

BIOLOGY *College of Science, Health & Engineering*

Margaret A. O'Connell, Chair			258 Science Bld.	509.359.6812
BAE	BS	Minors	General Science Endorsement	MS

Faculty:

P. Bhuta, R. Black, R. Brown, K. Carlberg, A. Castillo, D. Daberkow, B. Fillmore, F. Gibson, T. Hancock, C. Herr, J. Joyner-Matos, S. Kasuga, H. McKean, C. McNeely, M. O'Connell, R. O'Quinn, A. Scholz, S. Schwab

Adjunct Faculty:

J. Bastow, J. Hallett, L. Matos

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, 172, 173, 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: [WWW.BIOLOGY.EWU.EDU](http://www.biology.ewu.edu).

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, health sciences, 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.

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, 172, 173 and 270; CHEM 151, 152, 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. Physiology capstone and advanced elective courses are ordinarily taken in the senior year. A minimum of fifty credits of upper-division biology courses are required. Only 5 credits of BIOL 399 or 499 *Directed Study in Biology* and 5 credits of BIOL 395 or 495 *Internship* will be allowed toward the electives. The following biology courses will not fulfill elective requirements: BIOL 100 *Introduction to Biology* (5); BIOL 232/233/234 *Human Anatomy and Physiology for Non-Biology Majors* (5, 5); BIOL 335 *Elementary Medical Microbiology* (5); BIOL 390 *Biology Teaching Methods* (1).

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

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

BACHELOR OF ARTS IN EDUCATION (BAE)

STUDENT LEARNING OUTCOMES – STUDENTS WILL:

- create a community of diverse learners who construct meaning from their science experiences and possess a disposition for further exploration and learning;
- organize a safe and effective learning environment;
- interrelate and interpret important concepts, ideas and applications in the field of biology; and conduct scientific investigations;
- develop strategies for teaching that organic evolution is a unifying theme;
- construct and use effective assessment strategies to determine the backgrounds and achievements of learners and facilitate their intellectual, social and personal development;
- engage students both in studies of various methods of scientific inquiry and in active learning through scientific inquiry.

BIOLOGY/SECONDARY MAJOR (75 CREDITS)

This major satisfies the endorsement requirements for grades 5–12.

Required Biology Courses (48 credits)

- BIOL 171 Biology I (4)
- BIOL 172 Biology II (4)
- BIOL 173 Biology III (4)
- BIOL 270 Biological Investigation (3)
- BIOL 301 Microbiology (5)
- BIOL 302 Botany (5)
- BIOL 310 Fundamentals of Genetics (5)
- BIOL 340 Biology and Society (2)
- BIOL 423 Evolution (5)
- BIOL 440 Ecology (4)
- BIOL 441 Ecology Lab (2)
- BIOL 490 Department Senior Capstone (5)

Select one of the following courses (5 credits)

- BIOL 303 Invertebrate Zoology (5)
- BIOL 304 Vertebrate Zoology (5)

Required supporting courses (17 credits)

- BIOL 390 Biology Teaching Methods (1)
- CHEM 151 General Chemistry (5)
- CHEM 152 General Chemistry (5)
- CHEM 153 General Chemistry (5)
- SCED 390 Secondary Science Teaching Methods (1)

Select one of the following courses (5 credits)

- MATH 106 Precalculus II (5)
- or MATH 380 Probability and Statistics (5)

Required program credits **53 credits**

Required supporting courses **22 credits**

Credits for above major **75 credits**

Professional education requirements/secondary education: **46–47 credits**

See the Department of Education section of this catalog. Prerequisites may apply.

Minimum total credits for above major and professional education **121 credits**

Note: the above option requires more than 12 quarters to complete at 15 credits per quarter.

BACHELOR OF SCIENCE IN BIOLOGY (BS)

STUDENT LEARNING OUTCOMES – STUDENTS WILL:

- expand and deepen their knowledge of biology and integrate that knowledge in their specialization;
- become informed, critically thinking scientists who can design, execute and communicate original research in the field of biology;
- become proficient in oral communication about biology in general and their research area in particular.

