

Environmental Studies

Environmental Science

MAJORS, MINOR

PROFESSORS: Renee Godard (biology, director), LeeRay Costa (gender and women's studies), Bansi Kalra (chemistry), Edward A. Lynch (political science), Christina Salowey (classical studies), Annette Sampon-Nicolas (French, international studies), Morgan Wilson (biology)

ASSOCIATE PROFESSORS: Jon D. Bohland (international studies), Pablo Hernandez (economics), Thorpe Moeckel (English)

ASSISTANT PROFESSORS: Mary Jane Carmichael (biology), Margaret (Meg) du Bray (environmental studies), Brian Gentry (physics), Elizabeth Gleim (biology)

AFFILIATED FACULTY: Vladimir Bratic (communication studies), Bonnie Bowers (psychology), Julie M. Clark (mathematics and statistics), Casimir Dadak (business), James Patrick Downey (philosophy), Lori J. Joseph (communication studies), Darla Schumm (religious studies)

The field of environmental studies/environmental science (ES) explores the relationship between humans and the environment. To fully understand the causes and consequences of environmental problems, and to acquire skills for developing potential solutions, an interdisciplinary approach that draws on the natural and social sciences, as well as the arts and humanities, is required. The environmental studies program offers two degree pathways for students to explore the field.

The B.A. degree in environmental studies provides students, through the core curriculum, with a background in environmental issues from scientific, cultural, historical, and societal perspectives. With this grounding, B.A. students may then explore the field through a wide distribution of elective courses in environmental studies and affiliated programs. Thus, the B.A. degree provides students significant flexibility in selecting courses that fit their interests.

The B.S. degree is more focused on developing scientific and quantitative skills which students can use to approach environmental problems at the most fundamental of levels. The Hollins ES program is distinguished by its experiential component, which requires all majors (B.A. and B.S.) to be involved in an internship or service project that pertains to their field of interest within the interdisciplinary approach of environmental studies. In addition, our affiliation with the School for Field Studies allows both B.A. and B.S. students the opportunity to study abroad and to receive major elective (and in some instances core) credit for the courses taken in this program.

REQUIREMENTS FOR A MAJOR IN ENVIRONMENTAL STUDIES (B.A.):

12 courses (minimum of 46 credits) and Experiential Component

CORE COURSES (7)

- ES 117: Environmental Science (4)
- ECON 157: Principles of Microeconomics (4)
- ES 207: Ecology and ES 207L (4, 2)
- ES 234: Environmental Politics and Policy (4) **or** SFS course: Policy and Socioeconomic Values
- ES 357: Conservation Biology (4) **or** SFS Principles of Resource Management
- ES 470: Senior Seminar in Environmental Studies (4)

FIVE ADDITIONAL COURSES

- One course must be at 300 level and three courses must be at 200 level or higher
- Two courses must be ES, the other three can come from ES or affiliated courses listed below

EXPERIENTIAL COMPONENT

- All students must complete an experiential component, which consists of a related internship, service project, or completion of the Hollins Outdoor Leadership certificate.

ENVIRONMENTAL STUDIES COURSES

- ES/PHYS 121: Introduction to Oceanography and Hydrogeology (4)
- ES/INTL 210: World Geography (4)
- ES/ANTH/GWS 219: Food, Culture, and Social Justice (4)
- ES/INTL 220: Globalization and Local Responses (4)
- ES/PHYS 225: Energy and the Environment (4)
- ES/ECON 230: Economics and the Environment (4)
- ES/PHYS 236: Wind, Water, and Weather (4)
- ES/PHYS 241: Geology and Earth History (4)

- ES 250: Special Topic in Environmental Studies (2–4) (may be taken more than once for credit)
 - ES/INTL 305: Cultural Geography and Landscape Studies (4)
 - ES/BIOL 337/337L: Ornithology (4, 2)
 - ES/BIOL 328: Field Vertebrate Zoology (4)
 - ES/BIOL 341/341L: Plant Biology (4, 2)
 - ES 352: Topics in Human Geography (4)
 - ES 390: Independent Study (2 or 4) *
 - ES 480: Senior Thesis *
 - ES 490: Senior Honors Thesis *
 - Four elective courses are also available through the Hollins affiliated School for Field Studies. For more information see page 10 or contact Renee Godard
- * A student may apply up to two semesters of ES 390, ES 480, and ES 490 toward her elective courses.

