

DEPARTMENT OF ECOSYSTEM SCIENCE AND SUSTAINABILITY

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warnercnr.colostate.edu/ess/ (<https://warnercnr.colostate.edu/ess/>)

Established in 2011, the Department of Ecosystem Science and Sustainability investigates the intricate physical, chemical, human, and biological interactions driving ecosystems. Our responsibility is to understand the world's ecosystems and the effect of human societies on ecosystem processes and their long-term sustainability. Research and education are central to that understanding, enhancing our ability to manage for the sustainability of ecosystems, societies and the biosphere.

The Department of Ecosystem Science and Sustainability currently offers the following degrees and certificates:

- Major in Ecosystem Science and Sustainability
- Major in Watershed Science and Sustainability
- Minor in Watershed Science
- Graduate Certificate in Carbon Management
- Graduate Certificate in Water Resources
- Master of Science in Ecosystem Sustainability
- Master of Science in Watershed Science
- Professional Science Master's in Ecosystem Science and Sustainability
- Ph.D. in Ecosystem Sustainability
- Ph.D. in Watershed Science

Undergraduate Majors

- Major in Ecosystem Science and Sustainability (<http://catalog.colostate.edu/general-catalog/colleges/natural-resources/ecosystem-science-sustainability/ecosystem-science-sustainability-major/>)
- Major in Watershed Science and Sustainability (<http://catalog.colostate.edu/general-catalog/colleges/natural-resources/ecosystem-science-sustainability/watershed-science-sustainability-major/>)
- Major in Watershed Science (<http://catalog.colostate.edu/general-catalog/colleges/natural-resources/ecosystem-science-sustainability/watershed-science-major/>) (No new students are being admitted into this program of study. Please see the Major in Watershed Science and Sustainability).

Minor

- Minor in Watershed Science (<http://catalog.colostate.edu/general-catalog/colleges/natural-resources/ecosystem-science-sustainability/watershed-science-minor/>)

Graduate Graduate Programs in Ecosystem Science and Sustainability

The department offers master's and Ph.D. programs in Ecosystem Sustainability, and Watershed Science. Students interested in graduate work should refer to the Graduate and Professional Bulletin (<http://catalog.colostate.edu/general-catalog/graduate-bulletin/>) and the website for the Department of Ecosystem Science and Sustainability (<http://warnercnr.colostate.edu/ess-home/>).

Certificates

- Carbon Management (<http://catalog.colostate.edu/general-catalog/colleges/natural-resources/ecosystem-science-sustainability/graduate-certificate-carbon-management/>)
- Water Resources (<http://catalog.colostate.edu/general-catalog/colleges/natural-resources/ecosystem-science-sustainability/graduate-certificate-water-resources/>)

Master's Programs

- Master of Science in Ecosystem Sustainability, Plan A (<http://catalog.colostate.edu/general-catalog/colleges/natural-resources/ecosystem-science-sustainability/ecosystem-sustainability-ms/>)
- Master of Science in Watershed Science, Plan A (<http://catalog.colostate.edu/general-catalog/colleges/natural-resources/ecosystem-science-sustainability/plan-a-ms-watershed-science/>)
- Master of Science in Watershed Science, Plan B (<http://catalog.colostate.edu/general-catalog/colleges/natural-resources/ecosystem-science-sustainability/plan-b-ms-watershed-science/>)
- Professional Science Master's in Ecosystem Science and Sustainability (<http://catalog.colostate.edu/general-catalog/colleges/natural-resources/ecosystem-science-sustainability/ecosystem-science-sustainability-psm/>)

Ph.D.

- Ph.D. in Ecosystem Sustainability (<http://catalog.colostate.edu/general-catalog/colleges/natural-resources/ecosystem-science-sustainability/ecosystem-sustainability-phd/>)
- Ph.D. in Watershed Science (<http://catalog.colostate.edu/general-catalog/colleges/natural-resources/ecosystem-science-sustainability/watershed-science-phd/>)

Courses

Subjects in this department include: Ecosystem Science and Sustainability (ESS) and Watershed Science (WR).

Ecosystem Science and Sustainability (ESS)

ESS 120 Intro to Ecosystem and Watershed Sciences Credit: 1 (1-0-0)

Course Description: Exploration of the fields of Ecosystem Science and Sustainability and Watershed Science, including career pathways.

Prerequisite: None.

Restriction: Must be a: Undergraduate.

Registration Information: This is a partial semester course. Required field trips.

Term Offered: Fall.

Grade Mode: Traditional.

Special Course Fee: Yes.

ESS 129 Information Management for Sustainability Credit: 1 (1-0-0)

Course Description: Learn to access, retrieve, store, and manipulate information for natural resources and sustainability applications. Basic mapping, statistics, and graphing.

Prerequisite: None.

Registration Information: This is a partial semester course. Credit not allowed for both ESS 129 and ESS 180A1.

Term Offered: Fall.

Grade Mode: Traditional.

Special Course Fee: No.

ESS 130 Intro to Systems Theory for Sustainability Credit: 1 (1-0-0)

Course Description: Introduction to the concept of a "system," fundamental tenets of systems theory, and application of systems theory to the sustainability of social-ecological systems.

Prerequisite: ESS 129, may be taken concurrently.

Registration Information: This is a partial semester course.

Term Offered: Fall.

Grade Mode: Traditional.

Special Course Fee: No.

ESS 150 Imagining Sustainability Credits: 3 (3-0-0)

Also Offered As: ANTH 150.

Course Description: Science alone cannot imagine the revolutionary changes necessary to sustain future life on our planet. Explore key concepts and practices of sustainability as represented in contemporary fiction, film, and the news media. Interdisciplinary approach will be anthropological and historical, charting the development of sustainability thinking through different epochs of capitalism.

