BIOLOGY

Paul Spruell, Chair (biology@ewu.edu)
department web page (https://www.ewu.edu/cstem/biology/)

Faculty

Jessica Allen, 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, Robert Idsardi Jr., Joanna J. Joyner-Matos, Krisztian Magori, Luis F. Matos, Camille C. McNeely, Charlotte Milling, Robin L. O'Quinn, Paul Spruell, Jenifer Walke.

Programs

Biology (http://catalog.ewu.edu/stem/biology1/)
Middle Level Science Education (http://catalog.ewu.edu/stem/biology/natural-science/)

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

Admission to the Department of Biology

MATH 141	PRECALCULUS I	5

Must be completed with a grade ≥C unless otherwise noted.

Complete Major Declaration form and be assigned to Biology faculty advisor.

Meet with Biology faculty advisor. Advisors are assigned by Lisa Williams, the Biology Department Secretary.

Major Requirements for Biology

Upon declaring biology as a major each student should meet with a biology faculty advisor as soon as possible.

Plan to complete university MATH and ENGLISH graduation requirements and the following BIOL and CHEM series in the first two years of study.

BIOL 171	BIOLOGY I
& BIOL 172	and BIOLOGY II
& BIOL 173	and BIOLOGY III
& BIOL 270	and BIOLOGICAL INVESTIGATION
CHEM 171	GENERAL CHEMISTRY I
& 171L	and GENERAL CHEMISTRY LABORATORY I
& CHEM 172	and GENERAL CHEMISTRY II
& CHEM 172L	and GENERAL CHEMISTRY LABORATORY II
& CHEM 173	and GENERAL CHEMISTRY III
& CHEM 173L	and GENERAL CHEMISTRY LABORATORY III

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.

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, and BIOL 235.

Those students planning graduate study are encouraged to meet with their advisors to discuss recommended courses and to take a directed study (BIOL 499) course in biology.

Graduation Requirements

Have a cumulative GPA ≥2.0 for all courses in student's curriculum in Biology.

Complete the Educational Testing Service (ETS) Major Field Test for Biology.

Undergraduate Program

Biology encompasses the scientific study of life. The Department of Biology prepares students for careers in a variety of biological fields including the health sciences, natural resource management, biotechnology, pharmacy, veterinary medicine, education, environmental sciences, and more.

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 provides a broad background in biology, along with specialized training that will prepare them for specific careers. 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. **BS Biology degree options** include **General Biology, Pre-medicine Pre-dentistry,** and **Biotechnology**

Many careers start with a biology degree. Within the General Biology degree option, advising guides (https://www.ewu.edu/cstem/biology/biology-bs/#guides) are available with suggested courses for **pre-optometry, pre-physical therapy, pre-physician assistant, pre-medical laboratory science, pre-pharmacy, pre-veterinary medicine, fisheries, wildlife biology-management, restoration ecology, and plant science**.

The **BAE degree** prepares students for teaching biology in **secondary education**. More information on degree programs can be found on the Department of Biology website (https://www.ewu.edu/cstem/biology/).

Students in the Department of Biology have varied **hands-on 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 while earning directed study credit, or get internship credit for work related to biology.

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, geosciences, and statistics. 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 the Environmental Science section of the catalog for more information.

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

The Department of Biology has 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.

Graduate Program

Camille McNeely (fmcneely@ewu.edu), Biology Graduate Program Director
509.359.2798

The Master of Science in Biology program (https://www.ewu.edu/cstem/biology/biology-ms/) provides a demanding and rewarding experience in biology. The department emphasizes original research as a basic component of graduate study. A variety of research specialties are available within the department, and potential students are encouraged to explore faculty expertise and discuss research areas with potential faculty advisors. More information on faculty research interests is available by direct communication with faculty or by accessing our website (https://www.ewu.edu/cstem/biology/). Master's students from our program typically continue in PhD programs or are employed in various biological fields with federal, state, and local agencies, environmental consulting firms, tribes, 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 College Teaching; elective courses in advanced topics; and research thesis.

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

Graduate service appointments (GSAs), with resident and non-resident tuition waivers, are available on a competitive basis to qualified graduate students. Other financial support is possible through work-study programs, hourly employment by the department or faculty research grants or scholarship/fellowships. All applicants are encouraged to submit the Free Application for Federal Student Aid (https://www.ewu.edu/apply/financial-aid-scholarships-office/apply-for-aid/), which must be received by the EWU Financial Aid Office by the EWU priority deadline for support in the following academic year. Applications are available through the EWU Financial Aid Office (https://www.ewu.edu/apply/financial-aid-scholarships-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 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:

a. completed all admission requirements for the Eastern Washington University Graduate Programs Office,
b. provided a completed supplemental application to the Department of Biology and two evaluation/recommendation forms, and
c. 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 10. 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.

