Undergraduate Programs

BS: Biology

All biology majors must complete the following core and cognate courses:

**Biology Core—24**

**Cognate Core—24 or 26**

**General Education Cognates**
- RELT340, PSYC101. Students taking the Honors Core do not need RELT340.

Students must complete the biology core, the cognate core, and the requirements for one of the emphases listed below.

**Botany Emphasis—18**
Upper-division biology courses; must include a botany course (BOT prefix) drawn from each of the environmental, morphological, and functional groups of courses listed below. In addition, one zoological course (ZOO prefix) must be included.

**Zoology Emphasis—18**
Upper-division biology courses; must include a zoology course (ZOO prefix) drawn from each of the environmental, morphological, and functional groups of courses listed below. In addition, one botany course (BOT prefix) must be included.

**Biomedical Emphasis—13-14**
Must include four of the following: ZOOL315, 464, 465, BIOL475; or PHTH 417, 427. BCHM421 must be included in the cognate core.

**Molecular Biology Emphasis—12-13**
Must include BIOL418, 419, 445, 447, and one of the following four courses: BIOL475; BIOL444, 446; ZOOL315; BOT470 or ZOOL464. BCHM421 must be included in the cognate core.

**Neurobiology Emphasis—14**
Upper-division biology courses; must include a zoology course (ZOO prefix) drawn from each of the environmental, morphological, and functional groups of courses listed below. In addition, ZOOL475 and either PSYC364 or 449 must be taken. BCHM442 must be included in the cognate core.

**Special Emphasis—18**
In situations where students are preparing for a specific job opportunity or a graduate or professional program, the special emphasis may be considered if other degree programs are not adequate. The credits must include one biology course each from the functional, morphological, and environmental courses listed below. Additional credits to reach a minimum of 18 are to be selected from courses in biology or other disciplines in consultation with a Biology Department advisor. Departmental approval must be received before the beginning of the spring semester of the student’s junior year.

**Minor in Biology—22**
BIOL165, 166, 449 and one course each from environmental, morphological, and functional biology electives.

**SENIOR THESIS**
A minimum of 3 credits of BIOL495 or HONS497. Biology majors may elect to complete a minimum of 3 credits of original research in a topic of mutual interest with a Biology Department staff member and present this original work in the form of a senior thesis. This research experience may be supported by a research scholarship.
Graduate Programs

The Biology Department offers courses leading to the Master of Science degree and also cooperates with the School of Education in offering courses leading to the Master of Arts in Teaching degree. Students are strongly urged to incorporate into their programs a summer of study at the Rosario Beach Marine Station at Anacortes, Washington. During the 8-week summer session, students may earn 6 to 8 credits.

MS: Biology

In addition to the general requirements for admission to and enrollment in graduate degree programs outlined in this bulletin on pp. 41-50, students must meet the following departmental requirements.

Admission Requirements

- A bachelor's degree with major in biology or an approved, related discipline, including courses in cell/molecular biology, organismal physiology, developmental biology, genetics, and ecology.
- A minimum GPA of 3.00 (B) in the undergraduate major for admission to regular student status.
- Cognate sciences, including full-year courses in general chemistry, organic chemistry, and physics. Mathematics through calculus level is encouraged.

Degree Requirements

- The inclusion of BIOL550 or IDSC526, and BIOL681, 682.
- A written comprehensive examination completed before the third semester in residence.
- A thesis earning 6 credits.
- A final oral examination in defense of the thesis.
- A minimum of 30 credits of approved course work and thesis.

MAT: Biology

Designed to prepare students for teaching biology in secondary schools, this degree is offered through the School of Education. A minor or its equivalent in biology on the undergraduate level is a prerequisite. In consultation with the department chair or the graduate program director, a minimum of 12 (6 credits must be 500-level or above) credits from courses listed below may be applied toward this program.

Required courses are BIOL550 or IDSC526. For further information, see the School of Education section of this bulletin on p. 251.

Courses

See inside front cover for symbol code.

