Plant & Wildlife Sciences Graduate Course Descriptions

PWS 505	**Aquatic and Terrestrial Biogeochemistry** (3 Cr.) (Fall odd years) An in-depth treatment of global biogeochemical cycles, focusing on cycles of carbon, oxygen, nitrogen, phosphorus, and sulfur in the atmosphere, hydrosphere, and lithosphere. Special attention will be given to the microbial mediated transformations and the impact of human disturbances in terrestrial and aquatic environments.
PWS 511	**Environmental Biophysics: Soil and Plant Water Relations** (4 Cr.) (Winter even years) (Prereq: Phscs 105 and PWS 282; or equivalents) Integrating biological, physical, and chemical processes of water and solute movements through the soil-plant-atmosphere continuum.
PWS 512	**Rangeland Landscape Ecology and Geographic Information Systems** (3 Cr.) (Fall odd years) Applying landscape ecology theory to evaluate, describe, and predict spatial patterns and processes within rangeland ecosystems using geographic information systems (GIS), remote sensing, and global positioning systems (GPS).
PWS 532	**Advanced Scientific Writing and Communication** (3 Cr) (Fall) Designed for PWS graduate students who are preparing their research prospectus, this course focuses on components of scientific papers and barriers to writing.
PWS 540	**Plant Response to the Environment** (3 Cr.) (Fall even years) (Prereq: PWS 440 or equivalent; PWS 494R or concurrent enrollment) Advanced plant physiological ecology principles.
PWS 547	**Ungulate Conservation and Management** (2 Cr.) (Winter even years) (Prereq: PWS or Bio 350; and Bio 447; or equivalents) Integrating principles of natural history, population ecology, behavior, and conservation biology of North American ungulates. Special emphasis on management and conservation applications.
PWS 551	**Quantitative Ecology** (3 Cr.) (Winter even years) (Prereq: Bio 350 or equivalent; Stat 121 or 511 or concurrent enrollment) Quantitative methods for ecological sampling and data analysis.
PWS 553	**Restoration Ecology** (3 Cr.) (Winter odd years) (Prereq: PWS 282, 416; Bio 350; or equivalents) Nature of ecosystem disturbance and plant succession; developing science and practice of ecological restoration; case studies of applied restoration.
PWS 554	**Wildlife Behavioral Ecology** (3 Cr.) (Fall even years) (Prereq: Bio 100, 350; or equivalents) (Note: Field trips required) Integrating principles of ethology, sociobiology, and behavioral ecology using examples from wildlife resources; behavioral sampling methods.
PWS 559	**Molecular Plant Breeding** (3 Cr.) (Fall odd years) (Prereq: PWS 265, 340, 485, 586, PDBio 360; or equivalents; PWS 494R or concurrent enrollment) Molecular genetics methods applied to improvement of economically important plants. Theory and methods of plant transformations.
PWS 560	**Quantitative Environmental Chemistry** (2 Cr.) (Winter even years) (Prereq: Chem 105, 106, 107; or equivalent) (Recommended: Chem 223 and/or PWS 283, 306, 405, 406) Laboratory chemical analysis of soils and plant materials in soil and plant research.