Pre-Professional Programs

A Bachelor of Science degree in Biology can prepare you for a variety of professional programs, such as:

- Chiropractic Medicine
- Optometry
- Pharmacy
- Physical Therapy
- Physician Assistant
- Veterinary Medicine

When students declare their major, they should specify if they are interested in one of these pre-professional pathways so they are assigned to the appropriate faculty advisor. Most of these programs have pre-requisite course requirements, and many require entry exams and job specific experience. As requirements vary among programs and universities, it is important to review the entry requirements for the programs the student is planning to apply to. Faculty advisors can help navigate these pathways. Visit the Biology Department website for more information about courses recommended for these career tracks (https://www.ewu.edu/cstem/biology/biology-bs/#guides).

Biology Courses

BIOL 100. INTRODUCTION TO BIOLOGY. 5 Credits.
Notes: lecture is paired with weekly interactive, inquiry-based laboratory investigations to assist students in critical thinking and further illustrate lecture topics.
Pre-requisites: ≥C in ENGL 101.
Satisfies: a BACR for natural sciences.
This course furnishes an understanding of fundamental topics in biology–diversity of life, form and function of living organisms, information flow, and transfer of energy. The course covers basic chemistry, cell structure and function, animal physiology, introductory genetics, evolution, introductory ecology, and carbon flow.

BIOL 115. LIFE SCIENCE FOR TEACHERS. 5 Credits.
Notes: lecture with lab.
Satisfies: a BACR for natural science.
This course is designed to support students planning to teach elementary school in actively learning core concepts in biology. It includes inquiry-based biological investigations that model effective science instruction as outlined in the Next Generation Science Standards. This course requires analytical thinking and quantitative literacy.

BIOL 171. BIOLOGY I. 5 Credits.
Notes: course fee. Students must receive ≥C- to enroll in BIOL 173 and ≥C to enroll in BIOL 270.
Pre-requisites: concurrent enrollment in MATH 141 or completion of MATH 141 with ≥C.
Satisfies: a BACR for natural science.
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. Students must receive ≥C to enroll in BIOL 173 or BIOL 270.
Pre-requisites: concurrent enrollment in MATH 141 or completion of MATH 141 with ≥C.
Satisfies: 2nd Natural Sciences BACR if BIOL 171 and BIOL 270 are complete or BIOL 172 and BIOL 270 are completed.
This course includes an introduction to Biological concepts, covering evolution, the diversity of life and interactions among organisms and their environment. This course requires analytical thinking and quantitative literacy, and can be paired with BIOL 270 to satisfy the Natural Sciences breadth requirement in the general education curriculum.

BIOL 173. BIOLOGY III. 5 Credits.
Notes: course fee.
Pre-requisites: ≥C- in BIOL 171 and ≥C 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. 1-5 Credits.

BIOL 197. FRESHMAN SEMINAR. 1-5 Credits.

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

BIOL 232. HUMAN ANATOMY AND PHYSIOLOGY NON-BIOL MAJORS. 5 Credits.
Notes: laboratory included that utilizes human cadavers, models, multimedia and other technologies.
Pre-requisites: one college chemistry course.
Satisfies: a BACR for natural sciences.
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.

BIOL 233. HUMAN ANATOMY AND PHYSIOLOGY NON-BIOL MAJORS. 5 Credits.
Notes: laboratory included that utilizes human cadavers, models, multimedia and other technologies.
Pre-requisites: BIOL 232.
Satisfies: a BACR for natural sciences.
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 & Immunity will be completely and thoroughly covered.

BIOL 234. HUMAN ANATOMY AND PHYSIOLOGY NON-BIOL MAJORS. 5 Credits.
Notes: laboratory included that utilizes human cadavers, models, multimedia and other technologies.
Pre-requisites: BIOL 233.
Satisfies: a BACR for natural sciences.
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.

BIOL 235. ELEMENTARY MEDICAL MICROBIOLOGY. 5 Credits.
Pre-requisites: completion of or concurrent enrollment in 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: lecture and lab.
Pre-requisites: ≥C in BIOL 171 or BIOL 172.
Satisfies: the completion of BIOL 171 and BIOL 270 satisfies a BACR for natural sciences; the completion of BIOL 171, BIOL 172 and BIOL 270 satisfies a second BACR for natural sciences.
Experimental design and performance, including data collection and analysis, scientific writing and use of the biological literature. This is a research experience course, where students learn about the scientific process, and develop, conduct, analyze and document a scientific project in a small group.