BIOLOGY MAJOR (99–101 CREDITS)

Required Biology Courses (25 credits)

BIOL 171 Biology I (4)
 BIOL 172 Biology II (4)
 BIOL 173 Biology III (4)
 BIOL 270 Biological Investigation (3)
 BIOL 310 Fundamentals of Genetics (5)
 BIOL 490 Department Senior Capstone (5)

Select one of the following courses (5 credits)

BIOL 301 Microbiology (5)
 BIOL 302 Botany (5)
 BIOL 303 Invertebrate Zoology (5)
 BIOL 304 Vertebrate Zoology (5)

Select one of the following courses (4–5 credits)

BIOL 423 Evolution (5)
 or BIOL 440 Ecology (4)

Select one of the following courses (5 credits)

BIOL 436 Cell Biology (5)
 BIOL 438 Molecular Biology (5)

Required Supporting Courses (20 credits)

CHEM 151 General Chemistry (5)
 CHEM 152 General Chemistry (5)
 CHEM 153 General Chemistry (5)
 MATH 161 Calculus I (5)
 or MATH 380 Elementary Probability and Statistics (5)

Electives (40–41 credits)

Select additional 40–41 credits of upper division courses with advisor's consent. For students entering the university fall Quarter 2007 and beyond, 25 of the 40–41 credits must be biology electives. A complete 15 credit course sequence of lower division physics may be substituted with an advisor's consent.

Required program credits:	39–40 credits
Required supporting courses:	20 credits
Required elective credits taken in the program:	25 credits
Other elective credits:	15–16 credits
Minimum total credits for above major:	99 credits

BIOLOGY MAJOR WITH BIOCHEMISTRY/BIOTECHNOLOGY OPTION (136 CREDITS)

Required Biology Courses (44 credits)

BIOL 171 Biology I (4)
 BIOL 172 Biology II (4)
 BIOL 173 Biology III (4)
 BIOL 270 Biological Investigation (3)
 BIOL 301 Microbiology (5)
 BIOL 310 Fundamentals of Genetics (5)
 BIOL 485 Molecular Biotechnology (5)
 BIOL 486 Molecular Biotechnology (5)
 BIOL 488 Molecular Biotechnology Lab (2)
 BIOL 489 Molecular Biotechnology Lab (2)
 BIOL 490 Department Senior Capstone (5)

Select one of the following courses (5 credits)

BIOL 302 Botany (5)
 BIOL 303 Invertebrate Zoology (5)
 BIOL 304 Vertebrate Zoology (5)

Required supporting courses (85 credits)

CHEM 151 General Chemistry (5)
 CHEM 152 General Chemistry (5)
 CHEM 153 General Chemistry (5)
 CHEM 304 Quantitative Analysis (6)
 CHEM 351 Organic Chemistry (4)
 CHEM 352 Organic Chemistry (4)
 CHEM 372 Organic Chemistry Lab I (3)
 CHEM 420 Instrumental Analysis (5)
 CHEM 421 Physical Chemistry (4)
 CHEM 422 Physical Chemistry (3)
 CHEM 431 Physical Chemistry Lab (1)
 CHEM 432 Physical Chemistry Lab (2)
 CHEM 480 Biochemistry (5)
 CHEM 481 Intermediary Metabolism (5)
 CSCD 110 Introduction to Programming (5)
 MATH 161 Calculus I (5)
 MATH 162 Calculus II (5)
 PHYS 131 Introductory Physics I (4)
 PHYS 132 Introductory Physics II (4)
 PHYS 133 Introductory Physics III (4)
 PHYS 161 Mechanics Laboratory (1)
 PHYS 162 Heat and Optics Laboratory I (1)
 PHYS 163 Instrumentation Lab I (1)

Required program credits	49 credits
Required supporting courses	85 credits
Total credits for above major	136 credits

Note: the above option requires more than 12 quarters to complete at 15–16 credits per quarter.

BIOLOGY MAJOR WITH PRE-MEDICINE/PRE-DENTISTRY OPTION (109–111 CREDITS)

This curriculum is recommended for students planning a career in medicine or dentistry. The schedule of classes is designed to prepare students for the aptitude examination (MCAT, DAT) which is taken during a student's junior or early senior year. Students interested in other health care professions (e.g., physical therapy, physician's assistant) need to see a department advisor to plan a curriculum.

