field-oriented lab exercises utilize excellent geological exposures of the Cumberland Plateau and the nearby Appalachian Mountains. Lecture, three hours; laboratory and field trips (including one weekend trip).

**GEOL 221 Mineralogy (Lab) (4)**

A study of the occurrence, crystal structure, chemistry, and origin of minerals, with special emphasis on geological environments that form or modify them. Laboratory work includes hand-lens, microscopic, and X-ray diffraction analysis of minerals. Lecture, three hours; laboratory and field work. *Open only to juniors or seniors pursuing majors in forestry, geology, or natural resources and the environment. Prerequisite: GEOL 121 and one geology course at the 200 level or higher.*

**GEOL 222 Historical Geology (Lab) (4)**

A study of the history of the earth, including its physical environments, the history of life, and the tectonic development of the earth throughout geologic time as recorded in the rock record. Emphasis on North America and paleoenvironments of the Cumberland Plateau. Lecture, three hours; laboratory and field trips. *Prerequisite: GEOL 121.*

**GEOL 225 Sedimentology (Lab) (4)**

A study of sedimentary rocks and the processes that form them. Field and class studies stress the link between modern sedimentary environments and their ancient counterparts. Emphasis on rocks of the Cumberland Plateau and other nearby areas. Lecture, three hours; laboratory and field trips. *Prerequisite: GEOL 121.*

**GEOL 230 Paleocology (4)**

A study of individuals, populations, and communities of plants and animals of the geologic past: their taphonomic histories, interactions with changing environments, and relationships to the sedimentary rock record. One weekend field trip. *Prerequisite: GEOL 121.*

**GEOL 235 Earth Systems and Climate Change (4)**

A study of climate change, its causes, and the impact of such change on sea level, glacial regimes, and the development of life through geologic time. Special emphasis on evidence for past and recent climate change. *Prerequisite: GEOL 121.*

**GEOL 250 Special Topics (2 or 4)**

A seminar on a topic related to geology. This course may be repeated for credit when the topic differs. *Prerequisite: GEOL 121.*

**GEOL 303 Soils (Lab) (4)**

A study of soils as they relate to land use, bedrock and geomorphology, site quality, and vegetation processes. Emphasizes field interpretation of soils as one component of terrestrial ecosystems. Lecture, three hours; laboratory and field trips, three hours. *Prerequisite: FORS 121 or GEOL 121.*



**GEOL 305 Economic Geological Resources (Lab) (4)**

A study of economically valuable minerals and rocks (including metals, nonmetals, industrial minerals, and hydrocarbons) in terms of their origin, tectonic settings, extraction, and use. Topics include global distribution and genesis of deposits in relation to plate tectonic theory, prospecting techniques, mining methods, mining laws, economics of the mineral and petroleum industries, and environmental problems associated with exploration and development. Lecture, three hours; laboratory and field trips. *Open only to juniors or seniors pursuing majors in geology or natural resources and the environment. Prerequisite: GEOL 121 and one geology course at the 200 level or higher.*

**GEOL 314 Hydrology (Lab) (4)**

Occurrence, movement, quality, and behavior of water in the hydrologic cycle with emphasis on surface and underground water. Includes techniques and problems of measurement and utilization. Lectures, three hours; laboratory and field trips, three hours. *Prerequisite: GEOL 121.*

**GEOL 315 Watershed Contaminant Hydrology (2)**

This is a field and project-based course that investigates the movement of natural and man-made contaminants through the ground water and surface water systems of watershed. Non-laboratory course. *Prerequisite: GEOL 314.*

**GEOL 318 Geomorphology (Lab) (4)**

Geomorphology is the study of surficial landforms (erosional and depositional) and the processes that create them. This course investigates major controls on landform development, geologic structures, lithology, and erosional/depositional processes. Significant emphasis is on climatic, pedogenic (soil-related), and fluvial processes, with additional consideration given to glacial, eolian, karst, weathering, and slope-related (mass-wasting) processes. Labs focus on describing and measuring landforms in the field and quantitatively analyzing this data to understand better how local geomorphologic features form and evolve. Further course in introductory physics highly recommended. *Prerequisite: GEOL 121.*

**GEOL 320 Igneous and Metamorphic Petrology (Lab) (4)**

Systematic study of the genesis, occurrence, composition, and classification of igneous and metamorphic rocks. Topics to include origin and crystallization of different magma types, metamorphic processes, and tectonic environments specific to certain rock suites. Laboratory work includes hand specimen and microscopic examination of igneous and metamorphic rock suites. Lecture, three hours; laboratory and field trips. *Prerequisite: GEOL 221.*

**GEOL 322 Geology of the Western United States (4)**

The course focuses on the geological evolution of the Colorado Plateau, the Rio Grande Rift, and the Rocky Mountains. Extensive use of geologic maps and periodicals. An additional half course may be earned with successful completion of a field trip to the western United States. *Open only to juniors or seniors pursuing majors in forestry, geology, or natural resources and the environment. Prerequisite: One laboratory course in geology numbered 200 or above.*

**GEOL 323 Geology of the Western United States Field Trip (2)**

A detailed field notebook is kept by students on this three-week trip. *Prerequisite: Only open to students who have completed GEOL 322 and been admitted to the Geology of the Western U.S. Field Trip program.*

**GEOL 325 Field and Structural Geology (Lab) (4)**

A study of deformed rocks and an introduction to tectonics. Preparation and interpretation of geologic maps; solution of basic structural problems. Field work emphasizes geologic mapping on the Cumberland Plateau and in more structurally deformed areas in eastern Tennessee. Lecture, three hours. *Prerequisite: GEOL 121.*

**GEOL 332 Oral Presentations (2)**

Oral presentations of important topics and published data in forestry, geology, and other environmental sciences. Course goal is to train students through practice to give and critique oral presentations appropriate for scientific or other professional research. Each student gives several presentations and formally critiques other presentations as part of the course. *Open only to juniors or seniors pursuing majors in forestry, geology, or natural resources and the environment. Prerequisite: FORS 121 or GEOL 121.*

**GEOL 411 Geochemistry of Natural Waters (4)**

A quantitative examination of the chemical processes that occur in aquatic environments, including precipitation, gas exchange, acid-base, redox, complexation, and adsorption reactions. Emphasis is on equilibrium and steady-state calculations as a tool for understanding the distribution and fate of inorganic chemical species in natural waters. Examples and case studies are used to address a variety of water types (e.g., lakes, oceans, rivers, estuaries, groundwaters, and wastewaters), pollutant fate, and geochemistry. CHEM 311 and CHEM 352 recommended. *Prerequisite: CHEM 102 or CHEM 111.*

**GEOL 432 Senior Field Project (4)**

An interdisciplinary field-based study of a selected portion of the university Domain or surrounding area. The primary focus of the study is to conduct a detailed analysis of interrelationships between the project area's geology, forest cover, hydrology, archeology, economics, history, and current use, and to use these parameters to critically evaluate the land-use issues of the area. Students produce a professional-quality written report of their analysis and also orally present their results to department faculty and seniors. *Open only to seniors pursuing majors in forestry, geology, or natural resources and the environment. Prerequisite: GEOL 121.*

**GEOL 444 Independent Study (2 or 4)**

An opportunity for students to explore a topic of interest in an independent or directed manner. *Prerequisite: Instructor prerequisite override required.*