AFFILIATED COURSES:

DIVISION I

- PHIL 181: Contemporary Moral Issues (4)
- PHIL 252: Ethics (4)
- REL 126: Introduction to Religion in a Global Context (4)
- REL 218: Buddhist Traditions (4)

DIVISION II

- ANTH 145: Introduction to Anthropology (4)
- BUS 224: Ethical Leadership (4)
- COMM 225: Public Speaking (4)
- COMM 231: Writing for the Print Media I (4)
- COMM 238: Argumentation and Advocacy (4)
- COMM 322: Public Relations Principles (4)
- COMM 380: Global Communication & Media (4)
- ECON 241: Economics of Social Issues (4)
- ECON/INTL 259: International Political Economy (4)
- ECON 265: International Trade (4)
- ECON 312: Economics of Globalization and Development (4)
- GPS 121: Foundations of Social Justice (4)
- GWS/INTL 252: Gender and Globalization (4)
- INTL 120: Introduction to International Studies (4)
- INTL/POLS 302: Comparative Urbanism (4)
- INTL 303: Geopolitics (4)
- INTL 307: International Tourism (4)
- POLS 118: Controversial Issues in American Politics (4)
- POLS 226: International Law (4)
- POLS 363: Constitutional Law (4)
- SOC 234: Social Problems (4)

DIVISION III

- BIOL 236/236L: Cell and Molecular Biology (6)
- BIOL 312/312L: Microbiology (6)
- BIOL 313/313L: Invertebrate Zoology (6)
- BIOL/PSY 323/323L: Animal Behavior (6)
- BIOL/ES 341/341L: Plant Biology (6)
- CHEM 214/214L: Analytical Chemistry (6)
- CHEM 221/221L and 222/222L: Organic Chemistry I and II (6, 6)
- PSY 208: Research Statistics (4)
- STAT 251: Statistical Methods I (4)

REQUIREMENTS FOR A MAJOR IN ENVIRONMENTAL SCIENCE (B.S.):

17 courses plus related laboratories (62-76 credits) and Experiential Component

CORE COURSES (7)

- ES 117: Environmental Science (4)
- ECON 157: Principles of Microeconomics (4)

- ES 207: Ecology (4) and ES 207L (4, 2)
- ES 234: Environmental Politics and Policy (4) or SFS course: Policy and Socioeconomic Values
- ES 357: Conservation Biology and ES 357L (4,2) or SFS Principles of Resource Management
- ES 470: Senior Seminar in Environmental Studies (4)

ADDITIONAL SCIENCE/MATH COURSES (9)

- CHEM 101/101L and 102/102L (12) **or** CHEM 105/105L (6)
- PHYS 151/151L and PHYS 152/152L: Physical Principals I and II (12) **or** PHYS 201/201L and PHYS 201/201L Analytical Physics I and II (12)
- PSY 208: Research Statistics (4) **or** STAT 251: Statistical Methods (4)
- STAT 324: Data Wrangling with R (2)
- Three additional science courses from the following: BIOL 236/236L: Cell and Molecular Biology (6); BIOL 312/312L Microbiology (6); BIOL 313/313L Invertebrate Zoology (6); BIOL 323/323L Animal Behavior (6); BIOL/ES 328: Field Vertebrate Zoology; ES/BIOL 337/337L: Ornithology (6); BIOL/ES 341/341L: Plant Biology (6); CHEM 214/214L: Analytical Chemistry (6); CHEM 221/221L: Organic Chemistry I (6); CHEM 222/222L Organic Chemistry II (6); ES/PHYS 241: Earth History and Geology (4); ES/PHYS 236: Wind, Weather, Water; ES/PHYS 225: Energy and the Environment (4); ES 364: Biogeochemistry (4); School for Field Studies courses: SFS Directed Research (4); SFS Regional Ecology (4); SFS Resource Management (4); one semester of ES 390/480

ADDITIONAL ENVIRONMENTAL STUDIES COURSE (1)

- One course from the following: ES/PHIL 182: Environmental Ethics (4); ES/INTL 210: World Geography (4); ES/ANTH/GWS 219: Food, Culture and Social Justice (4); ES/INTL 220: Globalization and Local Response (4); ES/ECON 230: Economics and the Environment (4); ES/INTL 305: Cultural Geography and Landscape Studies (4); ES/CLAS 311: Environmental History of Ancient Mediterranean; SFS Policy and Socioeconomic Values (4)

EXPERIENTIAL COMPONENT

- All students must complete an experiential component, which consists of a related internship, service project, or completion of the Hollins Outdoor Leadership certificate.