Required Biology Courses (25 credits)

BIOL 171 Biology I (4)
BIOL 172 Biology II (4)
BIOL 173 Biology III (4)
BIOL 270 Biological Investigation (3)
BIOL 310 Fundamentals of Genetics (5)
BIOL 490 Department Senior Capstone (5)

Select one of the following (5 credits)

BIOL 301 Microbiology (5)
BIOL 302 Botany (5)
BIOL 303 Invertebrate (5)
BIOL 304 Vertebrate Zoology (5)

Select one of the following (5 credits)

BIOL 436 Cell Biology (5)
BIOL 438 Molecular Biology (5)

Required supporting courses (61 credits)

BIOL 471 Pre-Med, Dent, Vet and Pharm Preparation (1)
CHEM 151 General Chemistry (5)
CHEM 152 General Chemistry (5)
CHEM 153 General Chemistry (5)
CHEM 351 Organic Chemistry (4)
CHEM 352 Organic Chemistry (4)
CHEM 353 Organic Chemistry (3)
CHEM 372 Organic Chemistry Laboratory I (3)
CHEM 471 Pre-Med, Dent, Vet and Pharm Preparation (1)
CHEM 480 Biochemistry (5)
CHEM 481 Intermediary Metabolism (5)
MATH 161 Calculus I (5)

or MATH 380 Elementary Probability and Statistics (5)

PHYS 131 Introductory Physics I (4)
PHYS 132 Introductory Physics II (4)
PHYS 133 Introductory Physics III (4)
PHYS 161 Mechanics Laboratory (1)
PHYS 162 Heat and Optics Laboratory I (1)
PHYS 163 Instrumentation Laboratory I (1)

Select an additional three electives (13–15 credits)

ENGL 205 Introduction to Technical Communication (5)
BIOL 301 Microbiology (5)
BIOL 304 Vertebrate Zoology (5)
BIOL 332, 333, 334 Human Anatomy and Physiology I, II, III
for Biology Majors (5, 5, 5)
BIOL 411 Field Botany (5)
BIOL 420 Epidemiology (5)
BIOL 421 Medical Bacteriology (5)
BIOL 423 Evolution (5)
BIOL 430 Immunology (5)
BIOL 432 Virology (5)
BIOL 435 Biology of Cancer (5)
BIOL 436 Cell Biology (5)
BIOL 438 Molecular Biology (5)
BIOL 440 Ecology (4)
BIOL 460 Hematology (5)
BIOL 476 Muscle Physiology (5)
BIOL 477 Embryology (5)

Required program credits

35 credits

Required supporting courses

61 credits

Elective credits (with advisor's consent)

13–15 credits

Minimum total credits for above major

109 credits

Note: for GEGRs and other university requirements, see catalog.

MINORS

BIOLOGY MINOR (36–37 CREDITS)

Note: this minor does not meet the endorsement requirement for teachers.

Required Biology Courses

BIOL 171 Biology I (4)
BIOL 172 Biology II (4)
BIOL 173 Biology III (4)
BIOL 270 Biological Investigation (3)
BIOL 301 Microbiology (5)

BIOL 302 Botany (5)
BIOL 303 Invertebrate Zoology (5)
or BIOL 304 Vertebrate Zoology (5)
BIOL 340 Biology and Society (2)

Select one of the following (4–5 credits)

BIOL 423 Evolution (5)
BIOL 440 Ecology (4)

Minimum total credits for above minor

36 credits

HEALTH SCIENCE MINOR (30 CREDITS)

Required Courses

BIOL 232 Human Anatomy and Physiology for Non-Biology Majors (5)
BIOL 233 Human Anatomy and Physiology for Non-Biology Majors (5)
BIOL 234 Human Anatomy and Physiology for Non-Biology Majors (5)
CHEM 161 General Chemistry for the Health Sciences (5)
CHEM 162 Organic Chemistry for the Health Sciences (5)
CHEM 163 Biochemistry Chemistry for the Health Sciences (5)

Total credits for above minor

30 credits

BIOLOGY/SECONDARY MINOR (45 CREDITS)

This minor satisfies the endorsement for grades 5–12.