Prerequisite: None.

Registration Information: Credit allowed for only one of the following: ANTH 150, ANTH 181A1, ESS 150, or ESS 181A1.

Term Offered: Fall.

Grade Mode: Traditional.

Special Course Fee: No.

ESS 210 Physical Geography Credits: 3 (3-0-0)

Also Offered As: GR 210.

Course Description: Energy, mass budget, and human impacts on atmosphere, hydrosphere, and continental land surfaces.

Prerequisite: None.

Registration Information: Credit not allowed for both ESS 210 and GR 210.

Terms Offered: Fall, Spring.

Grade Mode: Traditional.

Special Course Fee: No.

ESS 211 Foundations in Ecosystem Science Credits: 3 (3-0-0)

Course Description: Linkage between society and ecosystems services as foundation for sustainability of the coupled human-environmental system.

Prerequisite: GR 210 or ESS 210.

Term Offered: Spring.

Grade Mode: Traditional.

Special Course Fee: No.

ESS 220 Research Skills for Ecosystem Science I Credit: 1 (0-0-1)

Course Description: Fundamental skills for participating in ecosystem science research through hands-on learning modules.

Prerequisite: None.

Registration Information: Written consent of instructor.

Term Offered: Fall.

Grade Mode: Traditional.

Special Course Fee: No.

ESS 221 Research Methods for Ecosystem Science II Credit: 1 (0-0-1)

Course Description: Advanced topics in the practice of the scientific method and participation in research.

Prerequisite: ESS 220.

Registration Information: Written consent of instructor.

Term Offered: Spring.

Grade Mode: Traditional.

Special Course Fee: No.

ESS 298 Research Credits: Var[1-3] (0-0-0)

Course Description: Directed ecosystem science research.

Prerequisite: ESS 221, may be taken concurrently.

Terms Offered: Fall, Spring, Summer.

Grade Mode: Traditional.

Special Course Fee: No.

ESS 311 Ecosystem Ecology Credits: 3 (3-0-0)

Course Description: Principles of ecosystems ecology, emphasis on their application to coupled natural and human systems.

Prerequisite: (PH 121 or PH 141) and (LIFE 320).

Registration Information: Required field trips.

Term Offered: Fall.

Grade Mode: Traditional.

Special Course Fee: No.

ESS 312 Sustainability Science Credits: 3 (3-0-0)

Course Description: Synthesize multifaceted information across a wide range of disciplines, with the goal to develop potential solutions to complex human-societal-environmental challenges at multiple scales. Implement methods for understanding current issues, develop alternative scenarios to current practices and policies, and stage interventions to achieve more sustainable behaviors and practices.

Prerequisite: LIFE 320.

Term Offered: Spring.

Grade Mode: Traditional.

Special Course Fee: No.

ESS 320 Internship and Career Preparation Credit: 1 (0-0-1)

Course Description: Career-related skills and professional development in ecosystem science and sustainability (ESS) for majors.

Prerequisite: LIFE 320.

Terms Offered: Fall, Spring.

Grade Mode: Traditional.

Special Course Fee: No.

ESS 330 Quantitative Reasoning for Ecosystem Science Credits: 3 (2-2-0)

Course Description: Understanding diverse approaches for using data and models to understand complex ecological systems.

Prerequisite: (ESS 211 or LIFE 320) and (MATH 155 or MATH 160) and (STAT 301 or STAT 307 or STAT 315).

Registration Information: Junior or senior standing.

Term Offered: Spring.

Grade Mode: Traditional.

Special Course Fee: No.

ESS 353 Global Change Impacts, Adaptation, Mitigation Credits: 3 (3-0-0)

Course Description: Explore challenges of climate change for mountain environments and society and their solutions.

Prerequisite: LAND 220 or LIFE 220 or LIFE 320.

Registration Information: Required field trips. Credit allowed for only one of the following: BZ 353, ESS 353, or NR 353.

Term Offered: Spring.

Grade Mode: Traditional.

Special Course Fee: No.

ESS 365 Global Climate Justice Credits: 3 (3-0-0)

Course Description: Explore how mechanisms of environmental transport (air, water, land, biota) act as drivers within different ecosystems and how such drivers create pathways that lead to climate justice issues among the world's vulnerable populations.

Prerequisite: None.

Registration Information: Completion of AUCC categories 2 and 3A. Credit not allowed for both ESS 365 and ESS 381A1.

Grade Mode: Traditional.

Special Course Fee: No.

ESS 382A Study Abroad: Socio-Ecological Landscapes of Mongolia Credits: 6 (0-0-6)

Course Description: Travel to Mongolia for a field-based, place-based experience with Mongolian students and herders. Engage in research projects partnering with Mongolian counterparts for field data collection using ecological, social science, and geospatial tools. Examine the intersection of culture and environment through observational exercises and experiential learning. Experience nomadic culture through field trips and participatory community activity.

Prerequisite: None.

Restriction: Must be a: Undergraduate.

Registration Information: Written consent of instructor.

Term Offered: Summer.

Grade Mode: Traditional.

Special Course Fee: No.

ESS 400 Global Perspectives on Sustainability Credits: 3 (3-0-0)

Course Description: Explores the intersections between ecosystem science, communities and sustainability in the context of the global challenges of climate change focusing on the new global framework (The Paris Agreement), Sustainable Development Goals (SDGs), and ecological indicators.

Prerequisite: ESS 311.

Term Offered: Spring.

Grade Mode: Traditional.

Special Course Fee: No.

ESS 401 Sustainability of Parks and Protected Places Credits: 3 (3-0-0)

Course Description: Explore connections between culture, sustainability, and park management topics while discussing people, parks, and places through the lens of diversity and inclusion in natural resources.

Prerequisite: None.

Registration Information: Completion of AUCC Categories 2 and 3A.

