

BIOLOGY

Rebecca L. Brown (rbrown@ewu.edu), Chair
509.359.2528

Robin L. O'Quinn (<http://catalog.ewu.edu/science-technology-engineering-mathematics/biology/%20mailto:roquinn@ewu.edu>),
Graduate Admissions
509.359.6118

department page (<https://www.ewu.edu/cstem/programs/biology>)
258 Science Building
email (biology@ewu.edu)
509.359.2339

Faculty

Jason W. Ashley, Justin L. Bastow, A.Ross Black, Rebecca L. Brown, Judd A. Case, Andrea R. Castillo, David P. Daberkow, Bradley J. Fillmore, Amy Gray, Charles M. Herr, Krisztian Magori, Joanna J. Matos, Luis F. Matos, Heather R. McKean, Camille C. McNeely, Javier Ochoa-Reparaz, Margaret A. O'Connell, Robin L. O'Quinn, Suzanne M. Schwab, Paul Spruell, Jenifer Walke.

Undergraduate Degrees

Bachelor of Arts in Education (BAE)

- Biology/Secondary (<http://catalog.ewu.edu/science-technology-engineering-mathematics/biology/biology-secondary-bae>)

Bachelor of Science (BS)

- Biology (<http://catalog.ewu.edu/science-technology-engineering-mathematics/biology/biology-bs>)
- Biology Major with Biotechnology Option (<http://catalog.ewu.edu/science-technology-engineering-mathematics/biology/biology-biotechnology-option-bs>)
- Biology Major with Pre-Medicine/Pre-Dentistry Option (<http://catalog.ewu.edu/science-technology-engineering-mathematics/biology/biology-pre-medicine-pre-dentistry-option-bs>)

Undergraduate Minors

- Biology (<http://catalog.ewu.edu/science-technology-engineering-mathematics/biology/biology-minor>)
- Biology/Secondary (<http://catalog.ewu.edu/science-technology-engineering-mathematics/biology/biology-secondary-minor>)

Teacher Certification/Add-on Endorsements

- General Science/Add-on Endorsement (<http://catalog.ewu.edu/science-technology-engineering-mathematics/biology/general-science-add-on-endorsement>)

Pre-Professional Program Requirements

- Pre-Dentistry and Pre-Medicine (<http://catalog.ewu.edu/science-technology-engineering-mathematics/pre-dentistry-pre-medicine>)
- Pre-Pharmacy (<http://catalog.ewu.edu/science-technology-engineering-mathematics/pre-pharmacy>)

- Pre-Veterinary Medicine (<http://catalog.ewu.edu/science-technology-engineering-mathematics/pre-veterinary-medicine>)

Undergraduate Programs

Biology encompasses the scientific study of life. The structure and function of organisms are studied at the molecular, cellular, organismal, population and ecosystems levels. The Department of Biology prepares students for careers in a variety of biological fields including the health sciences, natural resource management, biotechnology, veterinary medicine, education, and environmental sciences.

The Department of Biology offers undergraduate programs leading to a Bachelor of Science (BS) and a Bachelor of Arts in Education (BAE) for Biology. All students are expected to work closely with their faculty advisor to determine their curriculum. The BS degree is designed for students who require a broad background in biology, along with specialized training that will prepare them for specific careers. The program is based upon a core curriculum to provide the common background. Students are required to earn a minimum grade in the introductory sequence (BIOL 171, BIOL 172, BIOL 173, BIOL 270) to ensure a solid foundation for upper division courses. Coursework for specific careers is based on selection of elective courses tailored to career choice. Degree options or advising guides to different career options including pre-medicine, pre-dentistry, pre-physical therapy, pre-physician assistant, pre-optometry, pre-medical technology, pre-pharmacy, pre-veterinary medicine, wildlife biology, fisheries biology, and botany/range science are available. The BAE degree prepares students for teaching biology in secondary education. More information on degree programs can be found at the Department of Biology website (<http://www.ewu.edu/cstem/programs/biology>).

Students in the Department of Biology have varied opportunities to *do biology*. At the introductory level, students learn the basics of how to design, conduct, and present research projects. During their final year, the senior capstone course highlights a research project. Many upper-division elective courses in biology also incorporate research projects. In addition, undergraduate students can participate in faculty research.

In coordination with the Program in Environmental Science, the Department of Biology offers an Environmental Science major with an emphasis in Environmental Biology. This major includes a core curriculum that provides students with a broad exposure to biology, chemistry, geology, statistics, and geographic information systems. More focused courses in biology provide students with expertise in their emphasis area. Motivated students have the opportunity to obtain a double major in both Environmental Science and Biology. Refer to Environmental Science section of catalogue for more information.

The Department of Biology offers minors in biology, biology/secondary, and general science/add-on endorsements.

The Department of Biology is located in a building that houses laboratories designed for instruction and research in most aspects of biology. The department maintains its own aquarium rooms, cell culture facilities, greenhouse and herbarium.

In addition to on-campus facilities, the department operates the Turnbull Laboratory for Ecological Studies on the Turnbull National Wildlife Refuge about four miles from campus. These facilities provide opportunities for research in plant and animal physiology, ecology, fisheries and wildlife biology.

Admission to the Department of Biology

1. Complete the following courses
 - a. MATH 141 with ≥ 2.0
 - b. BIOL 171 with ≥ 1.7
 - c. BIOL 172, BIOL 270 with ≥ 2.0 .
2. Pay nonrefundable fee to cover costs of assessment testing.
3. Complete Major Declaration form and be assigned to Biology faculty advisor.
4. Meet with Biology faculty advisor.

Major Requirements for Biology

Upon declaring biology as a major each student should meet with an advisor as soon as possible. Students should plan to complete BIOL 171, BIOL 172, BIOL 173 and BIOL 270; CHEM 151, CHEM 152, CHEM 153 and the university English and departmental mathematics requirements in the first two years of study. Required 300-level coursework should be completed by the end of the third year. Capstone and advanced elective courses are ordinarily taken in the senior year. A minimum of 50 credits of upper biology courses are required. Only 5 credits of BIOL 399 or BIOL 499 and 5 credits of BIOL 395 or BIOL 495 will be allowed toward the electives for the BS in Biology, General Option. The following biology courses will not fulfill elective requirements: BIOL 100; BIOL 232, BIOL 233, BIOL 234; BIOL 235; BIOL 390.

