

# BIOE - Biology-Ecological

## **BIOE 103CS Environmental Science and Society: 3 Credits (3 Lec)**

(F, Sp, Su) We will investigate key topics in Environmental Science, including population ecology, human population growth, climate science, biodiversity, landscape management of forests, oceans, and fresh water resources, and agriculture. We will examine environmental hazards and pollution - and associated policies. We will explore energy sources for human societies, and we will review basic ideas of chemistry, evolution and natural selection. Finally, we will discuss concepts of ecology and biological conservation relevant to understanding and studying our changing world. Offered fall and spring.

## **BIOE 290R Undergraduate Research: 1-3 Credits (1-3 Other)**

PREREQUISITE: Consent of instructor and approval of department head. (F, Sp, Su) Directed research and study on an individual basis. Offered on demand  
Repeatable up to 6 credits.

## **BIOE 291 Special Topics: 1-4 Credits (1-4 Lec)**

PREREQUISITE: Course prerequisites 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  
Repeatable up to 12 credits.

## **BIOE 292 Independent Study: 1-3 Credits (1-3 Other)**

PREREQUISITE: Consent of instructor and approval of department head. (F, Sp, Su) Directed research and study on an individual basis. -  
Repeatable up to 6 credits.

## **BIOE 298 Internship: 1-4 Credits (1-4 Other)**

PREREQUISITE: Approval of internship program by consent of instructor and approval of department head. (F, Sp, Su) An individualized assignment arranged with an agency, business, or other organization to provide guided experience. May be repeated. Offered on demand  
Repeatable up to 8 credits.

## **BIOE 370 General Ecology: 3 Credits (3 Lec)**

PREREQUISITE: C- or above in M 121Q or placement in a Math Level 400, and BIOB 170IN; Recommended: STAT 216Q or BIOB 318. (F, Sp, Su) Relation of organisms to their environment. The composition, structure, function and distribution of populations, communities, and ecosystems. Emphasis on population ecology, including demography, population dynamics and evolutionary ecology. Offered fall and spring

## **BIOE 375 Ecological Responses to Climate Change: 3 Credits (3 Lec)**

PREREQUISITE: BIOB 160, and BIOB 170IN, and BIOE 370 or NRSM 240. (F, Sp) Junior standing. Students explore how ecosystems are responding to climate changes at a range of spatial and temporal scales. Case studies include changes in vegetation and soils, plant and animal phenology, and disease outbreaks. Offered in fall and spring

## **BIOE 405 Behavioral and Evolutionary Ecology: 3 Credits (3 Lec)**

PREREQUISITE: BIOE 370. (Sp) Junior standing. Abundance and distribution of organisms in relation to their evolution, behavior, population biology and interactions with other organisms. Offered in spring

## **BIOE 408 Rocky Mountain Vegetation: 3 Credits (2 Lec, 1 Lab)**

PREREQUISITE: BIOE 370 and in Biological Sciences major, or consent of instructor, recommended senior class standing. (F) Rocky Mountain Vegetation is an integrative, place-based course in vegetation ecology. Topics include: Geographic distribution and geological characteristics of the component ranges of the Rockies, interaction of geology and soils with climate to produce the extreme environmental gradients typical of the Rockies, the basic autecology of dominant and widespread species that characterize the vegetation of the Rockies, the principles of disturbance and succession and how the vegetation of the Rockies exhibits those principles, the distribution and dynamics of the common plant communities of the Rockies in response to the variable environment. Offered in fall

## **BIOE 416 Alpine Ecology: 3 Credits (1 Lec, 2 Lab)**

PREREQUISITE: BIOB 170IN. (Su) Junior standing recommended. The ecology characteristics of alpine areas. A three-day field trip will confirm and reinforce material presented in class and is a course requirement. Offered in summer