Term Offered: Fall.

Grade Mode: Traditional.

Special Course Fee: No.

ESS 405 Global Agriculture and Environmental Change Credits: 3 (3-0-0)

Also Offered As: SOCR 405.

Course Description: Explore the past, present, and future of global agroecosystems in a changing environment. Examine a range of environmental issues facing agroecosystems around the world, including water management, climate change, air pollution, and land use change. Assess the history of agricultural development and the factors that determine food security, as well as what strategies could help create a more sustainable and food secure world.

Prerequisite: BSPM 302 or BSPM 308 or BSPM 361 or LAND 220 or LIFE 220 or LIFE 320.

Registration Information: Credit not allowed for both ESS 405 and SOCR 405.

Term Offered: Spring.

Grade Mode: Traditional.

Special Course Fee: No.

ESS 411 Earth Systems Ecology Credits: 3 (3-0-0)

Course Description: Earth as a system, stressing ecological interactions among energy, water, and biogeochemistry.

Prerequisite: ESS 311 and ESS 312.

Term Offered: Fall.

Grade Mode: Traditional.

Special Course Fee: No.

ESS 412 Sustainable Cities Credits: 3 (3-0-0)

Course Description: Explore the ecology of cities, evaluate the most innovative science developed for the city, and discuss with renowned researchers leading these efforts. Analyze sustainability plans from a variety of cities around the globe, and interact with the practitioners developing and implementing sustainable goals. Delve into sustainability theory, specifically "the sustainable city myth."

Prerequisite: ANTH 100 or ANTH 200 or ESS 210 or GES 101 or GR 100 or GR 210 or LAND 220 or LIFE 220 or LIFE 320 or NR 120A or NR 130 or SOC 220.

Registration Information: Junior standing. Credit not allowed for both ESS 412 and ESS 480A1.

Term Offered: Spring.

Grade Mode: Traditional.

Special Course Fee: No.

ESS 432 Microbial Ecology Credits: 3 (2-0-1)

Also Offered As: MIP 432.

Course Description: Principles of microorganism interactions with their living and non-living environments; implications for the environment, plants, and animals.

Prerequisite: MIP 300.

Registration Information: Must register for lecture and recitation. Credit not allowed for both ESS 432 and MIP 432.

Term Offered: Fall (odd years).

Grade Mode: Traditional.

Special Course Fee: No.

ESS 433 Microbial Ecology Laboratory Credit: 1 (0-3-0)

Also Offered As: MIP 433.

Course Description: Experimental microbial ecology; the design, conduct and interpretation of experiments that illustrate basic principles of microbial ecology.

Prerequisite: MIP 300.

Registration Information: Must be taken concurrently with ESS 432 or MIP 432. Credit not allowed for both ESS 433 and MIP 433.

Term Offered: Spring (even years).

Grade Mode: Traditional.

Special Course Fee: No.

ESS 440 Practicing Sustainability Credits: 4 (2-0-2)

Course Description: Capstone integration of ecosystem science and sustainability, focused on case studies.

Prerequisite: ESS 311 and ESS 312.

Registration Information: Senior standing in WCNR. Must register for lecture and recitation.

Term Offered: Spring.

Grade Mode: Traditional.

Special Course Fee: No.

ESS 471 Special Topics in Ecosystem Sustainability Credits:

Var[1-6] (0-0-0)

Course Description:

Prerequisite: ESS 311.

Grade Mode: Traditional.

Special Course Fee: No.

ESS 474 Limnology Credits: 3 (2-2-0)

Course Description: Biology, chemistry, and physics of lakes including limnological methods.

Prerequisite: LAND 220 or LIFE 220 or LIFE 320.

Registration Information: Must register for lecture and laboratory. Required field trips. Credit not allowed for both BZ 474 and ESS 474.

Term Offered: Fall (even years).

Grade Mode: Traditional.

Special Course Fee: No.

ESS 486 Ecosystem Practicum Credits: 2 (0-0-4)

Course Description: One-week field practicum to examine ecosystem science and sustainability issues in Colorado landscapes.

Prerequisite: ESS 311.

Registration Information: Senior standing. Required field trips.

Term Offered: Fall.

Grade Mode: Traditional.

Special Course Fee: No.

ESS 487 Internship Credits: Var[1-6] (0-0-0)

Course Description: Supervised work experience in professional settings related to Ecosystem Science and Sustainability.

Prerequisite: ESS 320.

Registration Information: Written consent of instructor.

Terms Offered: Fall, Spring, Summer.

Grade Mode: S/U Sat/Unsat Only.

Special Course Fee: No.

ESS 495 Independent Study in Ecosystem Science Credits:

Var[1-6] (0-0-0)

Course Description:

Prerequisite: None.

Terms Offered: Fall, Spring, Summer.

Grade Mode: Instructor Option.

Special Course Fee: No.

ESS 501 Principles of Ecosystem Sustainability Credits: 3 (3-0-0)

Course Description: Principles of ecosystem sustainability and threats to sustainability. Students will investigate and develop case studies.

Prerequisite: BZ 300 to 499 or ECOL 300 to 499 or CHEM 300 to 499.

Registration Information: Admission to graduate school. Sections may be offered: Online.

Term Offered: Fall.

Grade Mode: Traditional.

Special Course Fee: No.

ESS 505 International Climate Negotiations Credits: 2 (2-0-0)

Course Description: Preparation for international climate negotiations including the Framework Convention on Climate Change (UNFCCC), Conference of the Parties (COP) in locations around the world. Explore environmental sustainability issues on international teams with peers from other institutions. Teams examine environmental issues/policies through a research project, and have the opportunity to prepare for actual climate action negotiations.

Prerequisite: None.