PWS 575	**Plant Pathology** (3 Cr.) (Fall odd years) (Prereq: PWS 100 or equivalent) Concepts associated with symptoms, development, control, and classification of plant diseases. Identification and classification of plant fungi, bacteria, and viruses.
PWS 588	**Metagenomics** (3 Cr.) (Winter odd years) (Prereq: Introductory coding and mommand-line experience (e.g. Bio 664 for grad students or seek instructor's consent); strongly recommend Bio/MMBio/PWS 468 or corresponding graduate sections) Introduction to comparative and fuctional analysis of genomic and metagenomic datasets, including microbial functions that affect host health. Analyzing existing and novel datasets with field-standard techniques.
PWS 598R	**Advanced Topics in the Plant and Wildlife Sciences** (1-3 Cr.) (Fall Contact Department, Winter Contact Department, Spring Contact Department, Summer Contact Department)
PWS 629	**Conservation of Mega and Meso Carnivores** (3 Cr.) (Fall odd years) Life histories of representative carnivores with political, popular, and managerial problems surrounding their existing and proposed conservation.
PWS 633	**Biometry and Experimental Design** (3 Cr.) (Fall) (Prereq: Stat 121 or 510 or equivalent) The design, analysis, and interpretation of biological research using modern analytical tools and relevant software.
PWS 634	**Analysis and Management of Plant and Animal Populations** (3 Cr.) (Winter odd years) Exposure to common tools for analysis and management of plant and animal populations. Program mark, program distance, movement and home range analysis, point pattern analysis, etc.
PWS 670	**Analysis of Complex Genomes** (3 Cr.) (Fall odd years) (Prereq: PWS 340 or equivalent) Assembly and analysis of eukaryotic genomes, including the theory underlying and application of commonly used methods. First in a two-course series.
PWS 672	**Comparative Genomics** (3 Cr.) (Winter even years) (Prereq: PWS 670) Analysis and interpretation of eukaryotic genomes in a comparative context. Theory behind commonly used methods for comparing whole genomes, such as read alignment, whole genome alignment, orthology prediction, variant calling, detection of positive selection, and phylogenomic analysis. Second of a two-course series.
PWS 673	**Plant Cytogenetics** (3 Cr.) (Winter even years) (Prereq: PWS 340, 485; or equivalents) Chromosome structure and function; classical and molecular cytological methods of chromosome and genome analysis.
PWS 694R	**Seminar** (1 Cr.) (Fall, Winter) Display fluency in the vocabulary and current research techniques in the four focal areas of the PWS Department: Environmental Science; Genetics and Biotechnology; and Wildlife and Wildlands Conservation. Explain the importance of Gospel-centered stewardship and sustainability.
PWS 697R	**Research** (1-9 Cr.) Graduate students will use scientific principles to answer objectives associated with their individual research projects. Skills and techniques acquired in class through advisors will be applied to research projects that will be evaluated by peers.

PWS 699R	**Master's Thesis** (1-9 Cr.) Students will be able to apply research principles to practical problems to alleviate concerns. Graduates will understand scientific principles and methods and be able to present research for peer evaluation.
PWS 799R	**Doctoral Dissertation** (1-9 Cr.) Students will be able to apply research principles to practical problems to alleviate concerns. Graduates will understand scientific principles and methods and be able to present research for peer evaluation.

Additional courses to consider for Program of Study

only one 300 level course and only two 400 level courses can be added to a PWS Program of Study

BIO 430	**Plant Classification and Identification** (4 Cr.) (Fall) (Prereq: BIO 230 or instructor's consent) Principles of plant systematics, taxonomy, and classification, emphasizing family recognition by sight, terminology, and use of identification keys to the temperate flora.
BIO 470	**History and Philosophy of Biology** (3 Cr.) (Fall) (Prereq: BIO 350) Development of fundamental generalizations of biology; nature of science; applications to major philosophical issues of current science.
BIO 503	**Research Orientation** (1 Cr.) (Fall) Introduction to graduate school and research techniques.
BIO 510	**Biological Systematics and Curation** (3 Cr.) (Fall even years) Principles, methods, and tools of taxonomy and systematics as applied to species delimitation, specimen-based research, nomenclatural codes, and the curation of biological specimens.
BIO 517	**Publishing in Peer-Reviewed Journals** (2 Cr.) (Fall Contact Department, Winter odd years) (Prereq: BIO 494R or BIO 699R or BIO 799R) Each student enrolled in this course will be guided through the processes of writing a scientific manuscript and submitting it for publication in a peer-reviewed journal.
BIO 520	**Symbiosis** (3 Cr.) (Fall Contact Department, Winter Contact Department) (Prereq: BIO 220 or BIO 230) For graduate and upper-level undergraduate students, an introduction to the differences and commonalities among a diverse range of symbioses involving animals, plants, fungi and prokaryotes and the ways in which they influence biological communities. Topics include the human gut microbiome, mycorrhizas, plant-rhizobium symbiosis, plant-insect symbioses, marine invertebrate-bacterial symbioses, ant symbioses, lichen and soil crusts.
BIO 541	**Aquatic Entomology** (4 Cr.) (Fall even years) (Prereq: BIO 441 or equivalent) Morphology, classification, biology, and functional ecology of aquatic insects. Field trips required.
BIO 555	**Evolutionary & Ecological Modeling** (2 Cr.) (Winter odd years) (Prereq: Senior status in bioinformatics program or graduate status; STAT 511, 512, or equivalent; instructor's consent) Using models in ecology. Practical experience in analytical, simulation, and agent-based models.