Required Biology Courses (33 credits)

BIOL 171 Biology I (4)
BIOL 172 Biology II (4)
BIOL 173 Biology III (4)
BIOL 270 Biological Investigation (3)
BIOL 310 Fundamentals of Genetics (5)
BIOL 340 Biology and Society (2)
BIOL 423 Evolution (5)
BIOL 440 Ecology (4)
BIOL 441 Ecology Lab (2)

Select one of the following (5 credits)

BIOL 301 Microbiology (5)
BIOL 302 Botany (5)
BIOL 303 Invertebrate Zoology (5)
BIOL 304 Vertebrate Zoology (5)

Required Supporting Courses (7 credits)

BIOL 390 Biology Teaching Methods (1)
MATH 105 Precalculus I (5)
or MATH 380 Elementary Probability and Statistics (5)
SCED 390 Secondary Science Teaching Methods (1)

Required program credits

38 credits

Required supporting credits

7 credits

Total credits for above minor

45 credits

Course Requirements for Teacher Certification/Add-on Endorsements

(For students who currently possess a Washington State Teaching Certificate)

GENERAL SCIENCE/ADD-ON ENDORSEMENT (65 CREDITS)

To improve their marketability as science teachers, students may wish to complete this option in addition to their BAE in Biology, Chemistry, Earth and Space Science or Physics. This add-on satisfies the General Science endorsement and allows teachers to teach any science grades 5–12.

Required Courses

BIOL 171 Biology I (4)
BIOL 172 Biology II (4)
BIOL 173 Biology III (4)
BIOL 270 Biological Investigation (3)
BIOL 390 Biology Teaching Methods (1)
CHEM 151 General Chemistry (5)
CHEM 152 General Chemistry (5)
CHEM 153 General Chemistry (5)
CHEM 390 Chemistry Methods for the Secondary School (1)
GEOG 314 Weather and Climate (5)
GEOL 120 Physical Geology—The Solid Earth (5)
GEOL 121 Physical Geology—Surficial Processes (5)
GEOG/GEOG 390 Earth Science Teaching Methods (1)
PHYS 121 Descriptive Astronomy (5)
PHYS 131 Introductory Physics I (4)
PHYS 132 Introductory Physics II (4)
PHYS 161 Mechanics Lab (1)
PHYS 162 Heat and Optics Lab (1)
PHYS 390 Physics Teaching Methods (1)
SCED 390 Secondary Science Teaching Methods (1)

Total credits for above add-on endorsement

65 credits

GRADUATE PROGRAM

Rebecca L. Brown: Admissions Coordinator		509.359.2528
Camille F. McNeely: Graduate Service Appointment Coordinator	258 Science Bld.	509.359.7049
A. Ross Black: Candidacy Coordinator		509.359.4815

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 at www.biology.ewu.edu. 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 thesis. 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/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 Studies 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 March 1. 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.

MASTER OF SCIENCE IN BIOLOGY

STUDENT LEARNING OUTCOMES – STUDENTS WILL:

- become proficient in oral communication about biology in general and their research area in particular;
- be informed, critically thinking scientists who can design, execute and communicate original research in the field of biology;
- expand and deepen their knowledge of biology and integrate that knowledge in their specialization.

Graduate Core (16 credits)

BIOL 500 Research Seminar (1, 1)
BIOL 510 Biological Research Methods I (4)
BIOL 511 Biological Research Methods II (4)

Plus any three of the following (6 credits, though additional current topics may be taken for elective credits)

BIOL 512 Current Topics in Physiology (2)
BIOL 513 Current Topics in Cell and Molecular Biology (2)
BIOL 514 Current Topics in Ecology/Evolution (2)
BIOL 515 Growth of Biological Thought (2)

Electives (16 credits)

To be determined in consultation with student's graduate committee. All 400 and 500 level courses may be used as electives; if a course is stacked as a 400- or 500-level course, students must enroll at the 500-level.

Thesis (14 credits)

To be determined in consultation with student's graduate committee. All Master's of Science in Biology students are required to conduct original research toward their Master's thesis.
BIOL 600 Thesis Research (14 credits)

Required core credits	16 credits
Elective credits	16 credits
Thesis credits	14 credits
Minimum total credits for above master's degree	46 credits

Teaching

All Master's of Science students in biology are required to either teach at least one quarter as a paid teaching assignment or arrange a teaching experience in consultation with their graduate committee. Students who do not have a paid teaching assignment may arrange to receive BIOL 595 credit for the development and execution of this teaching experience.