## **BIOE 420 Field Ornithology: 3 Credits (2 Lec, 1 Lab)**

PREREQUISITE: BIOB 100IN or BIOB 170IN. (Su) Junior standing. Field identification, habitat affinities and life histories of birds of the northern Rockies. Includes early morning field trips. Offered in summer

## **BIOE 421 Yellowstone Wildlife Ecology: 3 Credits (2 Lec, 1 Lab)**

PREREQUISITE: BIOB 100IN or BIOB 170IN, and BIOE 370. (Su) Junior standing. Basic ecology of the major animal species of the Yellowstone area and the ecological controversies surrounding their management. Offered in summer

## **BIOE 422 Insect Ecology: 3 Credits (3 Lec)**

PREREQUISITE: BIOO 262IN. Physiological ecology of insects. Influence of biotic and abiotic factors on insect population and community dynamics. Emphasis on seasonal adaptations, dispersion, life table analysis, r and k-selection, ecological methods, and insect-plant interactions. Co-convened with ENTO 510

## **BIOE 424 Ecology of Fungi: 4 Credits (2 Lec, 2 Lab)**

PREREQUISITE: BIOB 170IN, BIOB 256, a comparable course in introductory biology, or consent of instructor  
COREQUISITE: None, but an upper division biology course is recommended. This course emphasizes the important and varied roles of the higher fleshy fungi in natural and managed systems, focusing on forest habitats. Fungi are the ecological backbone of many terrestrial systems, yet their ecological roles as saprophytes, symbionts, and mycorrhizal mutualists are often minimized. Both traditional techniques and more recent molecular methods will be presented at the individual, population, community, landscape, and biome levels, along with topics on fungal conservation and global change. This course consists of twice weekly sessions of two hours each for lecture, discussions, and demonstrations. One or two afternoon or morning field trips to nearby forests are required to initiate a final project

## **BIOE 427RN Research in Freshwater Ecology: 3 Credits (1 Lec, 2 Lab)**

PREREQUISITE: Junior standing; BIOE 370  
COREQUISITE: Prior or concurrent registration in BIOE 428. (F) This course is designed to expose students to the full process of designing and conducting research in freshwater ecosystems. Students will develop a research question, propose a study design, conduct field and laboratory research, and present their research in oral and written form. This course will also include a stream invertebrate collection and identification assignment. Offered in fall

**BIOE 428 Freshwater Ecology: 3 Credits (3 Lec)**

PREREQUISITE: BIOE 370. (F, Sp) Junior standing. This course examines relationships between freshwater organisms and their environment. Students learn about the ecology of rivers, lakes, reservoirs, and wetlands, with exposure to a wide diversity of organisms and processes. Emphasis is placed on linking basic concepts and real-world applications. Offered fall and spring

**BIOE 439 Stream Ecology: 3 Credits (2 Lec, 2 Lab)**

PREREQUISITE: BIOB 170IN, CHMY 121IN or CHMY 141, and PHSX 205. Examination of the structure and function of stream ecosystems emphasizing connections among stream organisms, the aquatic chemical and physical environment, and the surrounding terrestrial landscape

**BIOE 440R Conservation Biology: 3 Credits (3 Lec)**

PREREQUISITE: BIOE 370 and STAT 216Q and STAT 337, and Junior standing. (F) RECOMMENDED: STAT 411. Examines issues relevant to conservation of wild populations, focusing primarily on animals. Emphasis is on approaches that use demography, population biology and genetics to address conservation questions. Approaches include empirical field studies, mathematical models, and the use of R programming for modeling and empirical analysis. Readings are from the primary literature and a textbook, including case studies. Co-convened with BIOE 521. Offered in fall

**BIOE 445 Macrosystems Ecology: Linking Plants, Animals, and Ecosystems Across Scales: 3 Credits (3 Lec)**

PREREQUISITE: BIOE 370. (Sp) Junior standing. Advanced ecology designed to help students "put the pieces together" and understand how plants, animals, and ecosystems interact. These interactions are examined across biomes of the world to better understand general principles and to derive effective local management strategies. Offered in spring