Those students planning graduate study are encouraged to take courses in physics, organic chemistry, calculus, statistics and a directed study (research) course in biology.

Graduation Requirements

1. Have a cumulative GPA ≥ 2.0 for all courses in student's curriculum in Biology.
2. Complete the Educational Testing Service (ETS) Major Field Test for Biology.

Required courses in the following programs of study may have prerequisites. Reference the course description section for clarification.

Graduate Degrees

Master of Science (MS)

- Biology (<http://catalog.ewu.edu/science-technology-engineering-mathematics/biology/biology-ms>)

Graduate Program

Robin L. O'Quinn (roquinn@ewu.edu), Graduate Admissions
509.359.6118

Camille F. McNeely, Graduate Service Appointment Coordinator
509.359.7049

David Daberkow, Candidacy Coordinator
509.359.2259

Eastern Washington University Department of Biology offers a Master of Science in Biology.

The Master of Science in Biology program provides a demanding and rewarding experience in biology, leading to competent scholarship and research capability. The department emphasizes research as a basic component of graduate study. A variety of research specialties are available within the department, including limnology, stream ecology,

riparian ecology, fisheries biology, embryology, exercise physiology, neurobiology, wildlife biology, animal physiology, mycology, plant ecology, microbiology and immunology. More information on faculty research interests may be obtained by writing the appropriate graduate program advisor or accessing our website. (<http://www.ewu.edu/cstem/programs/biology>) Graduates of the biology program either continue in PhD programs, or are employed in various biological fields with federal, state and local agencies, environmental consulting firms, public and private schools or private industry.

The Master of Science in Biology curriculum includes core courses in Biological Research Methods; Graduate Seminar; Current Topics in Ecology/Evolution, Physiology, Cell/Molecular Biology, and Growth of Biological Thought; elective courses in advanced topics; and research

In addition, an interdisciplinary master's program is available that can incorporate biology (see separate catalog listing).

The Department of Biology is housed in a remodeled and well-equipped facility. The department administers the nearby Turnbull Laboratory for Ecological Studies on the Turnbull National Wildlife Refuge.

Graduate service appointments, with resident and non-resident tuition waivers, are available on a competitive basis to qualified graduate students. Nonresident students who do not qualify for a graduate service appointment can apply for nonresident tuition scholarship waivers. Other financial support is possible through work-study programs, hourly employment by the department or faculty research grants. All applicants are encouraged to submit an application for federal student aid which, for incoming students, must be received by the EWU Financial Aid Office by February 15 for support in the following academic year. Applications are available through the EWU Financial Aid Office.

Entrance Requirements and Preparation

To be admitted to the Master of Science in Biology program, applicants must first meet all requirements for admission to the Graduate School as outlined elsewhere in this catalog. Prospective MS applicants must hold a four-year baccalaureate degree in biology or related natural science from an accredited college or university. Preparation often includes the equivalent of two quarters of organic chemistry and one quarter of statistics or calculus. Students who have deficiencies for admission or deficiencies as determined by their graduate committee may be allowed to make up deficient coursework while enrolled in graduate school. Admission to the program will be considered when applicants have:

1. completed all admission requirements for the Eastern Washington University Graduate Programs Office,
2. submitted scores from the general GRE test,
3. provided a completed supplemental application to the Department of Biology and two evaluation/recommendation forms and
4. identified an appropriate faculty research advisor willing to serve as the major professor.

Graduate students wishing to be considered for a graduate service appointment must have their completed application, including a graduate fellowship application, to the Department of Biology by February 20. Applicants not seeking teaching fellowships must have their completed application to the Department of Biology by April 1, October 15 and January 15 for admission in the fall, winter and spring quarters, respectively.

Candidacy

To be admitted to candidacy, graduate students in the Master of Science in Biology program must have:

- completed 15 credit hours (at least 10 at the 500 level) but not more than one half of the total minimum credits required for the degree;
- removed all deficiencies regarding entrance requirements (deficient coursework cannot be counted toward a degree);
- met with their graduate committee to determine an appropriate course curriculum;
- had their research proposal approved by their internal graduate committee and presented their proposal to the Department of Biology;
- submitted the completed application form with research advisor's and second committee member's signatures to the appropriate biology graduate candidacy coordinator;
- had their candidacy approved by the Department of Biology faculty.

Subjects codes: BIOL (p. 3), SCED (p. 9).

Biology Courses

BIOL 100. INTRODUCTION TO BIOLOGY. 5 Credits.

Satisfies: GEGR for natural sciences, biology.

This course is an introduction to the methods of study and the three levels of organization in living organisms: cell, organismal and population. A laboratory is included.

BIOL 115. INVESTIGATING BIOLOGY. 5 Credits.

Satisfies: GEGR for natural science, biology.

This course is for students planning to teach elementary school. It includes inquiry based biological investigations that support science instruction outlined in the National Science Education Standards and Washington Essential Academic Learning Requirements. Laboratory exercises are included.

BIOL 171. BIOLOGY I. 5 Credits.

Notes: course fee.

Pre-requisites: Concurrent enrollment in MATH 141 or completion of MATH 141 with ≥ 2.0 ; Students must receive ≥ 1.7 to enroll in BIOL 172 and ≥ 2.0 to enroll in BIOL 270.

This course includes an introduction to biology, covering a review of chemistry from atomic structure through respiration, cell and molecular biology and genetics.

BIOL 172. BIOLOGY II. 5 Credits.

Notes: course fee.

Pre-requisites: ≥ 1.7 in BIOL 171 and ≥ 2.0 in MATH 141.

Satisfies: 2nd Natural Sciences biology GEGR if BIOL 171 and BIOL 270 are complete or BIOL 172 and BIOL 270 are completed.

Introduction to biology, covering evolution, the diversity of life and interactions among organisms and their environment.

BIOL 173. BIOLOGY III. 5 Credits.

