Earth and Environmental Systems

Websites: Environment and Sustainability (https://new.sewanee.edu/programs-of-study/environment-and-sustainability/), Forestry (https://new.sewanee.edu/programs-of-study/forestry/), Geology (https://new.sewanee.edu/programs-of-study/geology/), Natural Resources and the Environment (https://new.sewanee.edu/programs-of-study/natural-resources-and-the-environment/)

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. Catherines 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 (Chair), Sherwood, Torreano

Assistant Professors: Dahlquist, Ezell, L. Thompson, Watson

Majors

Majors

- Environment and Sustainability (http://e-catalog.sewanee.edu/archives/2023-2024/arts-sciences/departments-interdisciplinary-programs/earth-environmental-systems/environment-sustainability-major/)

- Forestry (http://e-catalog.sewanee.edu/archives/2023-2024/arts-sciences/departments-interdisciplinary-programs/earth-environmental-systems/forestry-major/)
- Geology (http://e-catalog.sewanee.edu/archives/2023-2024/arts-sciences/departments-interdisciplinary-programs/earth-environmental-systems/geology-major/)
- Natural Resources and the Environment (http://e-catalog.sewanee.edu/archives/2023-2024/arts-sciences/departments-interdisciplinary-programs/earth-environmental-systems/natural-resources-environment-major/)

Minors

Minors

- Environmental Studies (http://e-catalog.sewanee.edu/archives/2023-2024/arts-sciences/departments-interdisciplinary-programs/earth-environmental-systems/environmental-studies-minor/)
- Forestry (http://e-catalog.sewanee.edu/archives/2023-2024/arts-sciences/departments-interdisciplinary-programs/earth-environmental-systems/forestry-minor/)
- Geology (http://e-catalog.sewanee.edu/archives/2023-2024/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.

A student deciding to pursue the certificate should contact one of the faculty members of the Watershed Certificate Organizing Committee to develop their study plan. The Organizing Committee is also available to help a student identify their area of emphasis and primary faculty supervisor for 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
Course Requirements		
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: [1]		12
BIOL 210	Ecology (Lab)	
BIOL 237	Freshwater Biology (Lab)	
ENST 217	Fundamentals of GIS	
ENST 235	Freshwater Conservation	
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 150	American Rivers
GEOL 303	Soils (Lab)
Total Semester Hours	**22**

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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 195 Introductory Mentored Research (2 or 4)
Students will gain hands-on experience with the practice of field or laboratory research in the context of a faculty member's research program. Students will be introduced to research methods, hypothesis-driven research, and/or approaches to long-term environmental monitoring. This course may be repeated for credit at the discretion of the instructor. *Prerequisite: Instructor prerequisite override required.*

ESCI 205 Landscape Ecology (4)

ESCI 215 Sound, Soundscapes, and the Environment (4)
A study of sound and its roles in terrestrial and aquatic ecology, biodiversity conservation, and environmental justice. Topics include the evolution and ecology of sonic communication and soundscapes, the role of sound in the study and management of ecosystems, the origins and effects of noise pollution, and the future of Earth's sensory richness. Labs emphasize the appreciation, measurement, and analysis of sounds from the local environment. *Prerequisite: BIOL 130 or ENST 101.*

ESCI 220 The Science of Sustainability (4)
In this course, students learn to carry out their own independent research on important issues in environmental management and sustainability. Meetings are focused upon hands-on practice in experimental design, field data collection, data management, basic coding, project management, grant proposal writing, and public speaking. Throughout those experiences, students gain foundational knowledge in the sciences of climate change, carbon sequestration, pollution, and environmental justice. *Prerequisite: One course in Biology (BIOL), Chemistry (CHEM), Environmental Studies (ENST), Environmental Sciences (ESCI), Forestry (FORS), Geology (GEOL), Mathematics Physics (PHYS), or Statistics (STAT).*

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 295 Mentored Research (2 or 4)
Supervised field or laboratory investigation in environmental science. Students will work with a faculty member on a research project. Faculty members may pose scientific questions and design experiments, but students will conduct experiments and collect data. This course may be repeated for credit at the discretion of the instructor.

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 395 Advanced Mentored Research (2 or 4)
This course is designed for students who have a strong background in environmental research and are ready for independent work, ideally leading to the completion of an honors thesis. Students will work with a faculty research mentor to design and carry out data collection and/or analysis aimed to address a novel scientific question. This course may be repeated for credit at the discretion of the instructor. *Prerequisite: ESCI 295 and instructor prerequisite override required..*

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.*

ESCI 460 Honors Thesis (1)
This course is for students who are conducting research in environmental science and are working toward an honors thesis. A faculty supervisor(s) will support students as they finalize their research and prepare a written report and an oral presentation at Scholarship Sewanee (or equivalent). *Prerequisite: ESCI 395 (or concurrent enrollment in ESCI 395) and instructor prerequisite override required.*

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 130 Introduction to Earth Science (Lab) (4)
While living and studying along the shores of Lake Tahoe, students will explore areas from the California coast to Yosemite and the deserts beyond. More specifically, students will investigate the relationships between the geosphere, atmosphere, and hydrosphere while also developing scientific skills pertinent to modern society.