**BIOE 455 Plant Ecology: 3 Credits (3 Lec)**

PREREQUISITE: BIOB 170IN, and BIOE 370 or NRSM 240, and Junior standing. (F, Sp) Principles of plant ecology, covering plant-environment relations, plant life histories, plant species interactions, plant community concepts, succession, and the role of plants in ecosystem processes. Offered in spring

**BIOE 490R Undergraduate Research: 1-6 Credits (1-6 Other)**

PREREQUISITE: Junior standing, consent of instructor and approval of department head. (F, Sp, Su) Directed undergraduate research which may culminate in a research paper, journal article, or undergraduate thesis. Course will address responsible conduct of research. Maximum of 6 credits as electives in Organismal Biology Option. Offered on demand Repeatable up to 12 credits.

**BIOE 491 Special Topics: 1-4 Credits (1-4 Lec)**

PREREQUISITE: Course prerequisites as determined for each offering. Offering dependent upon topic. 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 Repeatable up to 12 credits.

**BIOE 492 Independent Study: 1-3 Credits (1-3 Other)**

PREREQUISITE: Junior standing, consent of instructor and approval of department head. (F, Sp, Su) Maximum of 6 as electives in Organismal Biology Option. Directed research and study on an individual basis Repeatable up to 3 credits.

**BIOE 494 Seminar/Workshop: 1 Credits (1 Other)**

(F) Junior standing. Topics offered at the upper division level which are not covered in regular courses. Students attend and discuss seminar presentations by professional biologists. Offered in fall. Repeatable up to 4 credits.

**BIOE 498 Internship: 1-4 Credits (1-4 Other)**

PREREQUISITE: Junior standing, approval of intern program by consent of instructor and approval of department head. (F, Sp, Su) An individualized assignment arranged with an agency, business, or other organization to provide guided experience. May be repeated, offered on demand Repeatable up to 8 credits.

**BIOE 499 Senior Thesis/Capstone: 2 Credits (2 Other)**

PREREQUISITE: Senior standing in Ecology Department. (F, Sp) Senior capstone course. Discussion of topics that integrate evolutionary theory with ecology, genetics, medicine, behavior, or other subjects that are part of the biology curriculum. Offered in fall and spring

**BIOE 513 Terrestrial Ecology of Plains and Prairies: 1 Credits (1 Other)**

(Su) Students will develop plant keys for classroom use, quantitatively analyze two grassland communities, and develop classroom activities on ecology of grasslands. Distance learning, class offered by internet connection. This course is designed for secondary school teachers enrolled in MSSE program and cannot be used in graduate programs in Biological Sciences. Offered Summer.

**BIOE 514 Ecological Modeling: 3 Credits (3 Lec)**

PREREQUISITE: BIOE 370. Interactions and feedbacks between vegetation, disturbance, and climate will be explored using biogeography and biogeochemical models. Theory and computational techniques in ecological modeling

**BIOE 515 Landscape Ecol & Mgmt: 4 Credits (2 Lec, 2 Lab)**

PREREQUISITE: Graduate standing or consent of instructor. () Offered Fall, odd years. Principles on landscape pattern, change, and function. Application of theory to conservation including population viability, reserve design, multiple-use landscapes. Lab introduces GIS, GPS, and simulation models. For graduate students and motivated undergraduates. Offered fall of odd years

**BIOE 517 Advances in Ecological Modeling: 3 Credits (3 Lec)**

PREREQUISITE: BIOE 370. Advances in numerical modelling of disturbance, demography, and ecophysiology will be introduced with lectures and applied computational examples

**BIOE 519 Riparian Zones/Wetlands: 2 Credits (2 Other)**

(Su) Students will develop plant keys for classroom use, quantitatively analyze two riparian and two wetland areas, and develop classroom activities about ecology of those areas. Distance learning class offered by internet connection. This course is designed for secondary school teachers enrolled in the MSSE program and cannot be used in graduate programs in Biological Sciences. Offered Summer.