Notes: course fee.

Pre-requisites: ≥ 1.7 in BIOL 171 and ≥ 2.0 in BIOL 172.

This course is an introduction to biology, covering the structure and function of plants and animals, with emphasis on flowering plants and vertebrates.

BIOL 196. EXPERIMENTAL COURSE. 1-5 Credits.

BIOL 197. FRESHMAN SEMINAR. 1-5 Credits.

BIOL 199. SPECIAL STUDIES-BIOLOGY. 1-5 Credits.

BIOL 225. ELEMENTARY MEDICAL MICROBIOLOGY. 5 Credits.

Pre-requisites: completion of or concurrent enrollment in both BIOL 234 and CHEM 163.

This course will discuss micro-organisms and animal parasites, with chief emphasis on those which affect human health. A laboratory is included.

BIOL 232. HUMAN ANATOMY AND PHYSIOLOGY NON-BIOL MAJORS. 5 Credits.

Pre-requisites: one course in college chemistry.

Satisfies: a GEGR for natural sciences, biology.

First of a three-quarter sequence concerned with the structure and function of the human organism. Chemistry, cells, histology, integumentary system, skeletal system, excitable tissues and muscular system will be completely and thoroughly covered. Laboratory included that utilizes human cadavers, models, multimedia and other technologies.

BIOL 233. HUMAN ANATOMY AND PHYSIOLOGY NON-BIOL MAJORS. 5 Credits.

Pre-requisites: BIOL 232.

Satisfies: a GEGR for natural sciences, biology.

Second of a three-quarter sequence concerned with the structure and function of the human organism. Nervous system, autonomic nervous system, special senses, endocrine system, cardiovascular system, lymphatic system and immunity will be completely and thoroughly covered. Laboratory included that utilizes human cadavers, models, multimedia and other technologies.

BIOL 234. HUMAN ANATOMY AND PHYSIOLOGY NON-BIOL MAJORS. 5 Credits.

Pre-requisites: BIOL 233.

Satisfies: a GEGR for natural sciences, biology.

Third of a three-quarter sequence concerned with the structure and function of the human organism. Respiratory system, digestive system, nutrition and metabolism, urinary system, and reproductive system will be completely and thoroughly covered. Laboratory included that utilizes human cadavers, models, multimedia and other technologies.

BIOL 235. ELEMENTARY MEDICAL MICROBIOLOG. 5 Credits.

Pre-requisites: completion of or concurrent enrollment in both BIOL 234 and CHEM 163.

This course will discuss micro-organisms and animal parasites, with chief emphasis on those which affect human health. A laboratory is included.

BIOL 270. BIOLOGICAL INVESTIGATION. 3 Credits.

Notes: the completion of BIOL 171 and BIOL 270 satisfies a GEGR for natural sciences, biology; the completion of BIOL 171, BIOL 172 and BIOL 270 satisfies a second GEGR for natural sciences, biology.

Pre-requisites: ≥ 2.0 in BIOL 171 or BIOL 172.

Experimental design and performance, including data collection and analysis, scientific writing and use of the biological literature.

BIOL 295. INTERNSHIP. 1-15 Credits.

BIOL 296. EXPERIMENTAL COURSE. 1-5 Credits.

BIOL 299. SPECIAL STUDIES BIOLOGY. 1-5 Credits.

Pre-requisites: permission of the instructor, department chair and college dean.

An opportunity for students to explore problems of special interest.

BIOL 300. HISTORY OF BIOLOGY. 5 Credits.

Examines the development of biological ideas in the Western world from early times to the present.

BIOL 301. MICROBIOLOGY. 5 Credits.

Pre-requisites: ≥ 1.7 in BIOL 171, ≥ 2.0 in BIOL 270; CHEM 153.

This course covers morphology, physiology, taxonomy and ecology of the microorganisms, emphasizing prokaryotes, fungi and the viruses. A laboratory is included.

BIOL 302. BOTANY. 5 Credits.

Pre-requisites: ≥ 1.7 in BIOL 171, ≥ 2.0 in BIOL 172, BIOL 173, BIOL 270; completion of or concurrent enrollment in CHEM 151; or permission of instructor.

This course examines the structure, function and phylogenetic relationships in the plant kingdom. A laboratory is included.

BIOL 303. INVERTEBRATE ZOOLOGY. 5 Credits.

Pre-requisites: ≥ 1.7 in BIOL 171, ≥ 2.0 in BIOL 172, BIOL 173, BIOL 270; completion of or concurrent enrollment in CHEM 151; or permission of instructor.

This course examines structure, function and phylogenetic relationships of the invertebrate phyla. A laboratory is included.

BIOL 304. VERTEBRATE ZOOLOGY. 5 Credits.

Pre-requisites: ≥ 1.7 in BIOL 171, ≥ 2.0 in BIOL 172, BIOL 173, BIOL 270; completion of or concurrent enrollment in CHEM 151; or permission of instructor.

This course explores the structure, function and phylogenetic relationships of the vertebrates. A laboratory is included.

BIOL 306. NATURAL VEGETATION ECOLOGY OF NORTH AMERICA. 5 Credits.

Cross-listed: GEOG 306.

Pre-requisites: GEOG 100 or permission of the instructor.

This course is an introduction to the processes and patterns of natural vegetation, emphasizing the Pacific Northwest.

BIOL 310. FUNDAMENTALS OF GENETICS. 5 Credits.

Pre-requisites: ≥ 1.7 in BIOL 171, ≥ 2.0 in BIOL 172, and BIOL 173; CHEM 153.

This course provides comprehensive coverage of the major topic areas of genetics: classical, molecular and evolutionary.

BIOL 312. FUNDAMENTALS OF SOIL SCIENCE. 4 Credits.

Cross-listed: GEOG 312.

Pre-requisites: MTHD 104 or clearance by test.

A general introduction to physical, chemical and biological properties of soils.

BIOL 318. BIOLOGY OF WOMEN. 3 Credits.

Cross-listed: WMST 318.

The history, biology and myths of human reproduction as they apply to women and the interaction of brain, hormones and social life.