Registration Information: Department approval required. This is a partial semester course. Credit not allowed for ESS 505 and ESS 581A3.

Term Offered: Fall.

Grade Mode: Traditional.

Special Course Fee: No.

ESS 506 Virtual International Climate Negotiations Credit: 1 (0-0-1)

Course Description: Provides hands-on experience in international climate negotiations including the Framework Convention on Climate Change (UNFCCC), Conference of the Parties (COP) in locations around the world through virtual participation. Explore environmental sustainability issues on international teams with peers from other institutions. Teams examine environmental issues/policies through a research project, and have the opportunity to participate in actual climate action negotiations.

Prerequisite: None.

Registration Information: Must have concurrent registration in ESS 505. This is a partial semester course.

Term Offered: Fall.

Grade Mode: Traditional.

Special Course Fee: No.

ESS 516 Climate Justice and Policy Credits: 2 (2-0-0)

Also Offered As: NR 516.

Course Description: Overview on i) the unequal distribution of the benefits of natural resource use and the burdens of environmental degradation across spatiotemporal scales, and ii) the role of policy tools and approaches in creating, exacerbating, or addressing those inequalities. Examine environmental and climate justice (EJ/CJ) concepts, recognize environmental and climate inequalities, and learn how to integrate EJ/CJ considerations in policy analysis and review.

Prerequisite: None.

Restriction: Must be a: Graduate.

Registration Information: Bachelor's degree required. Offered as an online course only. Credit not allowed for both ESS 516 and NR 516.

Term Offered: Fall (odd years).

Grade Mode: Traditional.

Special Course Fee: No.

ESS 523A Environmental Data Science Applications:**Introduction Credits: 3 (3-0-0)****Also Offered As:** SOCR 523A.

Course Description: Explore tools and best practices for working with large environmental datasets primarily using the programming language R. Cover technical topics like: data types, file management, iteration, functional programming, debugging, code management and collaboration with git and GitHub. Use these tools to analyze environmental data using statistical approaches like: linear models, trend analysis, simple machine learning techniques.

Prerequisite: STAR 511 or STAT 158.**Registration Information:** This is a partial semester course. Credit not allowed for both ESS 523A and SOCR 523A.**Term Offered:** Spring.**Grade Mode:** Traditional.**Special Course Fee:** No.**ESS 523B Environmental Data Science Applications: Food and Agriculture Credits: 2 (2-0-0)****Also Offered As:** SOCR 523B.

Course Description: Explore the application of data science to the analysis of food and agricultural systems. Examine the ways food and agricultural researchers utilize data science in contemporary scientific literature and in research taking place across campus. Work in a team to create, document, and communicate an analysis that utilizes data science techniques to answer questions about food and agricultural system functioning and/or sustainability.

Prerequisite: ESS 523A, may be taken concurrently or SOCR 523A, may be taken concurrently.**Registration Information:** This is a partial semester course. Credit not allowed for both ESS 523B and SOCR 523B.**Term Offered:** Spring.**Grade Mode:** Traditional.**Special Course Fee:** No.**ESS 523C Environmental Data Science Applications: Water Resources Credits: 2 (2-0-0)****Also Offered As:** WR 523C.

Course Description: Focus on analyzing and understanding water resources. Examine key innovations in deep learning for hydrological prediction and model parameterization, with a focus on cutting-edge techniques and hands-on analyses.

Prerequisite: ESS 523A, may be taken concurrently or SOCR 523A, may be taken concurrently.**Registration Information:** This is a partial semester course. Credit not allowed for both ESS 523C and WR 523C.**Term Offered:** Spring.**Grade Mode:** Traditional.**Special Course Fee:** No.**ESS 524 Foundations for Carbon/Greenhouse Gas Mgmt Credits: 3 (3-0-0)**

Course Description: Foundations for understanding greenhouse gas emissions management and accounting.

Prerequisite: BZ 300 to 499 or ECOL 300 to 499 or CHEM 300 to 499.**Registration Information:** Sections may be offered: Online.**Term Offered:** Fall.**Grade Mode:** Traditional.**Special Course Fee:** No.**ESS 542 Greenhouse Gas Policies Credits: 2 (0-0-2)**

Course Description: Rules, regulations and standards for greenhouse gas management and accounting.

Prerequisite: ESS 524, may be taken concurrently.**Registration Information:** Graduate standing. Sections may be offered: Online.**Term Offered:** Spring.**Grade Mode:** Traditional.**Special Course Fee:** No.**ESS 543 Global Climate Change Credits: 2 (2-0-0)****Also Offered As:** ATS 543.

Course Description: Climate change science, climate change impacts, and climate change mitigation, including discussions of current topics in climate change.

Prerequisite: BZ 300 to 499 or ECOL 300 to 499 or LIFE 300 to 499 or CHEM 300 to 499.**Registration Information:** Sections may be offered: Online. Credit not allowed for both ATS 543 and ESS 543.**Term Offered:** Spring.**Grade Mode:** Traditional.**Special Course Fee:** No.**ESS 545 Applications in Greenhouse Gas Inventories Credits: 4 (2-6-0)**

Course Description: Overview of methods for estimating greenhouse gas emissions and mitigation potential for agriculture and forestry activities.

Prerequisite: (ESS 524) and (STAR 511 or STAT 511A).**Registration Information:** Must register for lecture and laboratory. Required field trips.**Term Offered:** Spring.**Grade Mode:** Traditional.**Special Course Fee:** No.**ESS 554 Ecological and Social Agent-based Modeling Credits: 3 (2-2-0)****Also Offered As:** ANTH 554.

Course Description: Exploring the use and making of agent-based models featuring interacting individuals in ecological and social simulation, with examples and projects.