**BIOE 520 Animal Biodiversity in GYE: 2 Credits (1 Lec, 1 Lab)**

(Su) The Greater Yellowstone Ecosystem is a dramatic setting composed of lands that vary widely in terms of their elevation, soils, habitat features, animal diversity, as well as in terms of land ownership, land use, and wildlife management. This course is designed to explore how animal diversity is distributed across the Greater Yellowstone Ecosystem (GYE), why such a distribution exists, the consequences of those distributions to animal conservation. To gain a better understanding of the causes consequences of spatial patterns of biodiversity, we will explore a variety of locations in Yellowstone National Park and its surrounding National Forests, Wildlife Refuges, and private lands. Offered Summer.

**BIOE 521 Conservation Biology: 3 Credits (3 Lec)**

PREREQUISITE: BIOE 370, BIOB 420, STAT 216Q and STAT 337. (F)  
RECOMMENDED: STAT 411 A broad survey of conservation biology, emphasizing approaches related to demography/population dynamics and evolution. Less extensively considers approaches related to community/ecosystem/landscape ecology. Approaches include empirical field studies, mathematical models, using R for modeling and empirical analysis, reading primary literature, writing a research paper and presenting a research talk. Co-convened with BIOE 440. Offered in fall

**BIOE 522 Birds of Prey: 2 Credits (1 Lec, 1 Lab)**

(Summer (odd years)) Offered Summer, odd years. This course presents a broad overview of the basic biology, ecology, and management of raptorial bird species that inhabit the varied habitats within the northern region of the Greater Yellowstone Area (GYA). Students will explore via lecture and discussions, and daily field trips, the prominent raptor species that inhabit diverse ecological communities in the Northern Rocky Mountains around Bozeman, Montana. Students will gain experience in raptor identification, basic ecology and management issues for raptors in the GYA.

**BIOE 523 Wildlife Ecology: 2 Credits (2 Lec)**

(Su) Introduction to wildlife species and the range of habitats present in the Northern Rocky Mountain ecosystems. Emphasis on large carnivores and ungulates within montane terrestrial systems. Application of the scientific method to study interactions between predators, prey, and human impacts. This course is designed for middle and high school teachers and cannot be used in graduate programs in Biological Sciences. Offered Summer.

**BIOE 524 Frontiers in Landscape Ecology: 3 Credits (2 Lec, 1 Lab)**

PREREQUISITE: BIOE 370 or the equivalent. (F) Offered Fall of even years. Students and instructor will write a scientific paper for publication that synthesizes an important question in landscape ecology. Students will select the topic, review and synthesize current knowledge on the topic, and write a scientific manuscript

**BIOE 526 Symbiosis for Teachers: Eat, Prey, Love: 3 Credits (3 Lec)**

(Offered Spring, even years.) This course is intended for pre-service (BIOE 436) and in-service (BIOE 526) teachers. "Symbiosis for Teachers: Eat, Prey, and Love" is a thought-provoking course designed for elementary, middle school, high school, and pre-service teachers. Students will participate in the process of science and develop creative and critical reasoning skills. The course provides an effective way to integrate instructional scientific strategies for teachers. Students will share cross-level instruction and constructive ideas. The goal of this course is to promote the study of symbiosis and applications of symbiotic relationships.

**BIOE 527 Teaching Evolution: 3 Credits (3 Lec)**

(F) The primary goal of this course is to change how evolution is taught. This course is designed to provide students with the knowledge, skills, and resources they need to teach evolution effectively. Students will learn why evolution is the fundamental concept that under-lies all life sciences. Students will acquire tools for making evolution relevant to the science classroom and students' lives and the background knowledge for addressing student misconceptions. Offered Fall.

