LRES - Land Resources & Env Sci

LRES 501 Writing and Professional Development for Environmental Scientists: 2 Credits (1 Lec, 1 Other)
PREREQUISITE: Graduate status or consent of instructor. Foundational skills for writing scientific manuscripts, grant proposals, and thesis chapters with a focus on career development in the environmental sciences

LRES 505 Concepts of GIS in Environmental Science: 3 Credits (2 Lab, 1 Other)
GIS Concepts in Environmental Science utilizing QGIS opensource software to build a spatial science toolkit. Evaluate vector and raster analysis in LRES topics. Semester project will deliver professional study area map, data management of graduate work, and exposure to advanced spatial techniques.

LRES 507 Environmental Risk Assessment: 3 Credits (3 Lec)
Principles of risk analysis, including risk assessment, perception, communication, and management. Emphasis on human toxicology, ecotoxicology, dose-response relationships, exposure analysis, environmental fate, and deterministic and probabilistic risk assessment. Case studies will include examples from pesticides, biotechnology, natural resource extraction, and invasive species. Co-convened with ENSC 407.

LRES 510 Biodiversity Survey and Monitoring Methods: 3 Credits (2 Lec, 1 Lab)
Biodiversity survey and monitoring designs, sampling methods, and data evaluation techniques are introduced. Emphasis is on plants but other taxa are addressed for agricultural, rehabilitation and wildland systems. One week of fieldwork required prior to semester; course completion 3rd week of October.

LRES 511 Environmental Data Mgmt: 2 Credits (2 Lec)
PREREQUISITE: Graduate standing. Foundational skills for wrangling and management of natural sciences data sets using the R statistical computing environment. Students develop a deep understanding of the inner workings of R, learn skills for data import, tidying, and restructuring to prepare data for statistical analysis, and techniques for integrating R with databases to facilitate management, analysis, and archival of large, complex and cumbersome data sets

LRES 515 Microbial Ecology: 3 Credits (3 Lec)
PREREQUISITE: BIOM 415. (F) Critical review of literature on the distribution and activity of microorganisms in natural microbial communities based on microbial adaption and physical, chemical and biological features of the microenvironment. A critical discussion of literature and approaches

LRES 521 Holistic Thought & Management: 3 Credits (3 Lec)
PREREQUISITE: Graduate Standing. Students will apply holism and systems thinking to natural and human resource management issues. Learn about the role of adaptability, resilience, and collaborative decision making for the long-term sustainability of socio-ecological systems. Use of real cases from the Greater Yellowstone Ecosystem and other locations. Critical study and discussion of literature

LRES 525 Applied Remote Sensing: 3 Credits (2 Lec, 2 Lab)
Applications of remote sensing for graduate students, including advanced studies of multispectral and hyperspectal sensors and image processing algorithms. Emphasis is on using remote sensing technologies for solving applied land resource issues.

LRES 528 Bridging Priciples & Practices of Sustainable Cropping Systems: 1 Credits (1 Other)
PREREQUISITE: Any graduate student or undergraduate student with approval from the instructor. The course goal is to elevate agricultural students' awareness of peer-reviewed literature that demonstrates application of principles to address issues of sustainability in cropping systems. The course will use a student-lead discussion format to highlight issues and principles in a series of papers that the class will read. The course will emphasize the practical interaction among agronomy, ecology, economics, and sociology to create an awareness of the interdisciplinary issues associated with sustainability in agriculture

LRES 529 Cropping Systems and Sustainable Ag: 3 Credits (3 Lec)
PREREQUISITE: AGSC 341 or AGSC 342; graduate standing or consent of instructor. The course goal is to elevate agricultural students' awareness of peer-reviewed literature that demonstrates application of principles to address issues of sustainability in agriculture. The course will use a student-lead discussion format to highlight issues and principles in review of a series of papers that the class will read, will focus on the interaction among agronomy, ecology, economics, and sociology to create an awareness of the interdisciplinary issues associated with sustainability in agriculture. Topical issues associated with climate change impacts, system resilience and thresholds and ways to understand complex interactions will be considered for discussion. Co-convened with AGSC 428

LRES 530 Natural Resource Law: 3 Credits (3 Lec)
The course examines major natural resources laws, emphasizing the federal model. A modified case study approach is used to review legislation and related court cases governing natural resources, including water, minerals, timber, range, wildlife, recreation, and wilderness. Co-convened with NRSM 430.