BIO 557	**Stream & Wetland Ecology** (4 Cr.) Stream and wetland ecology; their biota and their physical/chemical properties.
BIO 559R	**Advanced Systematics** (1-6 Cr.) (Contact Department) (Prereq: Instructor's consent)
BIO 652	**Evolutionary Ecology** (3 Cr.) Exploring the diversity of life by integrating ecological and evolutionary perspectives. Topics include theoretical population ecology, advanced evolutionary biology, and behavioral ecology.
BIO 653	**Community & Ecosyst Ecology** (3 Cr.) Integrating ecological and biogeochemical concepts to understand the structuring of biological communities and ecological systems. Topics include community assembly, trophic dynamics, systems biology, ecosystem services, and biodiversity-ecosystem function.
BIO 654	**Speciation and Phylogeography** (3 Cr.) Students will understand theoretical foundations of speciation and phylogeography including key theories and research practices; implement empirical approaches to analyze, interpret, and communicate relevant biological issues; and conceive, execute, and present a related independent research study.
BIO 664	**Bioinf & Data Analysis 1** (4 Cr.) Bioinformatics skills have become critical for biological research. This course is intended to be the first half of a two-semester sequence that introduces students to bioinformatics. Students will be introduced to the Linux operating system, Python, and high performance computing. Students will acquire the skills to perform data manipulations and simple analyses on biological datasets.
BIO 665	**Bioinf & Data Analysis 2** (2 Cr.) Students will develop skills in applying bioinformatics algorithms to biological data and in critically analyzing results. Building on skills and concepts learned in BIO 664, students will learn to write code in the R programming language, perform statistical tests, and create data visualizations. Students will interpret and discuss findings from prior research studies from various biological subdisciplines. Students will conceive, execute, and present an independent research study.
BIO 676	**Univ Teaching 1** (3 Cr.) An exploration into learning theories that influence teaching pedagogies: understanding how students learn; designing curriculum to fit current research-backed models of learning; understanding assessment strategies; practicing backward design; and preparing graduate students for an authentic teaching experience.
BIO 677	**Univ Teaching 2** (2 Cr.) (Prereq: Univ Teaching 1) Guided experience in development and evaluation of instructional product: analyzing learning outcomes; developing instructional materials and assessment instruments; critique of finished instruction; and practical experience under the direction of a faculty member.
BIO 691R	**Graduate Seminar** (0.5 Cr) (Fall, Winter)
CE 534	**Hydroinformatics** (3 Cr.) (Fall even years) (Prereq: CE 414 & CE 431) Principles of hardware and software systems for water and climate data collection, storage sharing, interpretation, analysis, and modeling.
CE 594R	**Selected Problems in Civil Engineering** (1-3 Cr.) (Fall; Winter; Spring; Summer) Water Policy- Survey of policy cycles, policy tools, and major laws