**BIOE 532 Physiological Plant Ecol: 3 Credits (2 Lec, 1 Lab)**

PREREQUISITE: BIOE 370. ( ) Offered Fall, even years. The goal of this course is to expose students to the fundamental theories of plant physiological ecology, ranging from biochemistry at the leaf scale to energy balance at the ecosystem scale. The lab is designed to expose students to the key instruments in this discipline. Offered fall of even years

**BIOE 534 Vegetation Ecology: 3 Credits (3 Lec)**

PREREQUISITE: BIOE 370. Considers the composition, structure, function, distribution in time and space, ecology and classification of communities. Emphasizes universal methods, current studies and Rocky Mountain systems. Complementary field experience is available in BIOE 408

**BIOE 535 Topics in Biodiversity & Nature's Services: 1 Credits (1 Other)**

PREREQUISITE: Graduate Status or Consent of Instructor. ( ) Offered Spring, even years. The diversity of plants and animals that is a unique feature of our planet plays an important role in regulating ecosystem functions and services. In this course, we explore the various ways that the diversity of living organisms influences community structure, productivity, geomorphological and hydrological regimes, and nutrient cycling. Using a variety of research approaches, from primary literature to podcasts, we investigate the foundations of the biodiversity ecosystem function and services field as well as the current state of knowledge across terrestrial, marine, and freshwater ecosystems. Offered spring of even years  
Repeatable up to 2 credits.

**BIOE 536 A Study of Local Ecosystems for Teachers: 2 Credits (1 Lec, 1 Lab)**

(F) A Study of Local Ecosystems for Teachers investigates ecological principles as students perform field studies of their local ecosystem. Students will also create lessons based on their findings for the respective K-12 teaching assignments or future assignments if not currently in the classroom.

**BIOE 540 Analysis of Ecological Communities: 3 Credits (1 Lec, 2 Lab)**

( ) Multivariate statistical analysis of data from terrestrial or aquatic, plant or animal communities. Classification, ordination, and predictive modeling of species and communities, emphasizing a hands-on approach and practical problem solving in community ecology. Offered spring of even years.

**BIOE 542 Community Ecology: 3 Credits (3 Lec)**

PREREQUISITE: At least one upper division or graduate course in each of the following: ecology and statistics, or consent of instructor. ( ) Offered Spring, odd years. Focuses on the origin, maintenance, and consequences of biological diversity within local communities by examining studies of natural patterns, explorations of mathematical models and direct experimentation. The complexities of species interactions are explored in multi species assemblages. Offered spring of odd years

**BIOE 548 Conservation Genetics: 3 Credits (3 Lec)**

PREREQUISITE: BIOB 375 or BIOH 320 and BIOB 420, and STAT 216Q. (F) Introduction to the application of genetics for the conservation of plant and animal populations. Emphasis will be placed on case studies from the primary literature and analyzing genetic data using mathematical models developed in class. Co-convened with BIOB 480. Offered in fall

**BIOE 554 Foundations of Ecology & Mgmt: 1 Credits (1 Other)**

(F) This course explores the origin, maturation, and application of core principles in ecology. Students gain an appreciation for the scope of ecology, how theory and application are linked, and how big ideas in ecology have matured (or not) over time. Offered in fall.

**BIOE 555 Communication in Ecol Sciences: 1 Credits (1 Other)**

PREREQUISITE: Graduate standing or consent of instructor. (Sp) This course will require students to gain experience presenting scientific information in a variety of communication methods. Offered in spring

**BIOE 585 Exploring Biology for Teachers: 3 Credits (2 Lec, 1 Lab)**

(Sp) This course is designed to introduce teachers interested in life science to major concepts in biology. The course focuses on key concepts and related content specific to biomolecules, biochemical processes, genetics, and evolution. The course emphasizes a constructivist philosophy in an applied educational setting. Participants in the course will develop lesson plans connecting one or more of the topics that can be used in their K-12 classrooms. Offered Spring.