REQUIREMENTS FOR A MINOR IN ENVIRONMENTAL STUDIES:

7 courses (26 credits)

- ES 117: Introduction to Environmental Studies (4)
- ES 207: Ecology (4) and ES 207L (4, 2)
- ES/POLS 234: Environmental Politics and Policy (4)
- Three additional courses from the list of environmental studies elective courses or affiliated courses.

COURSES IN ENVIRONMENTAL STUDIES:

ES 117: ENVIRONMENTAL SCIENCE (4)

Carmichael, du Bray

This lecture/laboratory core course for ES majors explores how organisms, communities, and ecosystems function under natural conditions, as well as how they function under human influence. We will cover a variety of current environmental concerns in both the classroom and laboratory, including the patterns of human population growth, the extinction crisis, global warming, acid rain, water pollution, solid waste management, sustainable agriculture, and renewable energy. Also listed as BIOL 117. Open to first-year students. No prerequisite. Offered both terms. (SCI)

ES 121: INTRODUCTION TO OCEANOGRAPHY/HYDROGEOLOGY (4)

Department

In this course we discuss the principles of physical, chemical, biological, and geological oceanography and hydrogeology. The course explores the dynamics and evolution of the oceans/ocean basins. Also, the course examines the occurrence, characteristics, movement, quality, development, and contamination of the Earth's water systems. These principles will be applied to water pollution, toxic waste, deforestations, soil erosion, biodiversity, and global warming. Also listed as PHYS 121. Open to first-year students. Prerequisite: q. Not offered in 2020-21. (Q, SCI)

ES 133: MARINE ECOLOGY (2)

Godard, Wilson

Students in this course will examine the ecology of marine ecosystems. Additionally, they will learn to recognize and identify characteristics and behavior of more than 100 marine species. This course is only open to students that will be participating in The Caribbean Environment Short Term course. Students will be enrolled by instructor. Also listed as BIOL 133. Open to first-year students with permission. Not offered in 2020-21.

ES 182: ENVIRONMENTAL ETHICS (4)**Lowney**

This seminar applies classical and modern moral theories to environmental issues. It includes philosophical examination of current ecological theory as it relates to environmental science. Central topics include pollution, global warming, population growth, animal rights, environmental degradation, conservation of the biosphere, and responsibilities to future generations. You are encouraged to think for yourself logically about these and other environmental philosophical issues. Also listed as PHIL 182. Open to first-year students. No prerequisite. Offered Term 2.

ES 207: ECOLOGY (4)**Gleim, Godard**

As one of the core courses for the environmental studies major, we will explore the structure and function of the natural world. We will examine the relationships between organisms and their physical and biological environment, global patterns of climate and biological life, patterns in population dynamics, as well as structure and change in communities of organisms. Also listed as BIOL 207. Open to first-year students. No prerequisite. Offered Term 1. (SCI: must take lab to fulfill SCI)

ES 207L: ECOLOGY LAB (2)**Gleim, Godard**

We will explore local aquatic and terrestrial ecosystems as well as gain hands-on experience carrying out ecological research in this field laboratory course. Students will also have several opportunities to carry out their own independent research. Also listed as BIOL 207L. Corequisite: ES 207. Offered Term 1. (SCI)

ES 210: WORLD GEOGRAPHY (4)**Bohland**

This course examines the methods of geography applied to global issues, patterns and linkages in the arrangement of human physical resources, mapping and elements of spatial analysis, and area studies. Also listed as INTL 210. Open to first-year students. Offered Term 2. (GLO, MOD)

ES 219: FOOD, CULTURE, AND SOCIAL JUSTICE (4)**Costa**

Explores the meanings of food and food-related practices in various cultural contexts in relation to structures of power and inequality including those shaped by race, ethnicity, gender, class, nationality, and geography. All students will participate in a community partnership project with a local food organization and volunteer a minimum of 20 hours during the semester. Also listed as ANTH/GWS 219. Prerequisite: sophomore standing. Not offered in 2020-21. (DIV)