Final Comprehensive Examination

The final comprehensive examination for the Master's of Science in biology consists of a research seminar and an oral defense of the master's thesis presented to the department. Immediately following the student's seminar, an oral examination is administered by the student's committee, which is composed of two or three departmental faculty members and a faculty member appointed by the Graduate Studies Office. The focus of the examination is the student's thesis and general biology knowledge.

Biology Courses

Terms offered: If no terms are indicated check with the department or EagleNET. **Course fees will be required on many biology courses.**

Some of the following courses are stacked as 400 - and 500- level courses. Biology graduate students enrolled in stacked courses must enroll at the graduate (500) level.

BIOL 100 Introduction to Biology (5)
Prerequisite: completion of pre-university basic skills in mathematics requirement. [satisfies the 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, organism and population. A laboratory is included.

BIOL 115 Investigating Biology (5)
Prerequisite: completion of pre-university basic skills in mathematics requirement.

[satisfies the 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 (4)
Prerequisites: completion of pre-university basic skills in mathematics requirement. Note: 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 (4)
Prerequisite: ≥ 1.7 in BIOL 171.

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

BIOL 173 Biology III (4)
Prerequisite: ≥ 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 232, 233, 234 Human Anatomy and Physiology for Non-Biology Majors (5, 5, 5)

[BIOL 232, BIOL 233 each satisfy a GEGR for Natural Science, Biology]

Prerequisites: one course in college chemistry for BIOL 232, BIOL 232 for 233 and BIOL 233 for 234.

A three-quarter sequence concerned with the structure and function of the human organism. Note: BIOL 232, 233, 234 and 335 are designed for students in allied health sciences.

BIOL 270 Biological Investigation (3)
 [the completion of BIOL 171 and 270 satisfies a GEGR for natural sciences, biology; the completion of BIOL 171, 172 and 270 satisfies a second GEGR for natural sciences, biology.]

Prerequisite: ≥ 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 299 Special Studies Biology (1-5)
Prerequisite: 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)
 Examines the development of biological ideas in the Western world from early times to the present.

BIOL 301 Microbiology (5)
Prerequisites: ≥ 1.7 in BIOL 171, ≥ 2.0 in 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)
Prerequisites: ≥ 2.0 in BIOL 172, 173, 270; completion of or concurrent enrollment in CHEM 151. This course examines the structure, function and phylogenetic relationships in the plant kingdom. A laboratory is included.

BIOL 303 Invertebrate Zoology (5)
Prerequisites: ≥ 2.0 in BIOL 172, 173, 270; completion of or concurrent enrollment in CHEM 151. This course examines structure, function and phylogenetic relationships of the invertebrate phyla. A laboratory is included.

BIOL 304 Vertebrate Zoology (5)
Prerequisites: ≥ 2.0 in BIOL 172, 173, 270; completion of or concurrent enrollment in CHEM 151. 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)
Prerequisite: GEOG 100 or permission of the instructor.
 This course is an introduction to the processes and patterns of natural vegetation, emphasizing the Pacific Northwest. (Cross-listed GEOG 306)

BIOL 310 Fundamentals of Genetics (5)
Prerequisites: BIOL 171, 172, 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)
Prerequisite: successful completion of MATH 100 or mathematics clearance by test.
 A general introduction to physical, chemical and biological properties of soils. (Cross-listed GEOG 312)

BIOL 318 Biology of Women (3)
 The history, biology and myths of human reproduction as they apply to women and the interaction of brain, hormones and social life. (Cross-listed WMST 318)

BIOL 320 The Human Prospect (5)
 [satisfies international studies university graduation requirement]
 Explores the biological and philosophical roots of human's relationship with the environment. (Cross-listed HUMN 320)

BIOL 324 Entomology (4)
Prerequisite: ≥ 2.0 in BIOL 172, 173, CHEM 151.
 This course is a study of insect biology. A laboratory is included.

BIOL 332, 333, 334 Human Anatomy and Physiology I, II, III (5, 5, 5) for Biology Majors
Prerequisites: \geq in BIOL 171, 173, 270; CHEM 153; BIOL 304 recommended for 332; BIOL 332 required for BIOL 333; BIOL 333 required for BIOL 334.