BIOL 320. THE HUMAN PROSPECT. 5 Credits.

Cross-listed: HUMN 320.

Satisfies: international studies university graduation requirement.

Explores the biological and philosophical roots of humans' relationship with the environment.

BIOL 332. HUMAN ANATOMY AND PHYSIOLOGY I. 5 Credits.

Pre-requisites: BIOL 173 with a grade ≥ 2.5 ; CHEM 153 with a grade ≥ 2.5 ; or instructor permission.

This is the first course in a three-quarter sequence covering the structure and function of the human body. Intended for students with significant background in biology and chemistry who are pursuing health care careers. A laboratory is included each quarter.

BIOL 333. HUMAN ANATOMY AND PHYSIOLOGY II. 5 Credits.

Pre-requisites: BIOL 332.

The second in a three-quarter sequence covering the structure and function of the human body. Intended for students with significant background in biology and chemistry who are pursuing health care careers. A laboratory is included each quarter.

BIOL 334. HUMAN ANATOMY AND PHYSIOLOGY III. 5 Credits.

Pre-requisites: BIOL 333.

The third in a three-quarter sequence covering the structure and function of the human body. Intended for students with significant background in biology and chemistry who are pursuing health care careers. A laboratory is included each quarter.

BIOL 338. DISCOVERING WOMEN IN SCIENCE. 1 Credit.

Cross-listed: CHEM 338, GEOL 338, HIST 338, PHYS 338, PSYC 338, WMST 338.

The course uses several scientific themes to rediscover from the past and find in contemporary research, the women who have made significant contributions to science.

BIOL 340. BIOLOGY AND SOCIETY. 2 Credits.

Pre-requisites: either BIOL 100 or ≥ 1.7 in BIOL 171 or one of them taken concurrently.

This course will discuss biological, social, ethical and economic implications of current advances in the biological sciences.

BIOL 343. BIOLOGY OF AGING. 3 Credits.

This course will discuss the aging of biological organisms, viewed from the molecular level through the population level. The emphasis will be on human aging.

BIOL 345. BIOLOGY OF SYMBIOSIS. 3 Credits.

Notes: lab included.

This course uses an interdisciplinary approach to explore mutually beneficial relationships between species. Course material will cover the chemistry, biochemistry, ecology, evolution, genetics, behavior and physiology of symbiotic relationships.

BIOL 351. PRINCIPLES OF ANIMAL PHYSIOLOGY. 4 Credits.

Pre-requisites: ≥ 1.7 in BIOL 171, ≥ 2.0 in BIOL 172 and BIOL 173; CHEM 153; or permission of instructor.

An integrative understanding of the physiological systems of vertebrates, analyzing physiological processes from the cellular level upwards, culminating in organismal function. This course reinforces concepts from biology, physics, chemistry and mathematics.

BIOL 352. PRINCIPLES OF PLANT PHYSIOLOGY. 4 Credits.

Pre-requisites: ≥ 1.7 in BIOL 171, ≥ 2.0 in BIOL 172 and BIOL 173; CHEM 153; or permission of instructor.

This course addresses mechanisms by which plants obtain nutrients from the soil and atmosphere, convert light energy to chemical energy, and coordinate responses to shifting environmental conditions in roots, leaves and reproductive structures.

BIOL 353. PRINCIPLES OF MICROBIAL PHYSIOLOGY. 4 Credits.

Pre-requisites: ≥ 1.7 in BIOL 171, ≥ 2.0 in BIOL 172 and BIOL 173; CHEM 153; or permission of instructor.

This course explores the physiology of unicellular microbes. It includes topics on microbial replication and how microbes adapt to their environment through regulating gene expression, horizontal gene transfer and cell-cell communication.

BIOL 371. PRE-MEDICAL, DENTAL, VETERINARY AND PHARMACY PREPARATION. 1 Credit.

Pre-requisites: junior standing or permission of instructor.

Prepares students for the application and interview process for medical, dental, veterinary, pharmacy and other professional programs. Includes discussions related to medical ethics.

BIOL 380. DATA ANALYSIS FOR BIOLOGISTS. 5 Credits.

Pre-requisites: ≥ 1.7 in BIOL 171, ≥ 2.0 in BIOL 172, BIOL 173, BIOL 270; completion of or concurrent enrollment in CHEM 151 and a ≥ 2.0 in MATH 141; or permission of instructor.

Satisfies: mathematics proficiency.

Students gain the knowledge and skills required to conduct and interpret data analysis and statistics commonly applied in Biology. Key concepts of statistical analysis such as populations and samples, uncertainty, p-values, hypothesis testing, Type I & Type II errors, statistical methods and R programming language are covered.

BIOL 390. BIOLOGY TEACHING METHODS. 2 Credits.

Notes: all courses in the major must have a ≥ 2.0 or greater.

Pre-requisites: BIOL 171, BIOL 172, BIOL 173 and BIOL 270; EDUC 303; concurrent SCED 390.

This course is designed for individuals seeking endorsement to teach junior or senior high school biology or general science. Various types of biology programs, organization of lesson materials, techniques and laboratory safety are included.

BIOL 395. INTERNSHIP/CO-OP FIELDWK. 1-15 Credits.

Pre-requisites: permission of the instructor, department chair and college dean; only 5 credits will be allowed toward the electives.

BIOL 396. EXPERIMENTAL COURSE. 1-6 Credits.**BIOL 397. WORKSHOP, SHORT COURSE, CONFERENCE, SEMINAR. 1-5 Credits.****BIOL 399. DIRECTED STUDY. 1-15 Credits.****BIOL 405. LIMNOLOGY. 5 Credits.**

Pre-requisites: any one of BIOL 301, BIOL 302, BIOL 303, BIOL 304 or concurrent enrollment.

This course includes the general study of the physical, chemical and biological features of lakes and streams. A laboratory is included.

BIOL 409. MYCOLOGY. 5 Credits.

Pre-requisites: any one of BIOL 301, BIOL 302, BIOL 303, BIOL 304 or concurrent enrollment.

This course includes discussion of the structure, physiology, ecology and taxonomy of microfungi and mushrooms with an emphasis on fungi of the Northwest. A laboratory is included.