ES 220: GLOBALIZATION AND LOCAL RESPONSES (4)**Breske**

Analyses of international issues and systems based on social science perspectives and methodologies, including statistics. Topics are drawn from the following: trade, finance, and development; diplomacy, terrorism and security; technology and communication; demographics and immigration; energy and transportation; and the global environment. Also listed as INTL 220/POLS 221. Open to first-year students. Prerequisite: *q*. Offered Term 2. (Q, GLO)

ES 225: ENERGY AND THE ENVIRONMENT (4)**Gentry**

This course will examine the physics of energy with a focus on human energy use and production and their effect on the environment. It will utilize the physical concepts of work, energy, and power with applications from electricity and magnetism and thermodynamics to provide an understanding of the challenges faced in implementing ecologically and economically sustainable energy. Not open to first-years. Prerequisite: ES 117 or PHYS 151 or PHYS 201. Also listed as PHYS 225. Not offered in 2020-21.

ES 230: ECONOMICS AND THE ENVIRONMENT (4)**Hernandez**

This course introduces students to conventional and unconventional views behind the interplay between the economizing problem and nature's household. Emphasis is placed on the management of natural resources from an economic standpoint. The course explores general and most urgent natural resources and environmental problems facing humanity, including: energy sources, water, agriculture, fisheries, and industrial pollution. The course addresses these environmental problems from the standard economic approach to environmental distress and the more avant-garde ecological economic approach to nature's household. Also listed as ECON 230. Open to first-year students. Prerequisite: ECON 157. Not offered in 2020-21. (*o, r, GLO, MOD*)

ES 234: ENVIRONMENTAL POLITICS AND POLICY (4)**Du Bray**

This course introduces environmental politics from a grass-roots, state, and international perspective. We analyze social movements, policymaking, patterns of consumption, developmental imperatives, and political culture. Among the key issues we examine are: the role of community, scientific, bureaucratic, media, and industry interests in shaping environmental discourse and policy. Close inspection of conditions such as car culture and fast food will help

us understand the complexity of formulating uniform international environmental policy. Also listed as POLS 234. Open to first-year students. Prerequisite: q. Offered Term 1. (A or I) (Q, GLO)

ES 236: WIND, WATER AND WEATHER (4)

Gentry

This course examines the physical principles of earth's dynamic weather systems, utilizing important concepts from physics, geology, hydrology, and meteorology. Students will gain a broad understanding of interactions between the atmosphere and fresh and ocean water, including global circulation systems, storms, weather forecasting, the carbon cycle and the greenhouse effect. Special emphasis will be placed on human-induced climate change. Also listed as PHYS 236. Open to first-year students. Prerequisite: ES 117 or PHYS 151 or PHYS 201 or Permission of Instructor. Offered Term 2.

ES 240: ONE HEALTH: LINKING HUMAN, ANIMAL, AND ENVIRONMENTAL HEALTH (4)

Gleim

Nearly two-thirds of all human infectious diseases are transmissible to animals and vice versa. One Health is a world-wide movement which focuses on the intersectionality of human, animal, and environmental health and how interdisciplinary efforts can be made to better study and solve these problems. This seminar-based course will take a case study approach to explore concepts and approaches integral to One Health. Key diseases and issues related to human, animal, and environmental health for which this approach could or has been utilized will be explored along with its associated peer-reviewed literature. This course is specifically targeted towards pre-health, pre-vet, and public health students, along with students interested in field biology and environmental science. Also listed as BIOL/PH 240. Pre-requisites: BIOL/ES 207/207L, BIOL 236/236L, or permission. Not offered in 2020-2021

ES 241: EARTH HISTORY AND GEOLOGY (4)

Gentry

Planet Earth's development as an integrated physical, chemical, and biological system over the past 4.6 billion years. Topics include: the origins of the solar system, Earth, and Moon; forces driving Earth's chemical and geological differentiation; plate tectonics; origins of life and humans; Earth's system dynamics; humans as geological agents; and Earth's climate system. Open to first-year students. Also listed as PHYS 241. Not offered in 2020-21. (SCI)

ES 250: SPECIAL TOPIC: BACKYARD BIRDS (2)

Wilson

Have you ever wondered what the names of the birds are that frequent your backyard birdfeeder? Do you wish you could identify bird songs? Are you curious about the biology and natural history of birds? In this field-oriented course, students will develop skills enabling them to identify, by both sight and sound, birds common to southwestern Virginia. We will explore a variety of habitats and observe the morphology and behavior of birds in their natural environments during several key aspects of their annual cycle (over-wintering, spring migration, and breeding). Not intended for students majoring in biology. Open to first-year students. Also listed as BIOL 250. No prerequisite. Offered Term 2.