Prerequisite: None.**Registration Information:** Junior standing. Must register for lecture and laboratory. Credit allowed for only one of the following: ANTH 554, ESS 554, or NR 554.**Term Offered:** Spring (odd years).**Grade Mode:** Traditional.**Special Course Fee:** No.**ESS 555 Life Cycle Assessment for Sustainability Credits: 3 (3-0-0)****Also Offered As:** ANEQ 555.

Course Description: The quantitative and qualitative measure of cradle-to-grave impacts of products and services on the environment, the economy, and society.

Prerequisite: BIOM 300 to 479 or BZ 300 to 379 or BZ 400 to 479 or CHEM 300 to 379 or CHEM 400 to 479 or CIVE 300 to 479 or ECOL 300 to 379 or ENGR 300 or MECH 300 to 379.**Registration Information:** Sections may be offered: Online. Credit allowed for only one of the following: ANEQ 555, ENGR 555, ESS 555, ENGR 581A1, or ESS 581A1.**Term Offered:** Spring.**Grade Mode:** Traditional.**Special Course Fee:** No.

ESS 565 Niche Models Credits: 4 (3-2-0)

Course Description: Concepts and application of niche models in ecosystem science.

Prerequisite: (BSPM 526 or BZ 526 or BZ 535 or BZ 548 or BZ 561 or ECOL 505 or ECOL 600 or ECOL 610 or ECOL 620 or FW 555 or FW 662) and (STAR 511 or STAT 511A).

Registration Information: Must register for lecture and laboratory.

Term Offered: Fall (odd years).

Grade Mode: Traditional.

Special Course Fee: No.

ESS 575 Models for Ecological Data Credits: 4 (3-2-0)

Course Description: Gaining insight about the operation of ecological processes using models and data.

Prerequisite: MATH 255 and STAT 340.

Registration Information: Must register for lecture and laboratory.

Term Offered: Spring.

Grade Mode: Traditional.

Special Course Fee: No.

ESS 582A Study Abroad--Europe and British Isles: UN Climate Change Conference (COP) Credit: 1 (0-0-1)

Course Description: Provides hands-on experience in international climate negotiations including the Framework Convention on Climate Change (UNFCCC), Conference of the Parties (COP) in locations around Europe/British Isles. Explore environmental sustainability issues on international teams with peers from institutions around the world. Teams examine environmental issues/policies through a research project, and have the opportunity to participate in actual climate action negotiations at the UN Climate Conference.

Prerequisite: None.

Registration Information: Must have concurrent registration in ESS 505. This is a partial semester course. Students should register for one of the following depending on where the conference is being held: ESS 582A, ESS 582B, ESS 582C, or ESS 582D.

Term Offered: Fall.

Grade Mode: Traditional.

Special Course Fee: No.

ESS 582B Study Abroad--Americas: UN Climate Change Conference (COP) Credit: 1 (0-0-1)

Course Description: Provides hands-on experience in international climate negotiations including the Framework Convention on Climate Change (UNFCCC), Conference of the Parties (COP) in locations in Latin America. Explore environmental sustainability issues on international teams with peers from institutions around the world. Teams examine environmental issues/policies through a research project, and have the opportunity to participate in actual climate action negotiations at the UN Climate Conference.

Prerequisite: None.

Registration Information: Must have concurrent registration in ESS 505. This is a partial semester course. Students should register for one of the following depending on where the conference is being held: ESS 582A, ESS 582B, ESS 582C, or ESS 582D.

Term Offered: Fall.

Grade Mode: Traditional.

Special Course Fee: No.

ESS 582C Study Abroad--Asia/Oceania: UN Climate Change Conference (COP) Credit: 1 (0-0-1)

Course Description: Provides hands-on experience in international climate negotiations including the Framework Convention on Climate Change (UNFCCC), Conference of the Parties (COP) in locations within Asia and Oceania. Explore environmental sustainability issues on international teams with peers from institutions around the world. Teams examine environmental issues/policies through a research project, and have the opportunity to participate in actual climate action negotiations at the UN Climate Conference.

Prerequisite: None.

Registration Information: Must have concurrent registration in ESS 505. This is a partial semester course. Students should register for one of the following depending on where the conference is being held: ESS 582A, ESS 582B, ESS 582C, or ESS 582D.

Term Offered: Fall.

Grade Mode: Traditional.

Special Course Fee: No.

ESS 582D Study Abroad--Africa: UN Climate Change Conference (COP) Credit: 1 (0-0-1)

Course Description: Provides hands-on experience in international climate negotiations including the Framework Convention on Climate Change (UNFCCC), Conference of the Parties (COP) in locations in Africa. Explore environmental sustainability issues on international teams with peers from institutions around the world. Teams examine environmental issues/policies through a research project, and have the opportunity to participate in actual climate action negotiations at the UN Climate Conference.

Prerequisite: None.

Registration Information: Must have concurrent registration in ESS 505. This is a partial semester course. Students should register for one of the following depending on where the conference is being held: ESS 582A, ESS 582B, ESS 582C, or ESS 582D.

Term Offered: Fall.

Grade Mode: Traditional.

Special Course Fee: No.

ESS 587 Internship Credits: Var[1-6] (0-0-0)

Course Description:

Prerequisite: None.

Terms Offered: Fall, Spring, Summer.

Grade Mode: Instructor Option.

Special Course Fee: No.

ESS 625 Ecology of Forest Production Credits: 3 (3-0-0)

Also Offered As: F 625.

Course Description: Develops student expertise in understanding carbon and nutrient flows in forests.

Prerequisite: None.

Restriction: Must be a: Graduate, Professional.

Registration Information: Must have taken a 300-level course in ECOL. Credit not allowed for both ESS 625 and F 625. Sections may be offered: Online.

Term Offered: Spring (even years).

Grade Mode: Traditional.

Special Course Fee: No.