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 first-year students and sophomores.*

ENST 200 Introduction to Environmental Arts and Humanities (4)
An introduction to Environmental Arts and Humanities, this course acquaints students with the diverse perspectives offered by environmental approaches in the fields of literature, history, art, art history, classical studies, music, philosophy, anthropology, and religion. Students are expected to integrate three of these perspectives in a transdisciplinary research project. *Open only to 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 207 Introduction to Modeling for Sustainability (4)
This course explores the role of models in addressing the challenge of sustainability. Models allow us to describe and predict the behavior of people and ecosystems, to understand complex social-ecological systems, and to make informed decisions in light of uncertainty. In this class, students explore multiple types of models and how they are applied to sustainability topics through peer reviewed literature. Students learn to use multiple mental models to better understand complex systems, and are introduced to quantitative modeling in the programming platform R.

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 219 Environment, Conservation, and Policy Issues in Ecuador (4)
This course introduces students to the most influential factors shaping the ecosystems and their conservation, looking at the global, regional and local factors that determine the climates and the contrasting ecosystems that can be found in Ecuador. The course includes several field visits to the Ecuadorian Amazon (Tiputini Biodiversity Station) and the Galapagos Islands. Thus, allowing students to experience first-hand current topics of conservation and policy issues, while discussing the main environmental challenges associated with the conservation of natural ecosystems in tropical developing countries. *Prerequisite: Only open to students admitted to the Global Environmental Challenges program..*

ENST 225 Environmental Challenges: Linking the Global to the Local (4)
This course examines local environmental challenges in Cuenca, Ecuador, and explores connections to the broader global context. Emphasis will be placed on learning about the ways and beliefs of local cultures and understanding the difficulties in maintaining cultural identity in today's environmental economic climate. Experiential learning will be a significant element of the course, and students will regularly visit local communities and NGOs so that students can learn from those who are most affected by these issues. *Prerequisite: Only open to students admitted to the Global Environmental Challenges program..*

ENST 230 Native Americans and Land Use (4)
An introduction to the past and current distribution of Native American tribes in the Americas, with a particular emphasis on North America. This course will focus on the current literature regarding past land use as well as the hunting practices of the various tribes and how those practices have changed today.

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 241 Sustain Leaders Seminar I (2)
In the first of two seminars for Sustain Leaders, students prepare for the Sustain Leaders program by developing their chosen projects and practicing the skills necessary to serve as effective, principled leaders in sustainability. Discussion focuses on topics related to student projects in the context of the current sustainability environment with an emphasis on real-world developments, issues, and outcomes. The course also examines leading best practices and leadership strategies in the field of sustainability. Students will practice effective planning, project management, and presentation skills as well as verbal and written communication skills through independent and collaborative work on their projects. *Prerequisite: Only open to students admitted to the Office of Environmental Stewardship and Sustainability's Sustain Leaders Program.*

ENST 242 Sustain Leaders Seminar II (2)
This seminar is designed to complement ENST 241. Students will continue the development and finalization of proposed projects that were initiated in ENST 241 and continue exploring sustainability studies topics related to project development. *Prerequisite: ENST 241.*

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 252 Writing for the Earth Sciences (4)
Science doesn't exist in a bubble! This course aims to make students more comfortable writing about scientific topics for a wide range of target audiences. Topics will include: the anatomy of a scientific paper, understanding peer review, the effective use of statistics and visual aids, writing at the intersection of science and policy, effective scientific outreach and its impact on scientific literacy, communication in the digital age, and effectively describing research experiences in the context of applying to jobs and/or graduate programs.