BIOL 295. INTERNSHIP. 1-15 Credits.

BIOL 296. EXPERIMENTAL. 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.
Notes: this course includes four hours of lecture and three hours of lab each week.
Pre-requisites: ≥C- in BIOL 171, ≥C in BIOL 270; CHEM 173 and CHEM 173L.
This course covers morphology, physiology, taxonomy and ecology of the microorganisms, emphasizing prokaryotes, fungi and the viruses.

BIOL 302. BOTANY. 5 Credits.
Notes: this course includes four hours of lecture and three hours of lab each week.
Pre-requisites: ≥C- in BIOL 171, ≥C in BIOL 172, BIOL 173, BIOL 270; completion of or concurrent enrollment in CHEM 171, or HONS 171, and CHEM 171L; or permission of instructor.
This course examines the structure, function and phylogenetic relationships in the plant kingdom.

BIOL 303. INVERTEBRATE ZOOLOGY. 5 Credits.
Notes: this course includes four hours of lecture and three hours of lab each week.
Pre-requisites: ≥C- in BIOL 171, ≥C in BIOL 172, BIOL 173, BIOL 270; completion of or concurrent enrollment in CHEM 171, or HONS 171, and CHEM 171L; or permission of instructor.
This course examines structure, function and phylogenetic relationships of the invertebrate phyla.

BIOL 304. VERTEBRATE ZOOLOGY. 5 Credits.
Notes: this course includes four hours of lecture and three hours of lab each week.
Pre-requisites: ≥C- in BIOL 171, ≥C in BIOL 172, BIOL 173, BIOL 270; completion of or concurrent enrollment in CHEM 171, or HONS 171, and CHEM 171L; or permission of instructor.
This course explores the structure, function and phylogenetic relationships of the vertebrates.

BIOL 310. FUNDAMENTALS OF GENETICS. 5 Credits.
Pre-requisites: ≥C- in BIOL 171, ≥C in BIOL 172, and BIOL 173; CHEM 173 and CHEM 173L.
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: GEOS 312, PLAN 312.
Pre-requisites: MTHD 104 or completion of the Quantitative and Symbolic Reasoning requirement.
A general introduction to physical, chemical and biological properties of soils.

BIOL 320. THE HUMAN PROSPECT. 5 Credits.
Cross-listed: HUMN 320.
Pre-requisites: sophomore standing.
Satisfies: a university graduation requirement–global studies.
Explores the biological and philosophical roots of humans' relationship with the environment.

BIOL 325. WETLAND SCIENCE I. 4 Credits.
Cross-listed: GEOS 325, PLAN 325.
Pre-requisites: completion of at least one Natural Science BACR course.
An introduction to the fundamental processes that form and sustain wetlands. Emphasizes the distinctive hydrology, soils, and vegetation of wetlands and field experience in delineation. Examines issues of regulation. Focus is on Pacific Northwest wetlands.

BIOL 332. HUMAN ANATOMY AND PHYSIOLOGY I. 5 Credits.
Notes: a laboratory is included each quarter.
Pre-requisites: BIOL 173 with a grade ≥B-; CHEM 173 and CHEM 173L with a grade ≥B-; 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.

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 340. BIOETHICS. 2 Credits.
Pre-requisites: either BIOL 100 or ≥C- 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: ≥C- in BIOL 171, ≥C in BIOL 172 and BIOL 173; CHEM 173 and CHEM 173L; 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: ≥C- in BIOL 171, ≥C in BIOL 172 and BIOL 173; CHEM 173 and CHEM 173L; 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: ≥C- in BIOL 171, ≥C in BIOL 172 and BIOL 173; CHEM 173 and CHEM 173L; 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 360. HUMAN GENETICS. 3 Credits.
Pre-requisites: BIOL 171.
The course reviews basic cell division before moving into heritability, pedigree analysis, complex traits, cytogenetics, development, chromosomes structure and function, gene expression, proteins and disease, and the genetics of cancer. Through the course the students will learn about a wide variety of genetic diseases.

BIOL 370. CAREERS IN BIOLOGY. 1 Credit.
This seminar prepares students majoring in General Biology for their career after graduation, including developing a connection to the Career Center, finding and applying for internships and jobs, resume writing, attending a Career Fair, and interview skills. The course features guest talks by Biology alumni employed in the region, as well as staff from the Career Center.