ES 250: SPECIAL TOPIC: NATURING COMMUNITY/NURTURING CONNECTION (4)

Costa, Godard

In this special topics course we will take a transdisciplinary and interdisciplinary approach to examine the relationships between human beings and the natural world. Recent research suggests that a connection to nature fosters the mental and physical well-being of individuals, the health of communities, and conservation of the earth support systems. Through readings, films, the close study of nature, and contemplative exercises we will explore the ways that we are interconnected with and dependent upon nature, and the ways that our social, environmental, and spiritual practices and beliefs both reinforce and dismantle such relationships. We will consider what it means to be in right relationship with the living world, how we can better cultivate connection to the earth, and how we can become more accountable for climate crisis in order to ensure a healthy planet and future for all beings. Beyond the scheduled classes, we will have a couple field trips during the semester to explore diverse Appalachian ecosystems. Also listed as GWS 250. Offered Term 2.

ES 271: POLITICS OF THE WORLD'S OCEANS (4)

Lynch

This course is designed to introduce the student to the most important contentious issues, including environmental issues, concerning the world's oceans. Since human beings learned to travel great distances across the seas, they have found themselves in conflict over bases, colonies and resources, and also over the handling of environmental issues related to the exploitation of the resources. We will begin by looking at the early European presence in the Atlantic, Indian and Pacific Oceans, and how international law and the international political system sought to handle those conflicts. We will move on to current issues concerning the oceans, from fishing to cruising. Open to first-years. Also listed as POLS 271. Offered Term 1. (MOD, GLO)

ES 290: INDEPENDENT STUDY (2 or 4)

Department

Independent study conducted below the advanced level. Application must be made with faculty prior to registration. Offered any term.

ES 305: CULTURAL GEOGRAPHY AND LANDSCAPE STUDIES (4)**Bohland**

This course introduces the student to the study of culture and landscape interpretation within modern geography. The course examines cultural processes and how they interact and construct the world we inhabit. After introducing a number of key themes and theoretical perspectives that will recur throughout the semester, we will be looking at cultural processes present within different geographical examples. In each of these cases we highlight popular cultural aspects such as sports, music, television and film, literature, etc. Also listed as INTL 305. Open to first-year students with permission. No prerequisite. Not offered in 2020-21.

ES 311: ENVIRONMENTAL HISTORY OF THE ANCIENT MEDITERRANEAN (4)**Salowey**

Humans have never existed in isolation but have had an awareness of and lived intertwined with the complex natural world that surrounds them. This is as true for the ancient societies in Mesopotamia, Egypt, Greece, and the Roman Empire, as it is for our contemporary world. Ancient mythologies, literature, theology, philosophy, and art give expression to the attitudes about nature. Farmsteads, urban centers, religious sanctuaries... and garbage pits preserve evidence of human alterations to their environment. New scientific and archaeological methods aid in exploring the adaptations forces on ancient inhabitants by earthquakes, floods, eruptions, landslides, and climate changes. This course introduces the essential primary and secondary sources, and research methods for discovering the destructive and successful ways humans have lived in the ancient Mediterranean, and explores and critiques a variety of case studies from across the region. Also listed and described as CLAS 311. Not offered in 2020-21. (PRE)

ES 316: WILDLIFE DISEASE (4)**Gleim**

This lecture/ lab course will provide a general understanding of disease ecology and examine both common and newly emerging diseases that are known to impact wildlife. We will also work to better understand the roles these diseases play in population regulation, conservation of rare and endangered species, and the impacts that these diseases can have on human and domestic animal health. Lab components of the course will involve both field and laboratory-based experiences involved in routine testing of wildlife and/or vectors for pathogens. Also listed as BIOL/PH 316. Pre-requisites: BIO/ES 207/207L, BIO 236/236L, or permission. Offered Term 2.