LRES 531 Applied Watershed Hydrology: 3 Credits (3 Lec)
PREREQUISITE: ENSC 245 or an equivalent course in soil science AND an introductory physical geography course (equivalent to GEO 103CS) or an introductory earth science course (equivalent to ERTH 101IN) Applied watershed hydrology explores how water from rain and snow moves through landscapes and stream networks. This class will provide a broad introduction that focuses on patterns of streamflow, their measurement, and underlying physical processes including precipitation, evapotranspiration, soil water dynamics, snowmelt, overland and subsurface hillslope runoff, and channel flow. Real-world examples will be used to illustrate the influence of climate, topography, geology, soils, vegetation, land use, and other factors. Applications to aquatic and riparian resources, environmental problems, and human safety will be emphasized

LRES 532 Soil Ecosystems and Processes: 3 Credits (3 Lec)
PREREQUISITES: BIOB 160. This course focuses on biological and non-biological processes in soil ecosystems. Topics covered are soil's function and role within our environment, nutrient and carbon cycling in soil, and effects of human activities and disturbance on soil and ecosystem function Repeatable up to 3 credits.

LRES 533 Wetland Ecology & Management: 3 Credits (3 Lec)
This class will examine wetland ecology and the management of resources. Students will study hydrological and geomorphic processes at watershed and site scales, how processes drive wetland hydrology and hydric soil development and maintenance, and the interaction with biological systems.

LRES 534 Environmental Data Analysis: 3 Credits (3 Lec)
PREREQUISITE: M 121Q or equivalent. Modern sciences are data-driven and this course focuses on making sense of data, both quantitatively and conceptually. Topics include a review of relevant algebra skills, methods to describe data, inferential statistical methods, sampling, experimental design, & regression focusing on interpretation

LRES 535 Techniques of Spatial Analysis: 3 Credits (2 Lec, 2 Lab)
PREREQUISITE: Either GPHY 426, 429R, 284, or 504 or LRES 525, and either STAT 401 or 411, or graduate standing and permission of instructor. Exploration and understanding of analytical techniques needed to deal with spatially correlated data. Emphasis is placed on practical applications within geographic information systems and image processing

LRES 536 Ecology of Invasive Plants II: 1 Credits (1 Lec)
PREREQUISITE: LRES 569
Through this course, students will learn to organize plant population data and analyze it to determine population temporal and spatial dynamics. In addition they will learn how to apply the conclusions drawn from the analysis to invasive species management decisions.

LRES 539 Ecological Restoration and Management: 3 Credits (2 Lec, 1 Lab)
PREREQUISITE: This course is restricted to LRES-online students only; General Biology, General Ecology; Insights into ecological processes require an understanding of the unique chemical environment that wetlands represent; You must be familiar with basic high school chemistry (Eh/pH/redox) to be able to succeed in this course; Similarly, you must be familiar with basic, high-school-level quantitative approaches in environmental sciences. This class combines readings, field measurements and site visits to examine scientific, legal and management components that define the practice of restoration. Fundamentals are based on foundational science and practical elements that affect the implementation of restoration projects

LRES 540 Ecology Plants & Community: 3 Credits (3 Lec)
PREREQUISITE: BIOB 160, BIOB 258 and STAT 216Q. This course will explore plant ecology at the individual, population and community levels. Topics include plant response to stress, population biology, and community assembly, and possibly non-native species and restoration. Quantitative measures for assessing populations and communities will be addressed

LRES 543 Agroecology/Appl Plant Ecology: 3 Credits (2 Lec, 2 Lab)
PREREQUISITE: BIOE 370, M 171, ENSC 443, STAT 216 Focus on the principles and theories of population and community ecology as they relate to invasive plant species in natural and agroecosystems. Measuring plant interference and assessing population interactions and dynamics through empirical and theoretical models. Review theory and methodology concerning plant population demographics, dispersal , and natural trait selection. Examine the role of biodiversity and evolution in determining sustainable management of ecosystems

LRES 544 Water Quality: 3 Credits (3 Lec)
PREREQUISITES: ENSC 110 or equivalent
This course covers water quality fundamentals (physical, biological, and chemical) and integrates science-policy management and research. This course uses examples from county Extension, watershed groups, conservation districts, and agencies across Montana interfaced with MSU hydrology and water quality research.