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: ≥C- in BIOL 171, ≥C in BIOL 172, BIOL 173, BIOL 270; completion of or concurrent enrollment in CHEM 171, or HONS 171, and CHEM 171L and a ≥C in MATH 141; or permission of instructor.
Satisfies: completion of this course with a grade ≥C satisfies the university proficiencies in mathematics.
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 and Type II errors, statistical methods and R programming language are covered.

BIOL 383. BIOTECH INDUSTRY CURRENT GOOD MANUFACTURING PRACTICES. 2 Credits.
Pre-requisites: MATH 141.
The course is an introduction to current Good Manufacturing Practices (cGMP) in the biotechnology industry that are used by the Food and Drug Administration. The FDA regulates and monitors biotech companies (via cGMP) as it relates to people, procedures, processes, premises, and products.

BIOL 384. BIOTECH INDUSTRY REGULATORY AFFAIRS. 3 Credits.
Pre-requisites: BIOL 171.
This course introduces regulatory affairs and the steps required to move a product from development through the regulatory approval process and into the market.

BIOL 385. MOLECULAR BIOTECHNIQUES. 3 Credits.
Pre-requisites: BIOL 171 and BIOL 172.
This course includes an introduction to molecular techniques most commonly used in the molecular biotechnology industry and research.

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.
Notes: this course includes four hours of lecture and three hours of lab each week.
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.
Notes: this course includes two hours of lecture and six hours of lab each week.
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: ≥C- in BIOL 171, ≥C 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: ≥C- in BIOL 171, ≥C 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: ≥C- in BIOL 171, ≥C in BIOL 172, BIOL 173, BIOL 270; BIOL 310; and CHEM 173 and CHEM 173L; 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: ≥C- in BIOL 171, ≥C in BIOL 172, BIOL 173, BIOL 270; MATH 161, HONS 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: ≥C- in BIOL 171, ≥C 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: ≥C- in BIOL 171, ≥C in BIOL 172, BIOL 173, 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.
Notes: this course includes four hours of lecture and three hours of lab each week.
Pre-requisites: ≥C- in BIOL 171, ≥C 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 447. ECOSYSTEM ECOLOGY. 5 Credits.
Notes: upper division elective.
Pre-requisites: BIOL 270; CHEM 171; MATH 380 or BIOL 380 or MATH 161 or HONS 161.
This is an elective course about how energy and matter flow through ecological systems. Ecosystem ecology uses chemistry and physics to understand the interactions between organisms and their physical environment. This course has a strong focus on ecological methods, both in discussing the methods used by ecologists in research that we cover, as well as activities in which students practice experimental design, formulating models, and working with data.

BIOL 450. MAMMALOGY. 5 Credits.
Notes: this course includes four hours of lecture and three hours of lab each week.
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 453. FISH AND WILDLIFE MANAGEMENT. 5 Credits.
Pre-requisites: ≥C in BIOL 172, BIOL 173, BIOL 270; or permission of the instructor.
Fish and Wildlife management can be defined as the application of ecological knowledge to populations of animals and their plant and animal associates in a manner that strikes a balance between the needs of those populations and the needs of people.

BIOL 454. ORNITHOLOGY. 5 Credits.
Notes: this course includes four hours of lecture and three hours of lab each week.
Pre-requisites: BIOL 304 or permission of the instructor.
Natural history and taxonomy of birds.

BIOL 460. HEMATOLOGY. 5 Credits.
Notes: this course includes four hours of lecture and three hours of lab each week.
Pre-requisites: BIOL 310 plus one of BIOL 301, BIOL 303 or BIOL 304; or permission of the instructor.
This courses discusses the morphology and hemostasis of the normal and abnormal human hematological system. A laboratory is included.

BIOL 462. ICHTHYOLOGY. 5 Credits.
Notes: this course includes four hours of lecture and three hours of lab each week.
Pre-requisites: ≥C 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: ≥C 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 468. SKELETAL BIOLOGY. 5 Credits.
Notes: may be stacked with BIOL 568.
Pre-requisites: BIOL 310.
This course examines the cellular and molecular biology of the skeleton with particular emphasis on signaling pathways, molecules, and genes that regulate the activity of bone cells. Course content includes readings from primary scientific literature, interpretation of research data, and integration of multiple biological concepts to interpret cell and tissue behavior as it relates to skeletal physiology, pathology, and interactions with extraskeletal systems.