ENST 254 Equitable Environmental Education (4)
A service-oriented exploration of environmental pedagogies, investigated through a critical lens that is dedicated to correcting historical barriers to access, opportunity, and belonging in nature for marginalized learners. Through readings, site visits, reflective writing, and self-designed lesson planning, students analyze educational models for developing environmental literacy, identity, and stewardship in learners of all ages in a wide range of contexts, from backcountry to rural county to inner city. *Prerequisite: ENST 101 or BIOL 101 or GEOL 121 or FORS 121.*

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 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, ECON 120, ENST 101, or PHIL 230.*

ENST 307 Food and Agriculture Policy (4)
This course covers how policy shapes food systems and the agricultural landscape throughout the United States. Specific units include the history of agricultural policy in the United States; agricultural markets; food safety; environmental impacts of agriculture; and policy innovations for sustainable agriculture. Field opportunities will seek to connect how policy shapes what we eat and the landscape around us. *Prerequisite: ENST 101.*

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 338 Marine Policy and Conservation (4)
A survey of the policies that have shaped humanity's relationship with marine resources coastal ecosystems throughout history and around the world. Using a case-study approach, this course critically evaluates how laws, treaties, and regulated markets interact with existing and emerging threats to the world's oceans. *Prerequisite: ENST 101 or ENST 209 or BIOL 130.*

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 399 Special Topics (4)
A seminar on a topic related to environmental studies. This course may be repeated for credit when the topic differs.

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 pursuing majors in environmental arts and humanities.*

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 the 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 225 Forests and Global Change (4)
This course examines how natural and anthropogenic changes in the earth system are affecting the composition, functioning, and stability of the world's forests. Topics include: the impacts of climate change, altered atmospheric chemistry, land-use change, invasive species, species extinctions, and sea level rise on forests at the regional scale and the accompanying feedbacks on the earth system at the continental to global scales. *Prerequisite: BIOL 130 or FORS 121.*

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 FORS 211.*

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 307 Biometrics (4)
Principles and methods employed in the estimation of forest and other natural resource parameters. Introduction to the uses of statistical models in drawing inferences about biological populations with an emphasis on sampling theory and field methods. Topics include: the scientific method, methods to assist students in the interpretation of both experimental and observational data, and elements of experimental design with an emphasis on biological applications. *Prerequisite: FORS 121 and (MATH 101 or STAT 204).*

FORS 312 Silviculture (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: BIOL 130, ECON 120, or FORS 121.*

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 150 American Rivers (4)
A watershed studies approach to investigating river systems of North and South America, including the Tennessee, Ocoee, Colorado, Amazon and Orinoco Rivers. Watersheds will be considered in terms of their geology, hydrology, forest cover and cultural history. Special emphasis will be placed on effects of pollution and climate change on these river systems.

GEOL 221 Mineralogy (Lab) (4)
A study of the chemistry, crystal structure, and properties of minerals. Lectures focus on the connection between the atomic structure and chemical bonding of minerals and the macro-scale physical properties that dictate their role in society. Laboratory work uses the physical properties of minerals observed in hand samples, combined with microscopy and X-ray diffraction to identify the most abundant minerals in the Earth's crust. *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 and Stratigraphy (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 229 Natural Hazards (4)
A study of natural hazards, their triggering factors, societal impacts, and methods of prediction, mitigation, and response. The course will examine earthquakes, volcanoes, floods, mass wasting (landslides), wildfire, and extreme weather events. Special emphasis is placed on local issues. One required Saturday field trip. *Prerequisite: GEOL 121 or GEOL 217.*

GEOL 230 Paleoecology (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 236 Geology of Our Solar System (4)
A study of the diverse geochemical and geophysical processes within our solar system, touching on terrestrial planets, gas giants, and minor bodies, including icy satellites. Lectures focus on the formation of the solar system, the interior structure of terrestrial planets, planetary atmospheres, volcanism, surface processes (fluvial, aeolian, impact), meteorites as clues to the solar system's origin, and current NASA missions. One required weekend field trip. *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 groundwater, streams, lakes and karst systems. 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)
A survey of the important natural and human-made contaminants and their movement through the groundwater and surface water systems of a watershed. Special emphasis is placed on metals and microplastics. *Prerequisite: GEOL 314.*

GEOL 318 Geomorphology (4)
Geomorphology is the study of surficial landforms (erosional and depositional) and the processes that create them. This course investigates major controls on the development and evolution of erosional and depositional landforms, with attention to the ways earth surface processes respond to tectonic and climatic forcing. Significant emphasis is on weathering, fluvial, and slope-related (mass-wasting) processes, with additional consideration given to glacial, eolian, karst, eathering, and pedogenic (soil-related) processes. The coursework will involve collecting and interpreting field data from different geomorphic environments on the Cumberland Plateau and quantitative analysis of remote sensing data. 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 (2)
The course focuses on the geological evolution of the West Coast, the Sierra Nevada, the Basin and Range, the San Andreas Fault, the Southern Cascades, and the Coast Ranges. Additional focus is placed on geologic issues and society, and the impact of geology on the living environment. Extensive use of geologic maps and periodicals. *Prerequisite: GEOL 121.*

GEOL 323 Geology of the Western United States Field Trip (4)
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 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.*