ES 328: FIELD VERTEBRATE ZOOLOGY (4)**Godard**

In this lecture/lab course, we will use vertebrates as our focus as we explore issues of evolution, ecology, physiology, behavior and conservation as well as develop skills associated with studying vertebrates in the field. Beyond the scheduled classes, students are required to participate in a 3-day weekend field trip to the Eastern Shore of Virginia to study avian biodiversity as well as several evening excursions to examine patterns of amphibian biodiversity. Course fee of \$150 is required. Prerequisite: BIOL/ES 207 or permission from instructor. Also listed as BIOL 328. Prerequisite: BIOL/ES 207 or permission. Offered Term 2.

ES 337: ORNITHOLOGY (4)**Wilson**

With nearly 10,000 recognized species, the taxonomic class Aves is one of the most diverse groups of animals on earth. In this lecture course students will explore the anatomy, physiology, behavior, taxonomy, evolution, and life history of birds. Also listed as BIOL 337. Prerequisite: ES 207 and 207L. Not offered in 2020-21.

ES 337L: LABORATORY FOR ORNITHOLOGY (2)**Wilson**

Students in this field laboratory course will explore the life history of birds, observe them in their natural environments, and learn to identify them by sight and sound. Students will be expected to participate in a weekend field trip (to either the North Carolina coast or Eastern Shore of Virginia) and in several other morning/evening activities. The cost of rooms and meals for the weekend trip will be shared by participants (\$150-200 required). Also listed as BIOL 337L. Corequisite: BIOL/ES 337. Prerequisite: BIOL/ES 207 or permission. Not offered in 2020-21.

ES 341: PLANT BIOLOGY (4)**Gleim**

In this course, students will gain a foundational comprehension of the structure, function, and diversity of plants, and will be challenged to build an integrated understanding of plants, from an awareness of their molecular biology to their roles in an ecosystem. We will then tap into this knowledge to engage in active learning experiences to recognize and appreciate practical applications of plant biology, including conservation, environmental sustainability, biotechnology, and the important connections of plants to society. Also listed as BIOL 341. Prerequisite: BIOL/ES 207. Offered Term 1.

ES 341L: LABORATORY FOR PLANT BIOLOGY (2)**Gleim**

Laboratory sessions will provide hands-on experiences in laboratory and field settings. A significant portion of the lab will be field-based, with time being spent learning to identify native and common invasive plants, with particular focus on woody species. Students will conduct a multi-week research project and present their findings. Also listed as BIOL 341L. Co-requisite: BIOL/ES 341. Offered Term 1.

ES 350: SPECIAL TOPIC: DISASTER! RESPONSES TO THE WORST (4)**du Bray**

This course takes a political economy approach to understand the social and physical problems that turn hazards into disasters. Throughout the course, we will re-evaluate our ideas about what a disaster is, how it is produced, and who is harmed. In examining technological, "natural", and medical disasters, we will consider the role of science and society in producing these events, and consider how we can better prevent such events in the future. Also listed as SOC 350. Prerequisite: ES 117. Offered Term 2.

ES 350: SPECIAL TOPIC: INTRODUCTION TO GEOGRAPHIC INFORMATION SYSTEMS (GIS) (2)**Gleim**

This course will explore basic concepts of geographic information systems (GIS) including applications of GIS and how to use it. Much of this course will be lab-based experiences learning to work with and use GIS via real-world and simulated scenarios and data sets. Students will ultimately gain basic working knowledge of how to use ArcGIS, the most commonly used GIS software on the market and gain limited experience with one or more additional GIS platforms. This course is specifically targeted to students who are otherwise unable to take BIOL/ES 357L: Conservation Biology Laboratory. Prerequisites: BIOL/ES 207 & 207L. Offered Term 2.

ES 350: SPECIAL TOPICS: RELIGION AND ECOLOGY (4)**Larsen-Harris**

Our current environmental problems have been caused not just by rampant industrialization but by our very notions of what nature is and our relationship to it. Some see the possibility of challenging our current ecological world views through an exploration of or a re-inspiration from the world's various religious and spiritual traditions. This course aims to discover how religious traditions have responded to the natural world through story, theology, and action. We will focus on Indigenous traditions, three Asian Religions (Taoism, Hinduism, and Buddhism) and two Western Traditions (Judaism and Christianity). We will explore how these diverse traditions offer both ancient and new perspectives on the ecological crisis and express the hope to reunite us with the earth. Topics will include animals, ecosystems, Climate Change, and sustainability, etc. Not open to first-year students. Also listed as REL 350. Offered Term 2.