LRES 545 Watershed Analysis: 3 Credits (3 Lec)
PREREQUISITE: ENSC 444 and STAT 216 or BIOB 318 Conceptual and quantitative analysis of watershed processes with an emphasis on modeling surface water hydrology and water resources management. Watershed modeling concepts including analysis of time series, spatially variable data, model calibration, and uncertainty analysis will be studied and demonstrated. The course will emphasize critical analysis of current hydrologic computational methods and hands-on use of watershed models

LRES 546 Quant Methods Environmental: 3 Credits (3 Lec)
PREREQUISITE: ENSC 445 or LRES 545 or consent of instructor. (Sp)
This course will focus on development of quantitative analysis and modeling skills in watershed and environmental science. Students will develop skills necessary to describe and evaluate model structure, including their inner workings, and evaluate the merit of different models of varying type and complexity

LRES 555 Aqueous Geochemistry: 3 Credits (2 Lec, 1 Other)
PREREQUISITE: CHMY 211, CHMY 228, ENSC 245 or equivalent. Advanced coverage of aqueous geochemistry in terrestrial and aquatic systems including chemical processes such as complexation, precipitation-dissolution, sorption-desorption, partitioning, oxidation-reduction and gas-water equilibria. Applications of these principles will be demonstrated in subject areas including biogeochemical cycling, bioremediation, contaminant fate and transport, salt-affected soils and wetland processes. Recitation will focus on current literature, applied problems, and case studies

LRES 557 Thermal Biology in YNP: 2 Credits (1 Lec, 1 Lab)
(Su) Science/Science Education; Enrollment limited to M.S. Science Education Graduate Program A survey of the ecology of important organisms common in thermal habitats of Yellowstone National Park, including a review of different life forms (prokaryotes and eukaryotes) and their modes of metabolism, and the physical, and chemical habitats that define their environment. Course includes lecture, laboratory, and field components. Students will be asked to design curricula for K-12 audiences. Offered Summer.

LRES 558 Isotope Biogeochemistry: 2 Credits (1 Lec, 1 Other)
PREREQUISITE: Consent of instructor . Fundamentals and applications of isotope systems useful in the environmental sciences, including light elements such as carbon, mid-mass elements such as iron, and heavy elements such as uranium. Measurement techniques will be discussed, and application to student inspired questions explored

LRES 561 Belowground Plant Ecology: 3 Credits (3 Lec)
PREREQUISITE: STAT 401 or equivalent; BIOE 370 or equivalent; BIOO 433 or equivalent. Application of basic ecological principles to belowground interactions of plant communities. Topics include plant competition, belowground herbivory, plant-microbe interactions including mycorrhizae, and diversity/productivity links in soil systems. Case studies will include invasive species, restoration scenarios, sustainable agriculture, and wildland communities

LRES 562 Land Rehab Field Problem: 2 Credits (4 Lab)
PREREQUISITE: ENSC 460, ENSC 461. Extended field trip to numerous drastically disturbed sites across the Northern Plains. On-site review of land rehabilitation problems, solutions, and methodologies. Participation by industry, regulatory agency staff, and rehabilitation professionals will occur at most sites

LRES 563 Restoration Ecology: 3 Credits (3 Lec)
PREREQUISITE: BIOE 370 or equivalent ecology course. Review of ecosystem structure and function, and community and population processes in intact systems, along with the effects of major disturbances on natural systems. Restoration amendments will be discussed in terms of their effects on ecosystem structure and function. The course includes case studies, and focuses on plant and soil systems. Co-convened with ENSC 461

LRES 564 Fundamentals of Environmental Monitoring: 2 Credits (1 Lec, 1 Lab)
Provides a graduate level perspective on field measurement methodology in environmental science. Foci are electronic transducers, data loggers, and programmatic approaches to measurement and uncertainty analysis. Incoming students are expected to have a quantitative undergraduate degree related to environmental science.