BIOL 411. FIELD BOTANY. 5 Credits.

Pre-requisites: junior standing or permission of instructor.

The goal of this course is to gain an appreciation of natural history and the unique array of plants found in our region. This will be a practical, hands-on, field-based course where students learn how to identify plants.

BIOL 420. EPIDEMIOLOGY. 5 Credits.

Pre-requisites: BIOL 301.

This course is a study of the factors which determine the frequencies and distributions of communicable diseases among humans.

BIOL 421. MEDICAL BACTERIOLOGY. 5 Credits.

Pre-requisites: BIOL 301.

This course addresses microbial agents of human disease, with an emphasis on bacteria.

BIOL 423. EVOLUTION. 5 Credits.

Pre-requisites: BIOL 310 plus any one of BIOL 301, BIOL 302, BIOL 303, BIOL 304.

This course is a study of variation, adaptation and speciation in biological systems.

BIOL 424. ENTOMOLOGY. 5 Credits.

Notes: may be stacked with BIOL 524.

Pre-requisites: ≥ 1.7 in BIOL 171, ≥ 2.0 in BIOL 172, BIOL 173, BIOL 270; or permission of instructor; BIOL 303 recommended.

This course is about the evolutionary history, current diversity, ecology and physiology of insects. Lab included.

BIOL 430. IMMUNOLOGY. 5 Credits.

Pre-requisites: Any one of BIOL 301, BIOL 303, BIOL 304 or permission of the instructor. BIOL 460 is recommended.

This course covers immune reactions of animals with principal emphasis on those associated with infectious diseases.

BIOL 432. VIROLOGY. 5 Credits.

Pre-requisites: Any one of BIOL 301, BIOL 303, BIOL 304 or permission of the instructor. BIOL 460 is recommended.

This course includes coverage of the molecular biology of microbial, animal and plant viruses and their host-parasite relationships. Those viruses associated with human and animal diseases are emphasized.

BIOL 435. BIOLOGY OF CANCER. 5 Credits.

Pre-requisites: ≥ 1.7 in BIOL 171, ≥ 2.0 in BIOL 172, BIOL 173, BIOL 270; and BIOL 310; or permission of instructor.

A general study of human neoplasms.

BIOL 436. CELL BIOLOGY. 5 Credits.

Pre-requisites: ≥ 1.7 in BIOL 171, ≥ 2.0 in BIOL 172, BIOL 173, BIOL 270; BIOL 310; and CHEM 153; or permission of instructor.

This course is a comprehensive study of cell biology from a structural and functional perspective.

BIOL 438. MOLECULAR BIOLOGY. 5 Credits.

Pre-requisites: BIOL 310 and one of BIOL 301, BIOL 302, BIOL 303, BIOL 304, CHEM 351.

This course includes study of gene structure, organization, function and regulation. Equal emphasis is given to the molecular processes and genetic phenomena of both prokaryotic and eukaryotic cells.

BIOL 440. ECOLOGY. 4 Credits.

Pre-requisites: ≥ 1.7 in BIOL 171, ≥ 2.0 in BIOL 172, BIOL 173, BIOL 270; MATH 161 or MATH 380 or BIOL 380; or permission of instructor.

This course involves the study of factors which determine the distribution and abundance of organisms.

BIOL 441. ECOLOGY LAB. 2 Credits.

Pre-requisites: current or prior enrollment in BIOL 440.

A field and laboratory course which emphasizes testing ecological hypotheses.

BIOL 442. CONSERVATION BIOLOGY. 4 Credits.

Pre-requisites: ≥ 1.7 in BIOL 171, ≥ 2.0 in BIOL 172, BIOL 173, BIOL 270 or permission of the instructor; BIOL 440 recommended.

Conservation biology is a synthetic discipline that has arisen in response to the current unprecedented rates of extinction and draws on a wide range of basic sciences and applied fields to address the problem of loss of biological diversity. This course introduces students to the discipline of conservation biology, familiarizes students with literature in conservation biology and provides students with a forum for discussion of some major topics in conservation biology.

BIOL 443. WILDLIFE MANAGEMENT. 4 Credits.

Pre-requisites: ≥ 1.7 in BIOL 171, ≥ 2.0 in BIOL 172, BIOL 173 and BIOL 270 or permission of the instructor; BIOL 440 recommended.

This course examines the historical and political development of wildlife management, the ecological principles that underpin management decisions, primary approaches to management, and current management issues.

BIOL 444. FIELD ECOLOGY. 4 Credits.

Pre-requisites: BIOL 423 or BIOL 440 or permission of the instructor.

In this course students conduct observational and/or experimental field studies designed to answer contemporary ecological questions. The course emphasizes hypothesis testing, study design, field techniques, data analysis, and written and oral study presentation. Aquatic ecology, terrestrial ecology, or both may be emphasized.

BIOL 445. STREAM ECOLOGY. 5 Credits.

Pre-requisites: one of: BIOL 301, BIOL 302, BIOL 303, BIOL 304; or permission of instructor.

This course covers the diverse ecological functions of streams and their roles in global processes. The primary focus is on ecosystem function. Stream organisms and their communities are also covered. Laboratories include field work, laboratory techniques, data analysis and professional methods for measuring rates of stream ecosystem processes and investigating stream communities.

BIOL 446. RIPARIAN ECOLOGY. 5 Credits.

Pre-requisites: ≥ 1.7 in BIOL 171, ≥ 2.0 in BIOL 172, BIOL 173, BIOL 270; or permission of instructor.

This course will focus on riparian areas (riparia), which experience intermittent flooding by water moving within a catchment. Riparia form the interface between terrestrial and aquatic habitats and perform critical ecosystem functions. This class will address riparian physical processes, biotic adaptations, human impacts, conservation, restoration and management.

BIOL 450. MAMMALOLOGY. 5 Credits.

Pre-requisites: BIOL 304 or permission of the instructor.

This course covers the classifications, life histories and ecology of mammals. A laboratory is included.

BIOL 454. ORNITHOLOGY. 5 Credits.

Pre-requisites: BIOL 304 or permission of the instructor.