This is 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 335 Elementary Medical Microbiology (5)
Prerequisites: 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 338 Discovering Women in Science (1)
 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. (Cross-listed CHEM/GEOG/HIST/PHYS/PSYC/WMST 338)

BIOL 340 Biology and Society (2)
Prerequisite: either BIOL 100 or ≥ 1.7 in 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)
 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 390 Biology Teaching Methods (1)
Prerequisites: ≥ 1.7 in BIOL 171, ≥ 2.0 in 172, 173 and 270; co-requisite 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 in the course.

BIOL 395 Internship/Co-op Fieldwork (1-15)
Prerequisite: permission of the instructor, department chair and college dean; only 5 credits will be allowed toward the electives.

BIOL 405 Limnology (5)
Prerequisites: any one of BIOL 301, 302, 303, 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)
Prerequisite: any one of BIOL 301, 302, 303, 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)
Prerequisites: 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)
Prerequisite: 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)
Prerequisites: BIOL 301, CHEM 351.
 The microbial agents of human disease, with an emphasis on bacteria.

BIOL 423 Evolution (5)
Prerequisites: 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 430 Immunology (5)
Prerequisite: any one of BIOL 301, 303, 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)
Prerequisite: any one of BIOL 301, 303, 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)
Prerequisites: BIOL 173 or 234, CHEM 153 or 163.
 A general study of human neoplasms.

BIOL 436 Cell Biology (5)
Prerequisites: ≥ 1.7 in BIOL 171, ≥ 2.0 in 172, 173, 270, 310 and CHEM 153.

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

BIOL 438 Molecular Biology (5)
Prerequisites: one of BIOL 301, 302, 303 or 304 and BIOL 310.

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

BIOL 440 Ecology (4)
Prerequisites: MATH 161 or 380; any one of BIOL 301, 302, 303, 304 or permission of the instructor.

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

BIOL 441 Ecology Lab (2)
Prerequisite: current or prior enrollment in BIOL 440.
 A field and laboratory course which emphasizes testing ecological hypotheses.

BIOL 442 Conservation Biology (4)
Prerequisites: ≥ 1.7 in BIOL 171, ≥ 2.0 in 172, 173, 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)
Prerequisites: ≥ 1.7 in BIOL 171, ≥ 2.0 in 172, 173 and 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)
Prerequisite: BIOL 423 or 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. May emphasize aquatic ecology, terrestrial ecology or both may be emphasized.

BIOL 445 Stream Ecology (5)
Prerequisite: one of BIOL 301, 302, 303, 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) alt
Prerequisite: ≥ 1.7 in BIOL 171, ≥ 2.0 in 172, 173 and 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 Mammalogy (5) alt
Prerequisite: 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) alt
Prerequisite: BIOL 304 or permission of the instructor.
 Natural history and taxonomy of birds.

BIOL 460 Hematology (5)
Prerequisites: BIOL 310 plus one of BIOL 301, 303 or 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)
Prerequisites: ≥ 2.0 in BIOL 172, 173, 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)
Prerequisites: ≥ 2.0 in BIOL 172, 173, 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)
Prerequisites: ≥ 2.0 in BIOL 172, 173, 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 471 Pre-Med, Dent, Vet and Pharm Preparation (1-2)
Prerequisites: junior standing or permission of the instructor.

Prepares students for their interviews for medical, dental, veterinary or pharmacy school and for professional activities. Discusses medical ethics and presents students with a wide range of dilemmas associated with the medical field and has students work toward resolutions.

BIOL 476 Muscle Physiology (3)
Prerequisite: 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)
Prerequisites: 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)
Prerequisite: admission to Professional Training at Sacred Heart Medical Center.

BIOL 479 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)
Prerequisite: 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 Invertebrate Zoology (5)
Prerequisites: ≥ 2.0 in BIOL 172, 173, 270 are required; BIOL 405 or 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)
Prerequisite: 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)
Prerequisite: 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, 486 Molecular Biotechnology (5, 5)
Prerequisites: BIOL 301, 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, 489 Molecular Biotechnology Laboratory (2, 2)
Prerequisite: BIOL 485 or concurrent enrollment for BIOL 488; BIOL 486 or concurrent enrollment for BIOL 489.

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 Department Senior Capstone: (5) Integrated Studies in Physiology-Microbial or Integrated Studies in Physiology-Plants or Integrated Studies in Physiology-Animals
Prerequisites: senior standing (135 credits) and for Microbial: BIOL 301; Plants: BIOL 172, 173, 270; Animals: BIOL 303 or 304.