LRES 565 Environmental Biophysics: 3 Credits (2 Lec, 2 Lab)
PREREQUISITE: BIOB 170 or equivalent and PHSX 205. The study of physical relationships between organisms, ecosystems, and their environment. Basic principles of Micrometeorology, Biometeorology, Ecological Climatology, and Biophysical Ecology as applied to contemporary ecological challenges. Laboratory sessions will focus on computer exercises using ecosystem models and field observations. Co-convened with ENSC 465

LRES 566 Chemical Ecology: 3 Credits (3 Lec)
PREREQUISITE: Graduate standing in LRES Graduate program or permission of instructor. How organismal interactions are shaped through plant secondary metabolites
emphasizing the impacts on ecosystems across multiple scales and in response to a rapidly changing climate. This course combines lectures with student led discussions on contemporary issues and developments in the field and is also designed to improve critical readings of the primary literature and effective communication in science. Co-convened with ENSC 466.

LRES 567 Biogeochem Analy Synthesis: 1 Credits (1 Other)
The course is meant to serve as an introduction to the study of biogeochemical dynamics from an Earth-systems perspective. The course will consist mostly of readings from primary literature and student-lead discussion. We will choose a problem/question, work together to survey relevant literature through a meta-analysis, and strive to produce a manuscript for publication.

LRES 568 Ecosystem Biogeochemistry: 3 Credits (3 Lec)
Introduction to the study of biogeochemistry and ecosystem dynamics from an Earth-systems perspective. Discussion will emphasize factors governing the "grand elemental cycles" of carbon, nitrogen, and phosphorous of Earth's major ecosystems and how modern human activities are affecting these cycles. Co-convened with ENSC 468.

LRES 569 Ecol of Invasive Plants in GYE: 2 Credits (1 Lec, 1 Lab)
(Su) Current theories on what makes species invasive and what ecosystem conditions invite or resist non-indigenous plant species will be considered. Direct involvement in field research associated with testing methodology for monitoring the invasive potential of several exotic species in the otherwise pristine mountain environments. Offered Summer.

LRES 571 Landscape & Ecosys Ecology: 3 Credits (3 Lec)
PREREQUISITE: General Biology, General Ecology, General Statistics Focuses on principles and applications of landscape and ecosystem ecology. Students will explore factors that shape landscape patterns in space and time and consequences for ecosystem processes. The course explores the methods and tools of landscape and ecosystem analysis.
-Department of Land Resources Environmental Sciences.

LRES 572 Frontiers in Remote Sensing: 1 Credits (1 Other)
PREREQUISITES: GPHY 429 or GPHY 426 or LRES 525 or equivalent. This course focuses on the emerging trends, technologies, and applications in remote sensing. Each time the course is taught, it will focus on a novel aspect of remote sensing science. Potential topics include UAS, lidar, radar, newly deployed satellites/sensors, and emerging scientific applications in remote sensing. Students who have a background and/or interest in remote sensing applications will be exposed to cutting-edge science, technologies and applications which will broaden their exposure to this rapidly developing field

LRES 573 Remote Sensing Env Sci: 3 Credits (3 Lec)
PREREQUISITE: BIOE 370 and STAT 216Q. This course focuses on understanding the basics of remote sensing science geared towards critical interpretation of the applications of remote sensing in environmental science. In addition, students will be exposed to hands-on exercises in basic digital image processing and analysis

LRES 575 Prof Paper & Project: 1-4 Credits (1-4 Lec)
PREREQUISITE: Graduate standing A research or professional paper or project dealing with a topic in the field. The topic must have been mutually agreed upon by the student, the major advisor, and graduate committee

LRES 582 Streamside Science for Teachers: 3 Credits (3 Lec)
(Su) The primary goal of this course is to increase the water resource knowledge of students through hands-on, field-based curriculum. To accomplish this, students will be asked to adopt a local stream and perform lab assignments "in the field" to better understand hands-on water quality monitoring techniques. The course will improve the teaching skills of secondary science teachers utilizing distant delivery technologies. By completing this course, secondary science teachers will have a better understanding and hands-on working knowledge of the characterization and quantification of water quality as it relates to secondary school science curriculum and environmental issues on a global scale. Offered Summer.

LRES 583 The Dirt on Soil Science for Elementary Teachers: 1 Credits (1 Lec)
(Sp) Offered Spring of odd years. This course is for those who want to understand and teach the science of “dirt” in an interactive, hands-on manner so that it engages students. The focus of instruction will be on basic soil physical properties and processes with the idea that soil science is merely the “platform” for introducing elementary graders to science. Teachers completing this course will engage in “hands on” active learning with techniques immediately transferable to the classroom. Offered odd Spring semesters.