Natural history and taxonomy of birds.

BIOL 460. HEMATOLOGY. 5 Credits.

Pre-requisites: BIOL 310 plus one of BIOL 301, BIOL 303 or BIOL 304; or permission of the instructor.

This course discusses the morphology and hemostasis of the normal and abnormal human hematological system. A laboratory is included.

BIOL 462. ICHTHYOLOGY. 5 Credits.

Pre-requisites: ≥ 2.0 in BIOL 172, BIOL 173, BIOL 270 or permission of the instructor.

This course is a systematic and ecological study of fishes with emphasis on the freshwater fishes of the U.S. A laboratory is included.

BIOL 463. FISHERIES BIOLOGY AND MANAGEMENT. 4 Credits.

Pre-requisites: ≥ 2.0 in BIOL 172, BIOL 173, BIOL 270 or permission of the instructor.

This course covers the development of the biological basis of fisheries management and the role of fish populations as sources of food and recreation for humans.

BIOL 470. BIOLOGICAL ILLUSTRATION. 5 Credits.

Pre-requisites: ≥ 2.0 in BIOL 172, BIOL 173, BIOL 270 or permission of the instructor.

The emphasis in this course is placed on developing the various techniques commonly used in rendering biological illustrations that are suitable for publication.

BIOL 473. NEUROBIOLOGY. 5 Credits.

Notes: PHYS 133 or PHYS 153 is recommended.

Pre-requisites: ≥ 2.0 in BIOL 172, BIOL 173, BIOL 270; CHEM 153 or permission from the instructor.

This course introduces students to the principles of neurobiology. Emphasis is placed on human neuroscience but examples from a wide range of invertebrates and vertebrates are used to best illustrate neurobiological principles, concepts, and mechanisms. The course also includes a laboratory component focusing on neuroanatomy.

BIOL 476. MUSCLE PHYSIOLOGY. 3 Credits.

Pre-requisites: BIOL 332 or permission of the instructor.

This course examines the structure, function and regulation of muscle tissue with emphasis on skeletal muscle.

BIOL 477. EMBRYOLOGY. 5 Credits.

Pre-requisites: BIOL 310.

This course examines the dynamics, physical features and mechanisms of early organismic development from both the classical embryology and modern genetic perspective. Emphasis is placed on mammalian embryology. Also discussed are state-of-art technologies currently in use in medical and veterinary practice and in research.

BIOL 479. CLINICAL LABORATORY THEORY AND PRACTICUM I. 6 Credits.

Pre-requisites: admission to Professional Training at Sacred Heart Medical Center. This course is a clinical laboratory science course, which will begin at the affiliate hospital in the latter part of summer of a student's junior year. It includes lecture and laboratory instruction in clinical immunohematology, clinical chemistry, phlebotomy, clinical hematology, clinical microscopy and urinalysis, clinical body fluids, transfusion techniques and clinical microbiology.

BIOL 480. CLINICAL LABORATORY THEORY AND PRACTICUM II. 12 Credits.

Pre-requisites: BIOL 479.

BIOL 480 is the second course in clinical laboratory science at the affiliate hospital. Students will review basic and advanced information in immunohematology, clinical chemistry, clinical hematology, clinical microbiology, clinical immunology, medical mycology and phlebotomy techniques. Students will perform patient laboratory testing under the guidance of trained professionals.

BIOL 481. FRESHWATER INVERT ZOOLOGY. 5 Credits.

Pre-requisites: ≥ 2.0 in BIOL 172, BIOL 173, BIOL 270 are required; BIOL 405 or BIOL 440 is recommended.

This is a field course stressing the collection, preservation and identification of freshwater invertebrates. A laboratory is included.

BIOL 482. CLINICAL LABORATORY THEORY AND PRACTICUM III. 12 Credits.

Pre-requisites: BIOL 480.

BIOL 482 is the third course in clinical laboratory science at the affiliate hospital. Students continue to study advanced clinical immunohematology, clinical chemistry, clinical microbiology and clinical hematology. During this course, students will perform actual patient laboratory testing under the guidance of trained professionals.

BIOL 483. CLINICAL LABORATORY THEORY AND PRACTICUM IV. 12 Credits.**Pre-requisites:** BIOL 482.

BIOL 483 is the fourth course in clinical laboratory science at the affiliate hospital. Students will learn financial and quality management of clinical laboratory, ethics and professional behavior. Students will continue their training in advanced diagnostics in clinical microbiology, clinical chemistry, hematology and immunohematology. During this course, students will perform actual patient laboratory testing under the guidance of trained professionals.

BIOL 485. MOLECULAR BIOTECHNOLOGY. 5 Credits.**Pre-requisites:** BIOL 301, BIOL 310, CHEM 480.

A study of the concepts, experiments and industrial applications of fermentation theory, recombinant DNA protocols, plasmids and cloning, DNA, RNA and protein sequencing and synthesis, monoclonal antibodies and cell fusion, solid support enzyme technology, bioenergy reactions, biomass and secondary metabolite production and biodegradation.

BIOL 488. MOLECULAR BIOTECHNOLOGY LABORATORY. 2 Credits.**Pre-requisites:** BIOL 485 or concurrent enrollment.

Experiments include basic analytical and separatory techniques, analytical and preparative fermentations, restriction analysis of viral DNA, RNA labelling and sequencing, tissue fractionation and lectin affinity column chromatography, DNA cloning, screening and blot analysis, mammalian cell culture and fusion, immunochemistry and in vitro translation.

BIOL 489. TOPICS IN MOLECULAR BIOTECHNOLOGY. 2 Credits.**Pre-requisites:** BIOL 485, BIOL 488.

Readings and discussion of research and issues in molecular biotechnology.

BIOL 490. SENIOR CAPSTONE. 5 Credits.**Pre-requisites:** senior standing (135 credits), BIOL 310, and one of the following: BIOL 301, BIOL 302, BIOL 303, or BIOL 304.

Satisfies: senior capstone university graduation requirement. Integrated Studies in Form and Function, or Integrated Studies in Microbial and Molecular Biology, or Integrated Studies in Ecology and Evolutionary Biology. See your major department advisor for the appropriate section number. A laboratory is included.