BIOL 470. BIOLOGICAL ILLUSTRATION. 5 Credits.
Pre-requisites: ≥C 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: ≥C in BIOL 172, BIOL 173, BIOL 270; CHEM 173 and CHEM 173L 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. 6-12 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: ≥C 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. 6-12 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 484. TOPICS IN MOLECULAR BIOTECHNOLOGY. 2 Credits.
Pre-requisites: CHEM 480 or permission of the instructor.
Readings and discussion of current research topics in molecular biotechnology. Experimental design and research planning.

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 490. SENIOR CAPSTONE. 5 Credits.
Pre-requisites: senior standing, BIOL 310, and one of the following: BIOL 301, BIOL 302, BIOL 303, or BIOL 304; concurrent enrollment in BIOL 490T is required for Biology majors.
Satisfies: a university graduation requirement–senior capstone.
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.
Notes: a laboratory is included.
Pre-requisites: senior standing, BIOL 484, BIOL 485, BIOL 488; concurrent enrollment in BIOL 490T is required for Biology majors.
Satisfies: a university graduation requirement–senior capstone.
This capstone course is specific to the Biotechnology Option. Integration of lecture and laboratory experience to culminate in research project. See your major department.

BIOL 490T. BIOLOGY EXIT EXAM. 0 Credits.
Notes: this zero-credit course is a co-requisite with BIOL 490 and BIOL 490A.
Completion of the ETS Biology Major Field Test is a graduation requirement for the following majors: Biology, Biology Major with Biotechnology Option, and Biology Major with Pre-Medicine/Pre-Dentistry Option. This course involves scheduling and completing the Biology Major Field Test.

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 theoratical 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 502. ADVANCED HUMAN ANATOMY AND PHYSIOLOGY I. 5 Credits.
Notes: a laboratory is included each quarter.
Pre-requisites: BIOL 173 with a grade ≥B-; CHEM 173 and CHEM 173L with a grade ≥B-; or instructor permission.
This is a three-quarter sequence covering the structure and function of the human body. Intended for students that have completed undergraduate coursework in Biology or Chemistry or a related field and who are pursuing teaching or health care careers. Students will be responsible for advanced cadaver dissection and/or histological course content.

BIOL 503. ADVANCED HUMAN ANATOMY AND PHYSIOLOGY II. 5 Credits.
Pre-requisites: BIOL 502.
Second in series.

BIOL 504. ADVANCED HUMAN ANATOMY AND PHYSIOLOGY III. 5 Credits.
Pre-requisites: BIOL 503.
Third in series.

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.
Notes: this course includes 4 hours of lecture and 3 hours of lab each week.
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 516. ADVANCED STATISTICS STUDIO. 1 Credit.
Pre-requisites: BIOL 511.
In this course, biology graduate students meet individually with the instructor to work on statistical analysis of the data collected for their thesis projects. This course supplements and applies the material learned in BIOL 511, and supports graduate students in identifying and applying current best practices for statistical analysis and data management.

BIOL 517. ADVANCED STATISTICS STUDIO II. 1 Credit.
Pre-requisites: BIOL 516.
In this course, biology graduate students meet individually with the instructor to work on statistical analysis of the data collected for their thesis projects. This course supplements and applies the material learned in BIOL 511, and supports graduate students in identifying and applying current best practices for statistical analysis and data management. This course is specifically for graduate students in at least their second year in the program.

BIOL 518. COLLEGE SCIENCE TEACHING. 2 Credits.
This course provides an introduction to how students learn, how to assess student learning, and best practices in undergraduate science teaching. Students will read primary literature on teaching and learning, engage in discussions and reflections on readings, and participate in activities that illustrate principles of teaching and learning. Students will apply these principles in their own teaching as they plan, implement, and evaluate mini-lessons within the course.

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 538. MOLECULAR BIOLOGY. 5 Credits.
Pre-requisites: admission to graduate program or permission of the instructor.
This course includes the study of gene structure, organization, function, and regulation. Equal emphasis is given to the molecular processes and genetic phenomena of prokaryotic and eukaryotic cells.

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 547. ECOSYSTEM ECOLOGY. 5 Credits.
Pre-requisites: BIOL 270; CHEM 171, or HONS 171, and CHEM 171L; MATH 380 or BIOL 380 or MATH 161; BIOL 301 or BIOL 302 or BIOL 303 or BIOL 304.
This is an elective course about how energy and matter flow through ecological systems. Ecosystem ecology uses chemistry and physics to understand the interactions between organisms and their physical environment. This course has a strong focus on ecological methods, both in discussing the methods used by ecologists in research that we cover, as well as activities in which students practice experimental design, formulating models, and working with data.