ESS 650 Edge Effects--Place, Embodiment, Environment Credits: 3 (3-0-0)**Also Offered As:** ANTH 650.**Course Description:** Interdisciplinary thinking on questions of place, power, embodiment, and environmental adaptation. Drawing on human geography, ethnography, political ecology, and social-ecological theory, develop an understanding of boundaries and transitional zones as places of complex social and species exchange by looking at some key philosophical texts, but also applying theoretical understanding to specific case studies.**Prerequisite:** None.**Restriction:** Must be a: Graduate, Professional.**Registration Information:** Credit not allowed for both ANTH 650 and ESS 650.**Term Offered:** Spring (even years).**Grade Mode:** Traditional.**Special Course Fee:** No.**ESS 655 Multivariate Analysis for Community Ecology Credits: 2 (2-0-0)****Course Description:** Techniques and conceptual understanding for analyzing multivariate ecological data characteristic of community ecology, including ordination, classification, and permanova.**Prerequisite:** (STAR 511 or STAT 511A) and (BZ 500 to 679 - at least 3 credits or ECOL 500 to 679 - at least 3 credits or ESS 500 to 679 - at least 3 credits or FW 500 to 679 - at least 3 credits).**Restriction:** Must be a: Graduate, Professional.**Term Offered:** Fall (even years).**Grade Mode:** Traditional.**Special Course Fee:** No.**ESS 660 Biogeochemical Cycling in Ecosystems Credits: 3 (3-0-0)****Course Description:** Biotic and abiotic processes responsible for distribution and fluxes of elements at ecosystem, landscape, and global scales.**Prerequisite:** CHEM 245 and SOCR 240 and ECOL 300 to 699.**Restriction:** Must be a: Graduate, Professional.**Term Offered:** Spring.**Grade Mode:** Traditional.**Special Course Fee:** No.**ESS 692 Seminar Credit: 1 (0-0-1)****Course Description:****Prerequisite:** None.**Restriction:** Must be a: Graduate, Professional.**Registration Information:** Sections may be offered: Online.**Terms Offered:** Fall, Spring.**Grade Mode:** Instructor Option.**Special Course Fee:** No.**ESS 695 Independent Study in Ecosystem Science Credits: Var[1-6] (0-0-0)****Course Description:****Prerequisite:** None.**Restriction:** Must be a: Graduate, Professional.**Terms Offered:** Fall, Spring, Summer.**Grade Mode:** Instructor Option.**Special Course Fee:** No.**ESS 696 Group Study Credits: Var[1-6] (0-0-0)****Course Description:** Group study projects on topics in ecosystem science and sustainability.**Prerequisite:** None.**Restriction:** Must be a: Graduate, Professional.**Registration Information:** Written consent of instructor. Sections may be offered: Online.**Terms Offered:** Fall, Spring, Summer.**Grade Mode:** S/U Sat/Unsat Only.**Special Course Fee:** No.**ESS 698 Research Credits: Var[1-18] (0-0-0)****Course Description:****Prerequisite:** None.**Restriction:** Must be a: Graduate, Professional.**Registration Information:** Written consent of advisor.**Terms Offered:** Fall, Spring, Summer.**Grade Mode:** S/U Sat/Unsat Only.**Special Course Fee:** No.**ESS 699 Thesis Credits: Var[1-18] (0-0-0)****Course Description:****Prerequisite:** None.**Restriction:** Must be a: Graduate, Professional.**Registration Information:** Written consent of advisor.**Terms Offered:** Fall, Spring, Summer.**Grade Mode:** S/U Sat/Unsat Only.**Special Course Fee:** No.**ESS 798 Research Credits: Var[1-18] (0-0-0)****Course Description:****Prerequisite:** None.**Restriction:** Must be a: Graduate, Professional.**Registration Information:** Written consent of advisor.**Terms Offered:** Fall, Spring, Summer.**Grade Mode:** S/U Sat/Unsat Only.**Special Course Fee:** No.**ESS 799 Dissertation Credits: Var[1-18] (0-0-0)****Course Description:****Prerequisite:** None.**Restriction:** Must be a: Graduate, Professional.**Registration Information:** Written consent of advisor.**Terms Offered:** Fall, Spring, Summer.**Grade Mode:** S/U Sat/Unsat Only.**Special Course Fee:** No.

Watershed Science (WR)

WR 204 Sustainable Watersheds (GT-SC2) Credits: 3 (3-0-0)**Also Offered As:** GR 204.**Course Description:** Effects of climate, land use, and water use on the sustainability of water quantity and quality.**Prerequisite:** None.**Registration Information:** Credit allowed for only one of the following: GR 204, GR 304, WR 204 or WR 304.**Terms Offered:** Fall, Spring.**Grade Mode:** Traditional.**Special Course Fee:** No.**Additional Information:** Biological & Physical Sciences 3A, Natural & Physical Sciences w/o lab (GT-SC2).

WR 406 Seasonal Snow Environments Credits: 3 (2-3-0)

Course Description: Evaluation of the physical environment; characteristics of snow; methods of studying snow; snow safety.

Prerequisite: None.

Restriction: Must be a: Junior, Senior, Senior - 5yr Bachelor, Senior - Post Bachelor, Senior - Second Bachelor.

Registration Information: Junior or senior standing. Must register for lecture and laboratory. Required field trips.

Term Offered: Spring (odd years).

Grade Modes: S/U within Student Option, Trad within Student Option.

Special Course Fee: No.

WR 416 Land Use Hydrology Credits: 3 (3-0-0)

Course Description: Fundamental concepts in hydrology and effects of land use on hydrologic processes.

Prerequisite: (ESS 210 or GEOL 110 and GEOL 120 or GEOL 122 or GEOL 124 or GEOL 150 or GR 210 or SOCR 240) and (CIVE 202 or STAT 201 or STAT 301 or STAT 307 or STAT 315) and (PH 110 or PH 121 or PH 141).