BIOL 490A. BIOTECHNOLOGY CAPSTONE. 5 Credits.**Pre-requisites:** senior standing, BIOL 485, BIOL 488, BIOL 489.

Satisfies: senior capstone university graduation requirement. This capstone course is specific to the Biotechnology Option. Integration of lecture and laboratory experience to culminate in research project. See your major department. A laboratory is included.

BIOL 491. SENIOR THESIS. 5 Credits.**Pre-requisites:** BIOL 483.

BIOL 491 is a Senior Thesis in clinical laboratory science at the affiliate hospital. Students will have lectures in ethics and professional behavior, management information and participate individually in small clinical laboratory experience and continue their training of advanced diagnostic work in clinical microbiology, clinical chemistry, hematology, and immunohematology. During this course, students will perform actual patient laboratory testing under the guidance of trained professionals. An individual senior project integrating practical and theoretical topics will be the culmination of this course.

BIOL 495. INTERNSHIP. 1-15 Credits.**Notes:** only 5 credits will be allowed toward the electives.**Pre-requisites:** permission of the instructor, department chair and college dean.**BIOL 496. EXPERIMENTAL COURSE. 1-5 Credits.****BIOL 497. WORKSHOP, SHORT COURSE, CONFERENCE, SEMINAR. 1-5 Credits.****BIOL 498. SEMINAR. 1-2 Credits.****Pre-requisites:** advanced standing in departmental program.**BIOL 499. DIRECTED STUDY. 1-15 Credits.****Pre-requisites:** permission of the instructor, department chair and college dean.**BIOL 500. RESEARCH SEMINAR. 1 Credit.****Notes:** must be repeated for at least 2 credits.**Pre-requisites:** admission to graduate program in biology.

Students develop and present seminars on their research to an audience of peers and faculty.

BIOL 501. SEMINAR PROGRAMMING. 1 Credit.**Notes:** graded Pass/No Credit; students shall be enrolled in BIOL 501 during all quarters of residency when not enrolled in BIOL 500.**Pre-requisites:** admission to graduate program in biology or permission of the instructor.

Students learn to host a scientific meeting by developing and distributing a scientific meeting program, making all necessary logistical arrangements for the meeting and conducting the meeting itself. The product produced is the Department of Biology's Graduate Student Symposium.

BIOL 505. LIMNOLOGY. 5 Credits.**Pre-requisites:** admission to graduate program.

An in-depth study of the physical, chemical, and biological features of lakes and streams incorporating independent field work and/or synthesis of primary literature.

BIOL 509. MYCOLOGY. 5 Credits.**Pre-requisites:** admission to graduate program or permission of the instructor.

Structure, physiology, ecology, and taxonomy of microfungi and mushrooms, with an emphasis on fungi of the Northwest and on the design and implementation of independent mycological experiments.

BIOL 510. BIOLOGICAL RESEARCH METHODS I. 4 Credits.**Pre-requisites:** admission to the Biology Master's Program or permission of the instructor.

Methods of biological research, including scientific writing and presentation, utilization of scientific literature, and a brief introduction to experimental design and data analysis.

BIOL 511. BIOLOGICAL RESEARCH METHODS II. 4 Credits.**Pre-requisites:** upper division undergraduate MATH or BIOL statistics course; BIOL 510; or permission of instructor.

This course will explore implications of observational and experimental study design and expose students to quantitative hypothesis tests appropriate for the biological sciences.

BIOL 512. CURRENT TOPICS IN PHYSIOLOGY. 2 Credits.**Notes:** may be repeated for credit.**Pre-requisites:** admission to the biology master's program or permission of the instructor.

Current readings in a specialized area of physiology, including functional aspects of animals, plants or micro-organisms or functions common to two or more groups of organisms.

BIOL 513. CURRENT TOPICS IN CELL AND MOLECULAR BIOLOGY. 2 Credits.

Notes: may be repeated for credit.

Pre-requisites: admission to the biology master's program or permission of the instructor.

This course will explore modern developments across the molecular and cell biology disciplines. Topics will build on research expertise of faculty as well as current literature. These areas include environmental and medical microbiology, recombinant DNA, immuno-pathology, embryo physiology.

BIOL 514. CURRENT TOPICS IN ECOLOGY AND EVOLUTION. 2 Credits.

Pre-requisites: admission to the Biology Master's Program or permission of the instructor.

Current readings on selected topics of ecology and evolution. Topics will depend upon interests of instructor and students. Possible topics include: evolution of mating systems, aquatic ecology, community ecology, microevolutionary processes, population dynamics, evolution of life history strategies.

BIOL 515. GROWTH OF BIOLOGICAL THOUGHT. 2 Credits.

Pre-requisites: admission to the Biology Master's Program or permission of the instructor.

This course will include readings on topics such as changing biological paradigms, philosophies and ethical behavior of biologists in their historic as well as current context. Topics will be developed in relation to antecedent discoveries, available technology, political events and social climate.

BIOL 519. REVIEW OF LITERATURE. 1 Credit.

Presentations by faculty and graduate students of current biological research papers.

BIOL 520. EPIDEMIOLOGY. 5 Credits.

Pre-requisites: admission to graduate program or permission of the instructor.

A study of the factors which determine the frequencies and distributions of the communicable diseases among humans with an emphasis on independent synthesis of current literature.

BIOL 521. MEDICAL BACTERIOLOGY. 5 Credits.

Pre-requisites: BIOL 301.

The microbial agents of human disease, with an emphasis on bacteria.

BIOL 530. IMMUNOLOGY. 5 Credits.

Pre-requisites: admission to graduate program or permission of the instructor.

Immune reactions of animals with principal emphasis on those associated with infectious diseases. Students will conduct primary literature review.

BIOL 532. VIROLOGY. 5 Credits.

Pre-requisites: admission to graduate program or permission of the instructor.

The molecular biology of microbial, animal and plant viruses, especially those viruses associated with human and animal diseases and their host-parasite relationships with an emphasis on synthesis of primary literature.

BIOL 535. BIOLOGY OF CANCER. 5 Credits.