[satisfies senior capstone university graduation requirement]
 See your major department advisor for the appropriate section number. A laboratory is included.

BIOL 491 Senior Thesis (20)
Prerequisite: BIOL 483

BIOL 491 is 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 Professional Internship (1-15); only 5 credits will be allowed toward the electives.
Prerequisite: permission of the instructor, department chair and college dean.

BIOL 496 Experimental Courses And Research Courses (1-5)

BIOL 497 Workshops, Short Courses, Conferences (1-5)

BIOL 498 Seminar (1-2)
Prerequisite: advanced standing in departmental program.

BIOL 499 Directed Study (1-5)
Prerequisite: permission of the instructor, department chair and college dean.

BIOL 500 Research Seminar (1)
Prerequisite: admission to graduate program in biology.
 Students develop and present seminars on their research to an audience of peers and faculty. (Must be repeated for at least 2 credits.)

BIOL 501 Seminar Programming (1)
Graded Pass/No Credit.
Prerequisite: 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.
Note: students shall be enrolled in BIOL 501 during all quarters of residency when not enrolled in BIOL 500.

BIOL 505 Limnology (5)
Prerequisite: 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)
Prerequisite: 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)
Prerequisite: 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)
Prerequisite: BIOL 510.
 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)
Prerequisite: 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 microorganisms or functions common to two or more groups of organisms. (*May be repeated for credit.*)

BIOL 513 Current Topics in Cell and Molecular Biology (2)
Prerequisite: 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. (*May be repeated for credit.*)

BIOL 514 Current Topics in Ecology/Evolution (2)
Prerequisite: 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)
Prerequisite: 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)
 Presentations by faculty and graduate students of current biological research papers.

BIOL 520 Epidemiology (5)
Prerequisite: 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)
Prerequisite: admission to graduate program or permission of the instructor.
 The microbial agents, especially bacteria, of human disease, with an emphasis on the study of molecular pathogenesis through independent readings and writings on regulation of the expression of pathogenic properties and an oral presentation of a research paper on a current topic in microbial pathogenesis.

BIOL 530 Immunology (5)
Prerequisite: 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)
Prerequisite: 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)
Prerequisite: 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)
Prerequisite: 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 Topics (1-5)
BIOL 542 Conservation Biology (4) alt
Prerequisite: 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)
Prerequisite: 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)
Prerequisite: 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 Mammalogy (5)
Prerequisite: 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)
Prerequisite: 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)
Prerequisite: 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)
Prerequisite: 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)
Prerequisite: 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 576 Muscle Physiology (3)
Prerequisite: BIOL 233 or 436 or 490.
 The structure, function and regulation of muscle tissue, with an emphasis on skeletal muscle.

BIOL 581 Freshwater Invertebrate Zoology (5)
Prerequisite: 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)
Prerequisite: 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 586 Molecular Biotechnology II (5)
Prerequisite: admission to graduate program or permission of the instructor.
 A thorough overview of principles and practice of recombinant DNA.

BIOL 588/589 Molecular Biotechnology Laboratory (2)
Prerequisite: admission to graduate program or permission of the instructor.
 Advanced quantitative procedures in recombinant DNA and monoclonal antibodies.

BIOL 596 Experimental Course (1-5)
BIOL 597 Workshops (1-5)
Note: only one workshop course for up to 3 credits may be used to fulfill graduate degree requirements.

BIOL 598 Seminar (1-5)
BIOL 599 Independent Study (1-5)
Prerequisites: permission of the instructor, department chair and college dean.

BIOL 600 Thesis Research Project (1-10)
Prerequisites: 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)
Prerequisites: permission of the instructor, department chair and college dean.
 Non-thesis directed research. Not available for Master of Science in Biology.

Secondary Science Teaching Course

Terms offered: If no terms are indicated check with the department or EagleNET.

SCED 390 Secondary Science Teaching Methods (1)
Prerequisite: EDUC 303 or by permission of the instructor.
 This course is designed for biology, chemistry, earth and space science and physics majors and individuals seeking endorsement to teach junior or senior high school. Students will study types of science programs, organization of lesson materials, techniques, laboratory safety and evaluation.