Term Offered: Fall.

Grade Mode: Traditional.

Special Course Fee: No.

WR 417 Watershed Measurements Credits: 3 (2-3-0)

Course Description: Instrument and field techniques in watershed science. Project design and data analysis.

Prerequisite: WR 416 and WR 418.

Registration Information: Must register for lecture and laboratory. This is a partial semester course. Required field trips.

Term Offered: Fall.

Grade Modes: S/U within Student Option, Trad within Student Option.

Special Course Fee: Yes.

WR 418 Land Use and Water Quality Credits: 3 (3-0-0)

Course Description: Physical, chemical, biological water quality parameters affecting land use; land management to maintain water quality; water quality standards, legislation.

Prerequisite: (CHEM 103 and CHEM 104 or CHEM 107 and CHEM 108 or CHEM 111 and CHEM 112) and (STAT 158) and (STAT 301 or STAT 315).

Term Offered: Spring.

Grade Modes: S/U within Student Option, Trad within Student Option.

Special Course Fee: No.

WR 419 Water Quality Analyses Credits: 3 (2-2-0)

Course Description: Analyze freshwater samples for water quality constituents. Analyze data along with public water quality datasets.

Prerequisite: (CHEM 107 or CHEM 111) and (STAT 301 or STAT 315) and (WR 417).

Registration Information: Must have concurrent registration in WR 418. Must register for lecture and laboratory.

Term Offered: Spring.

Grade Mode: Traditional.

Special Course Fee: No.

WR 440 Watershed Problem Analysis Credits: 3 (2-2-0)

Course Description: Capstone integration of spatial watershed issues, focused on problem solving in watershed science.

Prerequisite: (NR 319 or NR 322) and (WR 416 and WR 418).

Registration Information: Must register for lecture and laboratory.

Term Offered: Spring.

Grade Mode: Traditional.

Special Course Fee: No.

WR 474 Snow Hydrology Credits: 3 (3-0-0)

Course Description: Snowfall, accumulation, distribution, physical processes in the snowpack, energy balance, ablation and runoff, measurement methods, runoff forecasting.

Prerequisite: WR 416, may be taken concurrently.

Term Offered: Fall.

Grade Mode: Traditional.

Special Course Fee: No.

WR 486 Watershed Field Practicum Credits: 2 (0-6-0)

Course Description: Field visits to watershed management projects and sites of significant field studies.

Prerequisite: None.

Restriction: Must be a: Junior.

Registration Information: Junior standing. Required field trips.

Term Offered: Fall.

Grade Mode: Traditional.

Special Course Fee: No.

WR 487 Internship Credits: Var[1-6] (0-0-0)

Course Description: Supervised work experience in professional settings related to Watershed Science.

Prerequisite: None.

Registration Information: Written consent of instructor.

Terms Offered: Fall, Spring, Summer.

Grade Mode: S/U Sat/Unsat Only.

Special Course Fee: No.

WR 492 Seminar Credits: Var[1-18] (0-0-0)

Course Description:

Prerequisite: None.

Terms Offered: Fall, Spring, Summer.

Grade Mode: Instructor Option.

Special Course Fee: No.

WR 495 Independent Study-Watershed Resources Credits: Var[1-18] (0-0-0)

Course Description:

Prerequisite: None.

Terms Offered: Fall, Spring, Summer.

Grade Mode: Instructor Option.

Special Course Fee: No.

WR 510 Watershed Management in Developing Countries Credits: 2 (2-0-0)

Course Description: Watershed management problems, approaches, and solutions in developing countries.

Prerequisite: CIVE 322 or WR 416.

Term Offered: Spring (odd years).

Grade Mode: Traditional.

Special Course Fee: No.

WR 511 Water Resource Development Credits: 3 (3-0-0)

Course Description: Basic principles of water resource management including surface and subsurface flows.

Prerequisite: None.

Registration Information: Graduate standing. Offered as an online course only. Written consent of instructor.

Term Offered: Spring.

Grade Mode: Traditional.

Special Course Fee: No.

WR 512 Water Law for Non-Lawyers Credits: 3 (0-0-3)

Course Description: Basics of water law and policy for Colorado, western states, and the U.S.

Prerequisite: None.

Registration Information: Graduate standing. Written consent of instructor. Offered as an online course only.

Term Offered: Spring.

Grade Mode: Traditional.

Special Course Fee: No.

WR 514 GIS and Data Analysis in Water Resources Credits: 3 (1-4-0)

Course Description: Exposure to multiple data analysis and GIS tools used to study water resources. Assess online data sources, download and pre-process digital data, and analyze water information.

Prerequisite: None.

Restriction: Must be a: Graduate.

Registration Information: Graduate standing. Must register for lecture and laboratory. Offered as an online course only. Credit not allowed for both WR 514 and WR 581A1.

Term Offered: Spring.

Grade Mode: Traditional.

Special Course Fee: No.

WR 516 Cumulative Effects and Watershed Analysis Credits: 3 (2-0-1)

Course Description: Definition, causal processes, and modeling of cumulative watershed effects; comparison and evaluation of current watershed analysis procedures.

Prerequisite: WR 416 and WR 417.

Registration Information: Must register for lecture and recitation.

Term Offered: Spring (odd years).

Grade Mode: Traditional.

Special Course Fee: No.

WR 520 Evapotranspiration Credits: 2 (2-0-0)

Course Description: Theory, estimation, measurement, simulation, and application of evapotranspiration processes in hydrology.

Prerequisite: PH 122.

Term Offered: Spring.

Grade Modes: S/U within Student Option, Trad within Student Option.

Special Course Fee: No.