LRES 584 Twelve Principles of Soil Science for Teachers: 3 Credits (3 Lec)
() Offered every other Fall, even years. The goal of this course is to introduce teachers to the basic principles of soil science as an integral part of the curriculum for environmental sciences, ecology, earth science, geology, water quality, and geography. The course is structured around twelve basic soil concepts, beginning with the significance of soil in our everyday lives and progressing through soil formation, the physical and chemical properties of soils, and the role soil and the earth play in environmental management today and in the future. This course is filled with "how to" and hands-on classroom teaching opportunities and resources. Offered odd Spring semesters.

LRES 585 Water Quality in the Classroom for Teachers: 3 Credits (3 Lec)
() Offered every other Spring, even years. Water Quality in the Classroom for Teachers - is a 'must' course for teachers involved in any aspect of biological sciences. The course has three central foci: 1) to increase student knowledge and assessment skills about the physical, chemical, and biological aspects of water quality investigations, 2) to develop and implement new pedagogy for teaching water quality concepts in the secondary school science classroom, and 3) increase student awareness and understanding of some of the more significant global water quality issues that will face science teachers and their students in the 21st century. Offered even Spring semesters.

LRES 586 Lake Ecology for Teachers: 2 Credits (1 Lec, 1 Lab)
This course will provide a comprehensive understanding of the biotic and abiotic factors that influence lake dynamics. It will address the unique ecosystem of Yellowstone Lake with an emphasis on the aquatic invertebrate life. This will be accomplished through lecture, field investigation, and laboratory analysis. Students will synthesize and be able to apply learned skills and knowledge in their classroom (grades 5-12). The course will take place in Yellowstone National Park and on the MSU campus. Montana State University educators, National Park Service resource managers, and other agency professionals will join the class to provide a multi-disciplinary perspective.

LRES 588 Professional Development: 1-3 Credits (1-3 Lec)
PREREQUISITE: Graduate standing, teaching experience and/or current employment in a school organization, consent of instructor and Dean of Graduate Studies. Courses offered on a one-time basis to fulfill professional development needs of in service educators. A specific focus is given to each course which is appropriately subtitled

LRES 589 Graduate Consultation: 3 Credits (3 Other)
PREREQUISITE: Master's standing, consent of instructor and approval of the Dean of Graduate Studies. This course may be used only by students who have completed all of their coursework (and thesis, if on a thesis plan), but who need additional faculty or staff time or help

LRES 590 Master's Thesis: 1-10 Credits (1 Other)
PREREQUISITE: Master's standing
Repeatable up to 99 credits.

LRES 591 Special Topics: 1-4 Credits (4 Lec, 4 Other)
PREREQUISITE: Upper division courses and others as determined for each offering. Courses not required in any curriculum for which there is a particular one-time need or given on a trial basis to determine acceptability and demand before requesting a regular course number
Repeatable up to 12 credits.

LRES 592 Independent Study: 1-3 Credits (1 Other)
PREREQUISITE: Graduate standing, consent of instructor, approval of department head, and Dean of Graduate Studies. Directed research and study on an individual basis
Repeatable up to 6 credits.

LRES 593 Grand Challenges in Ecology and Environmental Sciences: 1 Credits (1 Lec)
Foundational course designed as a requirement for all incoming Ecology and Environmental Science (EES) PhD students. The course will have three focal areas including: 1) graduate student professional development, 2) grand challenges in Ecology and Environmental Science, and 3) a field trip to a Montana ecosystem (e.g. Greater Yellowstone, Central Prairie or Crown of the Continent Ecosystem) to immerse the students in observation and discussion of grand challenges associated with these ecosystems. Three-day field trip required.

LRES 594 Seminar: 1 Credits (1 Other)
PREREQUISITE: Graduate standing or seniors by petition. Course prerequisites as determined for each offering. Students prepare, present, and critique scientific presentations
Repeatable up to 6 credits.

LRES 598 Internship: 2-4 Credits (2 Other)
PREREQUISITE: Graduate standing, consent of instructor and approval of department head, and Dean of Graduate Studies. An individualized assignment arranged with an agency, business or other organization to provide guided experience in a field of study
Repeatable up to 12 credits.

LRES 690 Doctoral Thesis: 1-10 Credits (1 Other)
PREREQUISITE: Doctoral standing
Repeatable up to 99 credits.