DEPARTMENT OF ECO SYSTEM SCIENCE AND SUSTAINABILITY

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The Department of Ecosystem Science and Sustainability currently offers a B.S. in Ecosystem Science and Sustainability, a B.S. in Watershed Science, a minor in Watershed Science, an M.S. in Watershed Science, and a Master of Greenhouse Gas Management and Accounting program.

Undergraduate Majors
- Major in Ecosystem Science and Sustainability
- Major in Watershed Science

Minors
- Minor in Watershed Science

Graduate Graduate Programs in Ecosystem Science and Sustainability
The department offers graduate programs leading to a Master of Science in Watershed Science or a Master of Science in Greenhouse Gas Management and Accounting. Students interested in graduate work should refer to the Graduate and Professional Bulletin and website for the Department of Ecosystem Science and Sustainability (http://warnercnr.colostate.edu/ess-home).

Master Programs
- Master of Greenhouse Gas Management and Accounting, Plan C (M.G.M.A.)

Courses
- Master of Science in Watershed Science, Plan A
- Master of Science in Watershed Science, Plan B

Ecosystem Science and Sustainability (ESS)

- ESS 130 System Theory and Information Management Credit: 1 (0-2-0)
  Course Description: Applying computers, networks, software applications, and the internet for managing information in ecosystem science and sustainability.
  Prerequisite: AGRI 140 or BUS 150 or CS 110.
  Term Offered: Spring.
  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: ESS 211.
Registration Information: Required field trips.
Term Offered: Fall.
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 400 Sustainability and Ecosystem Science Credits: 3 (2-0-1)
Course Description: Integrates ecosystems services and sustainability strategies, application to coupled natural and human systems.
Prerequisite: ESS 311 and ESS 330.
Registration Information: Must register for lecture and recitation.
Term Offered: Spring.
Grade Mode: Traditional.
Special Course Fee: No.

ESS 411 Earth Systems Ecology Credits: 3 (2-2-0)
Course Description: Earth as a system, stressing ecological interactions among energy, water, and biogeochemistry.
Prerequisite: ESS 311.
Registration Information: Must register for lecture and laboratory.
Term Offered: Fall.
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 330.
Registration Information: Senior standing in WCNR. Must register for lecture and recitation.
Term Offered: Spring.
Grade Mode: Traditional.
Special Course Fee: Yes.

ESS 486 Ecosystem Practicum Credits: 2 (0-0-2)
Course Description: One-week field practicum to examine ecosystem science and sustainability issues in Colorado landscapes.
Prerequisite: ESS 211 and NR 220.
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: None.
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: ESS 400.
Registration Information: Admission to graduate school. Sections may be offered: Online.
Term Offered: Fall.
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: ESS 524.
Registration Information: Graduate standing. Sections may be offered: Online.
Term Offered: Spring.
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.
Registration Information: Graduate standing. Sections may be offered: Online.
Term Offered: Spring.
Grade Mode: Traditional.
Special Course Fee: No.

ESS 543 Current Topics in Climate Change Credits: 2 (2-0-0)
Also Offered As: ATS 543.
Course Description: Climate fundamentals and current topics in climate change.
Prerequisite: ESS 524.
Registration Information: Credit not allowed for both ESS 543 and ATS 543.<Sections may be offered: Online.br>
Term Offered: Fall.
Grade Mode: S/U Sat/Unsat Only.
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.
Registration Information: Must register for lecture and laboratory. Required field trips.
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 (STAT 511).
Registration Information: STAT 511 or written consent of instructor. Must register for lecture and laboratory.
Term Offered: Fall (even 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 587 Internship Credits: Var[1-6] (0-0-0)
Course Description: None.
Terms Offered: Fall, Spring.
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: 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 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: (STAT 511) 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: No.
Prerequisite: None.
Restriction: Must be a: Graduate.
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: No.
Prerequisite: None.
Restriction: Must be a: Graduate, Professional.
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: No.
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: No.
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 304 Sustainable Watersheds Credits: 3 (3-0-0)
Also Offered As: GR 304.
Course Description: Effects of climate, land use, and water use on the sustainability of water quantity and quality.
Prerequisite: None.
Registration Information: Completion of the AUCC 1B Mathematics requirement. Credit not allowed for both WR 304 and GR 304.
Terms Offered: Fall, Spring.
Grade Mode: Traditional.
Special Course Fee: No.
Additional Information: Biological & Physical Sciences 3A.

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: Yes.

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: (GEOL 120 or GEOL 122 or GEOL 124 or GEOL 150 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 Modes: S/U within Student Option, Trad within Student Option.
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: None.
Registration Information: Must have concurrent registration in WR 416. Must register for lecture and laboratory. Required field trips.
Term Offered: Fall.
Grade Modes: S/U within Student Option, Trad within Student Option.
Special Course Fee: No.

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: None.
Registration Information: CHEM 103; CHEM 104 or CHEM 107; CHEM 108 or CHEM 111; CHEM 112.
Term Offered: Spring.
Grade Modes: S/U within Student Option, Trad within Student Option.
Special Course Fee: No.

WR 419 Water Quality Laboratory for Wildland Managers Credits: 2 (0-4-0)
Course Description: Sampling and determination of water quality parameters.
Prerequisite: None.
Registration Information: Must have concurrent registration in WR 418.
Term Offered: Spring.
Grade Modes: S/U within Student Option, Trad within Student Option.
Special Course Fee: Yes.

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 322 or NR 319) and (WR 416 and WR 418).
Registration Information: Must register for lecture and laboratory.
Term Offered: Spring.
Grade Modes: S/U within Student Option, Trad within Student Option.
Special Course Fee: No.

WR 465 Eolian and Fluvial Transport Processes Credits: 4 (3-3-0)
Course Description: Fundamental physical principles of eolian and fluvial transport processes.
Prerequisite: PH 141.
Registration Information: Must register for lecture and laboratory.
Term Offered: Fall.
Grade Modes: S/U within Student Option, Trad within Student Option.
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: None.
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: Focused on problem solving in watershed science.
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: None.
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 ENVE 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. Sections may be offered: Online.
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 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 322 or ENV 322 or WR 416) and (STAT 301 or STAT 315 or CIVE 202) and (MATH 141 or MATH 155 or MATH 160).
Registration Information: Must register for lecture and laboratory. Credit not allowed for both WR 524 and CIVE 524.
Term Offered: Spring (odd years).
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 322 or ENV 322 or WR 416) and (STAT 301 or STAT 315 or CIVE 202) and (MATH 141 or MATH 155 or MATH 160).
Registration Information: Must register for lecture and laboratory. Credit not allowed for both WR 524 and CIVE 524.
Term Offered: Spring (odd years).
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 ENVE 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 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: None.
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: (WR 416 or CIVE 322 or ENVE 322) 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.