ES 357: CONSERVATION BIOLOGY (4)**Gleim**

In this courser, students will apply active learning strategies to build a conceptual foundation for conservation biology, including conservation values and ethics. Building on this foundation, we will explore the primary threats to biological conservation, including habitat degradation, overexploitation, invasive species, and biological impacts of climate change. We will also explore how to apply this knowledge through learning about and utilizing various professional approaches used to solve conservation problems. Students will also be expected to participate in a weekend field trip to Front Royal Virginia & Washington D.C. to explore conservation biology research and efforts occurring at the Smithsonian. Course fee of \$150-200 required. Also listed as BIOL 357. Prerequisites: BIOL/ES 207 and 207L or permission. Not offered 2020-21.

ES 357L: LABORATORY FOR CONSERVATION BIOLOGY (2)**Gleim**

Laboratory activities will cultivate an understanding of real-world, hands-on conservation biology through completing a multi-week research project that will involve experimental design and methodology development, use of various field techniques to collect data, analysis and interpretation of data, and presentation of research findings. In addition, students will be trained to use common professional tools and methods, including geographic information systems (specifically ArcGIS), which aid in the management and preservation of biodiversity. Also listed as BIOL 357L. Corequisite: BIOL 357. Not offered 2020-21.

ES 364: BIOGEOCHEMISTRY: AN ANALYSIS OF GLOBAL CHANGE (4)**Carmichael**

Much like the human body, the Earth's climate and ecological systems have been finely tuned to maintain homeostasis. In the human body, this occurs via feedback loops and exchange between major organ systems. In the Earth's climate and ecological systems, this balance is maintained by the flow of energy and materials. Biogeochemistry is the study of this flow of energy and materials within the Earth's planetary system. In this course, we will cover processes that control the cycling of C, N, and P and other biochemical elements in terrestrial and aquatic systems, with special emphasis placed on the coupling between human and natural systems. Topics include the origin of Earth and the development of elemental cycles, the Earth as a chemical system, the biogeochemical cycling of elements in the atmosphere, lithosphere, and biosphere, the global cycles of H₂O, C, N and P, and the expanding human footprint on biogeochemical processes. Prerequisites: CHEM 101/102 or CHEM 105, BIOL 207 or BIOL/ES 117. Also listed as BIOL 364. Not offered in 2020-21.

ES 364L: BIOGEOCHEMISTRY LABORATORY (2)**Carmichael**

The biogeochemistry laboratory will introduce students to common analytical techniques used to assess the biogeochemical transformation of nutrients in the environment. Co-requisite: ES 364. Also listed ad BIOL 364L. Not offered in 2020-21.

ES 390: INDEPENDENT STUDY (2 or 4)**Department**

Independent study conducted at the advanced level. Application must be made with faculty prior to registration. Offered any term.

ES 399: INTERNSHIP (4)**Department**

Application must be made with faculty prior to registration. May be proposed in any term.

ES 470: SEMINAR IN ENVIRONMENTAL STUDIES (4)**du Bray, Godard**

Students in this capstone course tie together the various academic perspectives that form their major by exploring common readings and presenting (30-45 minutes) on a relevant topic of interest. In addition, each student prepares a portfolio (paper, course summaries, internship summaries, c.v., résumé) summarizing her academic experience. Students will also explore career options in the ES field as well as graduate school opportunities. This course is intended for senior ES majors and minors. Offered Term 1.

ES 480: SENIOR THESIS (4)**Department**

Students must undertake a research project investigating a specific aspect of environmental studies. Students must consult with the ES director in the spring semester of junior year and if approved, research would traditionally be carried out during Fall and Short Terms.

ES 490: SENIOR HONORS THESIS (4, 4)**Department**

Offered to qualified ES majors. Students must consult with the ES director in the spring semester of the junior year. If approved, the research project is completed over Fall, Short, and Spring Terms. Departmental honors will be awarded only if the research project is successfully defended to a panel of ES faculty members.