**BIOE 590 Master's Thesis: 1-10 Credits (1-10 Other)**

PREREQUISITE: Master's standing. (F, Sp, Su)  
Repeatable up to 99 credits.

**BIOE 591 Special Topics: 1-4 Credits (1-4 Lec)**

PREREQUISITE: Upper division courses and others as determined for each offering. Offering dependent upon topic. 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.

**BIOE 592 Independent Study: 1-3 Credits (1 Other)**

PREREQUISITE: Graduate standing, consent of instructor, approval of department head and Dean of Graduate Studies. (F, Sp, Su) Directed research and study on an individual basis

Repeatable up to 6 credits.

**BIOE 593 Alpine Ecology for Teachers: 2 Credits (1 Lec, 1 Lab)**

(Su) The primary goals in this course will be to understand how altitude affects the structure, function and evolution of alpine and sub-alpine plants and animals, and to create ways to bring this understanding into the grade 6-12 classroom. We will explore and gather data describing the biotic (living) and abiotic (non-living) constraints of sub-alpine and alpine environments to infer how these factors affect the form, abundance and niches of a variety of plants and animals. Offered Summer.

**BIOE 594 Seminar: 1 Credits (1 Other)**

PREREQUISITE: Graduate standing or seniors by petition; and course prerequisites as determined for each offering. () Offering dependent on topic. Topics offered at the graduate level which are not covered in regular courses. Students participate in preparing & presenting discussion material

Repeatable up to 4 credits.

**BIOE 595 Ecology and Conservation of the World's Marine Ecosystems for Teachers: 3 Credits (1 Lec, 1 Lab, 1 Other)**

PREREQUISITE: Graduate students only. (F) This course is designed for students to gain a broad understanding of structure and function of the world's marine ecosystems and a broad knowledge of the major conservation issues in the oceans including climate change, overfishing, coral reef loss, and ocean acidification. The course will integrate in-depth study of each of the major marine ecosystems with reading and discussion of major conservation issues. Offered Fall

**BIOE 596 Land Use Issues in GYE for Teachers: 2 Credits (1 Lec, 1 Other)**

(Su) This course will lay the groundwork for an understanding the legal and political basis for scientific management of natural resources. Readings, field visits and skill-building exercises will equip science educators with the social context of complex ecological issues. Offered Summer.

**BIOE 597 Ecology of Trout Streams for Teachers: 2 Credits (1 Lec, 1 Lab)**

PREREQUISITE: Graduate students only. (Su) Offered summer of even years. Montana is home to world-renowned trout streams, and this course is designed to delve into how trout and trout streams function and some of the current issues surrounding their management. The course content will include principles and techniques for studying trout and trout streams in the laboratory and the field. This course will combine laboratory lectures and exercises with day-long field visits to area streams to collect aquatic insects, conduct habitat analyses, and view various types of stream management practices. On one field trip, students will don wet suits and directly observe trout behavior. Offered Summer

**BIOE 598 Internship: 2-12 Credits (2-12 Other)**

PREREQUISITE: Graduate standing, consent of instructor and approval of department head. (F, Sp, Su) An individualized assignment arranged with an agency, business or other organization to provide guided experience in the field

Repeatable up to 12 credits.

**BIOE 599 Advanced Ecology for Teachers: 2 Credits (1 Lec, 1 Lab)**

(F) Our primary goals in this course will be to understand the theoretical underpinnings of ecological interactions and link these theories to the real world study of ecology. Through a mix of class and field work, students will move rapidly from foundational theory, to hands-on field work and data collection, to the basics of analyses. The course capitalizes on the ecology of Yellowstone in winter. Offered Fall.

**BIOE 690 Doctoral Thesis: 1-10 Credits (1-10 Other)**

PREREQUISITE: Doctoral standing. (F, Sp, Su)

Repeatable up to 99 credits.