WR 523C Environmental Data Science Applications: Water Resources Credits: 2 (2-0-0)

Also Offered As: ESS 523C.

Course Description: Focus on analyzing and understanding water resources. Examine key innovations in deep learning for hydrological prediction and model parameterization, with a focus on cutting-edge techniques and hands-on analyses.

Prerequisite: ESS 523A, may be taken concurrently or SOCR 523A, may be taken concurrently.

Registration Information: This is a partial semester course. Credit not allowed for both ESS 523C and WR 523C.

Term Offered: Spring.

Grade Mode: Traditional.

Special Course Fee: No.

WR 524 Modeling Watershed Hydrology Credits: 3 (2-2-0)

Also Offered As: CIVE 524.

Course Description: Development and application of watershed models: structure, calibration, evaluation, sensitivity analysis, simulation.

Prerequisite: (CIVE 203 or STAT 301 or STAT 315) and (CIVE 322 or WR 416).

Registration Information: Must register for lecture and laboratory. Credit not allowed for both CIVE 524 and WR 524.

Term Offered: Spring.

Grade Mode: Traditional.

Special Course Fee: No.

WR 574 Advanced Snow Hydrology Credits: 4 (3-0-1)

Course Description: Snow processes in hydrologic cycle; physical and conceptual methods of modeling; techniques for measuring different states and change rates.

Prerequisite: CIVE 322 or ENVE 322 or WR 416.

Registration Information: Must register for lecture and recitation.

Term Offered: Fall (even years).

Grade Mode: Traditional.

Special Course Fee: No.

WR 575 Snow Hydrology Field Methods Credit: 1 (0-2-0)

Course Description: Field course offering hands-on experience in snow hydrology.

Prerequisite: None.

Registration Information: Enrollment in a graduate program. Required field trips.

Term Offered: Spring.

Grade Mode: Traditional.

Special Course Fee: No.

WR 616 Hillslope Hydrology and Runoff Processes Credits: 3 (1-0-2)

Course Description: Hillslope hydrology and runoff processes in different environments; implications for management and modeling.

Prerequisite: CIVE 322 or WR 416.

Restriction: Must be a: Graduate, Professional.

Registration Information: Must register for lecture and recitation.

Term Offered: Spring (even years).

Grade Mode: Traditional.

Special Course Fee: No.

WR 671 Advanced Topics in Watershed Science Credits: Var[1-6] (0-0-0)

Course Description: Explores advanced topics in watershed hydrology, biogeochemistry, and ecology.

Prerequisite: None.

Restriction: Must be a: Graduate, Professional.

Registration Information: May be repeated for a maximum of 9 credits.

Grade Mode: Traditional.

Special Course Fee: No.

WR 674 Data Issues in Hydrology Credits: 3 (3-0-0)

Course Description: Types of data, data sources, data quality, missing data, spatial data, data usage, sensitivity in models, error, presentation of data and results.

Prerequisite: WR 574.

Restriction: Must be a: Graduate, Professional.

Term Offered: Spring (even years).

Grade Mode: Traditional.

Special Course Fee: No.

WR 692 Seminar Credits: Var[1-18] (0-0-0)

Course Description:

Prerequisite: None.

Restriction: Must be a: Graduate, Professional.

Terms Offered: Fall, Spring, Summer.

Grade Mode: Instructor Option.

Special Course Fee: No.

WR 695 Independent Study Credits: Var[1-18] (0-0-0)

Course Description:

Prerequisite: None.

Restriction: Must be a: Graduate, Professional.

Terms Offered: Fall, Spring, Summer.

Grade Mode: Instructor Option.

Special Course Fee: No.

WR 696 Group Study Credits: Var[1-18] (0-0-0)

Course Description:

Prerequisite: None.

Restriction: Must be a: Graduate, Professional.

Terms Offered: Fall, Spring, Summer.

Grade Mode: Instructor Option.

Special Course Fee: No.

WR 698 Research Credits: Var[1-18] (0-0-0)

Course Description:

Prerequisite: None.

Restriction: Must be a: Graduate, Professional.

Terms Offered: Fall, Spring, Summer.

Grade Mode: Instructor Option.

Special Course Fee: No.

WR 699 Thesis Credits: Var[1-18] (0-0-0)

Course Description:

Prerequisite: None.

Restriction: Must be a: Graduate, Professional.

Terms Offered: Fall, Spring, Summer.

Grade Mode: Instructor Option.

Special Course Fee: No.

WR 712 Watershed Systems Credits: 3 (2-2-0)

Course Description: Dynamic simulation of watershed behavior; application and evaluation of current hydrologic models.

Prerequisite: (CIVE 322 or WR 416) and (STAT 340).

Restriction: Must be a: Graduate, Professional.

Registration Information: Must register for lecture and laboratory.

Term Offered: Fall (even years).

Grade Mode: Traditional.

Special Course Fee: No.

WR 714 Water Quality for Wildland Managers Credits: 3 (3-0-0)

Course Description: Sampling, statistics of sampling, concepts of ionic equilibrium, water quality modeling, instream flow requirements.

Prerequisite: WR 418.

Restriction: Must be a: Graduate, Professional.

Term Offered: Fall (even years).

Grade Mode: Traditional.

Special Course Fee: No.

WR 798 Research Credits: Var[1-18] (0-0-0)

Course Description:

Prerequisite: None.

Restriction: Must be a: Graduate, Professional.

Terms Offered: Fall, Spring, Summer.

Grade Mode: Instructor Option.

Special Course Fee: No.

WR 799 Dissertation Credits: Var[1-18] (0-0-0)

Course Description:

Prerequisite: None.

Restriction: Must be a: Graduate, Professional.

Terms Offered: Fall, Spring, Summer.

Grade Mode: Instructor Option.

Special Course Fee: No.