BIOL 550. MAMMALOGY. 5 Credits.
Notes: this course includes 4 hours of lecture and 3 hours of lab each week.
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 553. FISH AND WILDLIFE MANAGEMENT. 5 Credits.
Pre-requisites: ≥C in BIOL 172, BIOL 173, BIOL 270; or permission of the instructor.
Fish and Wildlife management can be defined as the application of ecological knowledge to populations of animals and their plant and animal associates in a manner that strikes a balance between the needs of those populations and the needs of people.

BIOL 554. ORNITHOLOGY. 5 Credits.
Notes: this course includes 4 hours of lecture and 3 hours of lab each week.
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.
Notes: this course includes 4 hours of lecture and 3 hours of lab each week.
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.
Notes: this course includes 4 hours of lecture and 3 hours of lab each week.
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 568. SKELETAL BIOLOGY. 5 Credits.
Notes: may be stacked with BIOL 468.
Pre-requisites: admission to graduate program or permission of the instructor.
This course examines the cellular and molecular biology of the skeleton with particular emphasis on signaling pathways, molecules, and genes that regulate the activity of bone cells. Course content includes readings from primary scientific literature, interpretation of research data, and integration of multiple biological concepts to interpret cell and tissue behavior as it relates to skeletal physiology, pathology, and interactions with extraskeletal systems.

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 584. TOPICS IN MOLECULAR BIOTECHNOLOGY. 2 Credits.
Pre-requisites: CHEM 480 and admission to graduate program or permission of the instructor.
Readings and discussion of current research topics in molecular biotechnology. Experimental design and research planning.

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 590A. MOLECULAR BIOTECHNOLOGY CAPSTONE. 5 Credits.
Pre-requisites: BIOL 584, BIOL 585, BIOL 588.
This capstone course is specific to the Biotechnology course series. Integration of lecture and laboratory experience in a research project as the culmination of the year-long biotechnology series.

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 Courses

SCED 196. EXPERIMENTAL COURSE. 1-6 Credits.
Experimental.

SCED 390. SCIENCE TEACHING METHODS. 5 Credits.
Notes: designed for BAE Biology, Chemistry, Earth Science, Physics majors and minors as well as those seeking middle level science endorsement.
Pre-requisites: junior standing or permission of instructor.
Students study principles of teaching and learning in science disciplines, including assessment techniques, inquiry-based teaching, and laboratory safety. This course prepares students for teaching positions in science education and certification requirements by emphasizing a data-driven approach to teaching and learning.

SCED 391. MIDDLE LEVEL AND EARTH AND SPACE SCIENCE METHODS. 3 Credits.
Notes: This course is designed for students seeking an endorsement to teach middle school science and/or secondary earth and space science. Students must complete ≥70% of program to enroll in this course.
Pre-requisites: SCED 390 or concurrent enrollment.
The course includes information and strategies for teaching the Next Generation Science Standards. Focus is on addressing commonly held misconceptions, as well as techniques and activities for teaching life, earth and space and physical sciences at the middle school level.

SCED 395. INTERNSHIP. 1-15 Credits.
Pre-requisites: permission of the instructor, department chair, and college dean.

SCED 396. EXPERIMENTAL COURSE. 1-6 Credits.
Experimental.

SCED 399. DIRECTED STUDY. 1-5 Credits.
Pre-requisites: permission of the instructor, department chair, and college dean.

SCED 490A. SCIENCE TEACHING CAPSTONE SEMINAR. 3 Credits.
Notes: must be taken concurrently with SCED 490B.
Pre-requisites: EDUC 341 and SCED 390.
Satisfies: a university graduation requirement-senior capstone (when completed with SCED 490B).
This seminar and dialogue course supports secondary science students in planning, implementing, and evaluating effective science teaching practices that align with Washington State standards.

SCED 490B. SCIENCE TEACHING CAPSTONE FIELD APPLICATION. 2 Credits.
Notes: must be taken concurrently with SCED 490A.
Pre-requisites: EDUC 341 and SCED 390.
Satisfies: a university graduation requirement—senior capstone (when completed with SCED 490A).
This field application course supports secondary science students in planning, implementing, and evaluating effective science teaching practices that align with Washington State standards.

SCED 499. DIRECTED STUDY. 1-5 Credits.
Pre-requisites: permission of the instructor, department chair, and college dean.