	on water quantity, quality, and management, with civil engineering applications.
GEOG 414	**Low Altitude, Large-Scale Image Acquisition and Processing** (3 Cr.) (Fall) Small Unmanned Aerial Systems (sUAS) provide high-quality aerial imagery. Emphasizes flight planning, acquisition, and processing of sUAS data to study a variety of complex natural and human systems. Prepare and sit for FAA commercial sUAS license exam.
GEOG 503	**Geographic Information Systems** (4 Cr.) (Fall, Winter, Spring Contact Department) (Prereq: Graduate standing) Using geographic information for solving advanced spatial problems. Introduction to using and producing maps and computer-based geographic information systems (GIS) as geographic tools. Hands-on research applications in the students' disciplines.
GEOL 435	**Groundwater** (3 Cr.) (Fall) (Prereq: GEOL 111; or GEOL 330; Math 110 or equivalent.) Introduction to the occurrence, movement, and properties of subsurface water. Topics include surface and groundwater relationships, water budgets and the hydrologic cycle, Darcy's law, the physics of groundwater flow, flow nets, flow paths in confined and unconfined aquifers, and basin hydrogeology.
GEOL 531	**Geoscience Data Analysis** (3 Cr.) (Fall) Basic scientific computing skills in MATLAB, and application of statistical and numerical modeling techniques to geoscientific problems.
GEOL 535	**Contaminant Hydrogeology** (3 Cr.) (Winter odd years) (Prereq: GEOL 435 or equivalent) Principles, tools, and applications used to solve heavy metal, organic, and radionuclide groundwater contamination problems. Topics include regulations, mass transport, multiphase flow, transformation, retardation, and attenuation.
GEOL 550	**Environmental Soil Chemistry** (3 Cr.) (Fall Contact Department, Winter Contact Department) (Prereq: CHEM 105, 106, 107; or equivalents) Chemistry of soil systems at macroscopic and microscopic scales, examined from the perspective of scientists interested in environmental assessment and remediation.
HLTH 606	**Environmental Hlth Sciences** (3 Cr.) (Winter) Environmental risks for human disease. Contributions of physical and biological factors and social, economic, and political determinants relative to sustainable development and promotion of health.
LAW 788R	**Law School Clinic** (3 Cr.) Live-client interactions with underserved populations under the supervision of seasoned practitioners. Students will advise and represent one or more actual clients with predominant focus on immigration law, consumer law, government benefit law and other areas of law common to the immigrant, refugee and Hispanic populations. Emphasis will be on the development of professional skills including interviewing and counseling, conducting legal research and drafting legal documents. Students must attend a weekly seminar taught by the clinical supervisor. An offsite requirement to work in the clinic from 5 to 7 pm on Thursdays at the Provo Deseret Industries is also required.
LING 501	**Advanced Research and Writing Techniques for Second Language Writers** (3 Cr.) (Winter) (Prereq: For graduate international ESL students) Non-native

	English speaking students will develop research and writing techniques necessary for graduate-level writing.
MBA 692	**Social Impact** (3 Cr.) (Fall, Winter) Issues facing social innovators, those that work full-time for them, and those who support them; understanding complex systems of for-profit, nonprofit, and hybrid social ventures; outlining involvement in social innovation as part of a lifetime of meaningful service.
MBA 693R	**Special Topics in Management** (3 Cr.) (Fall, Winter, Spring)
MMBIO 551R	**Current Topics in MMBio** (2 Cr.) Readings from current literature on a specific topic; student presentations and discussion.
MMBIO 552	**Flow Cytometry** (2 Cr.) (Fall) The theory and instrumentation of flow cytometry, including current applications and hands-on training.
MMBIO 663	**Articulating Science** (2 Cr.) (Winter) (Prereq: Molecular Genetics in Practice) Identifying open scientific questions and crafting written proposals describing context, impact, and detailed experimental research plans. Also, learning to critically evaluate the scientific writing of others.
MMBIO 667	**Quantitative Genomics** (2 Cr.) (Fall) Students will understand, evaluate, and apply common genomic/transcriptomic methods, which will facilitate processing and interpreting results from large datasets in a biologically meaningful way.