Pre-requisites: admission to graduate program or permission of the instructor.

An advanced study of human neoplasms through synthesis of current literature.

BIOL 536. CELL BIOLOGY. 5 Credits.

Pre-requisites: admission to graduate program or permission of the instructor.

A comprehensive study of cellular biology from a structural and functional perspective incorporating independent laboratory and/or synthesis of primary literature.

BIOL 539. SPECIAL STUDIES. 1-5 Credits.**BIOL 542. CONSERVATION BIOLOGY. 4 Credits.**

Pre-requisites: admission to graduate program or permission of the instructor.

Conservation biology is a synthetic discipline that has arisen in response to the current unprecedented rates of extinction and draws on a wide range of basic sciences and applied fields to address the problem of loss of biological diversity. This course examines the discipline of conservation biology, familiarizes students with literature in conservation biology, and provides students with a forum for discussion of some major topics in Conservation Biology. Students incorporate independent field work and/or synthesis of primary literature.

BIOL 543. WILDLIFE MANAGEMENT. 4 Credits.

Pre-requisites: admission to graduate program or permission of the instructor.

An examination of the historical and political development of wildlife management, the ecological principles that underpin management decisions, primary approaches, and current management issues incorporating independent field work and/or synthesis of primary literature.

BIOL 546. RIPARIAN ECOLOGY. 5 Credits.

Pre-requisites: admission to the Biology Master's Program or permission of the instructor.

This course will focus on riparian areas (riparia), areas which experience intermittent flooding by water moving within a catchment. Riparia form the interface between terrestrial and aquatic habitats and perform critical ecosystem functions. This class will address riparian physical processes, biotic adaptations, human impacts, conservation, restoration and management.

BIOL 550. MAMMALOLOGY. 5 Credits.

Pre-requisites: admission to graduate program or permission of the instructor.

The classifications, life histories and ecology of mammals with an emphasis on independent field or literature review studies.

BIOL 554. ORNITHOLOGY. 5 Credits.

Pre-requisites: admission to graduate program or permission of the instructor.

Natural history and taxonomy of birds with an emphasis on independent field or literature review studies.

BIOL 560. HEMATOLOGY. 5 Credits.

Pre-requisites: admission to graduate program or permission of the instructor.

An in-depth study of the morphology and hemostasis of the normal and abnormal human hematological system incorporating primary literature review and seminar preparation.

BIOL 562. ICHTHYOLOGY. 5 Credits.

Pre-requisites: admission to graduate program or permission of the instructor.

An in-depth systematic and ecological study of fishes, especially the freshwater fishes of the U.S., incorporating review of primary literature and independent field research.

BIOL 563. FISHERIES BIOLOGY AND MANAGEMENT. 4 Credits.

Pre-requisites: admission to graduate program or permission of the instructor.

Development of the biological basis of fisheries management and the role of fish population as sources of food and recreation for humans. Synthesis of this information by developing a comprehensive management plan for a particular species or body of water.

BIOL 573. NEUROBIOLOGY. 5 Credits.

Pre-requisites: admission to the MS Biology Program or permission of instructor.

This course introduces students to the principles of neurobiology. Emphasis is placed on human neuroscience but examples from a wide range of invertebrates and vertebrates are used to best illustrate neurobiological principles, concepts, and mechanisms. The course also includes a laboratory component focusing on neuroanatomy.

BIOL 576. MUSCLE PHYSIOLOGY. 3 Credits.

Pre-requisites: BIOL 233 or BIOL 436 or BIOL 490.

The structure, function and regulation of muscle tissue, with an emphasis on skeletal muscle.

BIOL 581. FRESHWATER INVERT ZOOLOGY. 5 Credits.

Pre-requisites: admission to graduate program or permission of the instructor.

A field course incorporating techniques used in the collection, preservation and identification of freshwater invertebrates into independent field research.

BIOL 585. MOLECULAR BIOTECHNOLOGY I. 5 Credits.

Pre-requisites: admission to graduate program or permission of the instructor.

An in-depth examination of animal and plant cell culture and microbial fermentation from the perspective of physiology and biochemical engineering.

BIOL 588. MOLECULAR BIOTECHNOLOGY LAB. 2 Credits.

Pre-requisites: admission to graduate program or permission of the instructor.

Advanced quantitative procedures in recombinant DNA and monoclonal antibodies.

BIOL 589. MOLECULAR BIOTECHNOLOGY LAB. 2 Credits.

Pre-requisites: admission to graduate program or permission of the instructor.

Advanced quantitative procedures in recombinant DNA and monoclonal antibodies.

BIOL 595. INTERNSHIP. 1-15 Credits.**BIOL 596. EXPERIMENTAL COURSE. 1-5 Credits.****BIOL 597. WORKSHOP, SHORT COURSE, CONFERENCE, SEMINAR. 1-5 Credits.**

Notes: only one workshop course for up to 3 credits may be used to fulfill graduate degree requirements.

BIOL 598. SEMINAR. 1-5 Credits.

Students select, develop, and present seminars on selected topics in biology to an audience of peers and faculty.

BIOL 599. INDEPENDENT STUDY. 1-5 Credits.

Pre-requisites: permission of the instructor, department chair and college dean.

BIOL 600. THESIS RESEARCH. 1-10 Credits.

Pre-requisites: permission of the instructor, department chair and college dean.

Thesis will represent culmination of original research under direction of graduate committee.

BIOL 601. RESEARCH REPORT. 1-10 Credits.

Pre-requisites: permission of the instructor, department chair and college dean.

Non-thesis directed research. Not available for Master of Science in Biology.

BIOL 696. COLLEGE TEACHING INTERNSHIP. 1-5 Credits.

Secondary Science Teaching Course

SCED 390. SCIENCE TEACHING METHODS. 2 Credits.

Notes: designed for BAE Biology, Chemistry, Earth Science, Physics majors and minors as well as those seeking middle level science endorsement.

Pre-requisites: EDUC 303 or by permission of the instructor plus upper level major courses.

Students study types of science programs, organization of lesson materials, techniques, laboratory safety and evaluation.