GENERAL

BIOL100 $ (3)

Human Biology

A survey of the structure and function of the human body, for those not requiring the depth offered in BIOL111, 112. Meets the natural science elective course requirement. Two lectures, one lab per week. Does not apply to a major or minor. Spring

BIOL111, 112, 113 $ (4, 3, 1)

Anatomy and Physiology I, II, III

BIOL111 and 112 includes cell biology, functional anatomy and control of each organ system of the human. BIOL111 Weekly: 3 lectures and 1 lab; BIOL112 Weekly: 2 lectures and 1 lab; BIOL113 Weekly: 1 lecture and 1 lab, includes more detailed anatomy. BIOL111 is a prerequisite for BIOL112. BIOL112 or consent of the instructor is the prerequisite for BIOL113. Does not apply to a major or minor. BIOL111: Fall; BIOL112: Spring; BIOL113: Spring.

BIOL208 $ (4)

Principles of Environmental Science

Study of basic ecological principles as applied to human activities. Discussions deal with contemporary environmental issues. Lab includes field trips, guest speakers, and experiments. Meets General Education science requirements for non-science majors and applies toward the environmental science major and certain state educational certification requirements. Weekly: 3 lectures and 1 lab. Fall

BIOL260 $ (4)

General Microbiology

Includes history, morphology, classification, control, growth, transmission, and pathogenicity of selected bacteria, viruses, rickettsia, fungi, and parasites. Covers the nature of host defenses against pathogens, including the acquisition of specific immunity and immune disorders. Weekly: 3 lectures and two 1½ hour labs. Does not apply on major or minor. Fall

BIOL330 $ (3)

History of Earth and Life

Survey of fundamental concepts of geology and paleontology with application to a study of the history of the earth and of life. Consideration is given to interactions of religious, philosophical, and geological ideas, within a biblical world view. Weekly: 2 lectures and 1 lab. Does not apply to a major or minor. Spring

REQUIRED CORE

BIOL165, 166 $ (5, 5 or 4, 4)

Foundations of Biology

Provides a firm foundation for students majoring or minoring in the biological sciences. Weekly: 5 lectures and one 3-hour lab. Ten credits when offered during the academic year; 8 credits when offered at the Marine Biological Station during the summer. BIOL165: Fall; BIOL166: Spring

BIOL348 $ (3)

General Ecology

Ecological principles as applied to individual, population, community, and ecosystem levels of organization. Labs feature the characterization of ecological systems using standard field and lab techniques. Weekly: 2 lectures and 1 lab. Prerequisites: BIOL165, 166 or 208. Fall

BIOL371 $ (3)

Genetics, Cellular and Molecular Biology I

Mechanisms of heredity are considered in light of classical population and molecular genetics. Labs feature experience in Drosophila genetics, chromosome analysis, statistical techniques, and recombinant DNA technology. Prerequisite: BIOL166, and completion of or simultaneous enrollment in CHEM131. Fall

BIOL372 $ (3)

Genetics, Cellular and Molecular Biology II

Information from molecular biology, biochemistry, biophysics, phys-
Elective courses offered at the Marine Biological Station may be included under these electives.

**Group A: Environmental Biology**

**BIOL208 Principles of Environmental Science**  S $ (4)
Study of basic ecological principles as applied to human activities. Discussions deal with contemporary environmental issues. Lab includes field trips, guest speakers, and experiments. Meets General Education science requirements for non-science majors and applies toward the environmental science major and certain state education-certification requirements. Weekly: 3 lectures and 1 lab. *Fall*

**BIOL479 Marine Ecology (offered only at Marine Station)**  g (3.5)
A study of interspecific, intraspecific, and community relationships demonstrated by marine organisms. *Summer*

**BIOL487 Biogeography**  g $ (3)
The distribution of plants and animals in relation to their environment, including consideration of major biogeographic regions of the world and the role of distribution in adaptive change and diversification of life in the past and present. Weekly: 2 lectures and 1 conference period. *Spring* (odd years)

**BOT450 Medical Botany**  g $ (3)
Designed as an interface between botany, medicine, anthropology and pharmacology to define the impact plants have with the remedial, harmful or psychoactive health of humans. Weekly: 3 lectures & 1 lab. Prerequisites: BIOL112. *Spring*

**BOT468 Marine Botany (offered only at Marine Station)**  g (3.5)
A systematic study of marine plants found in Puget Sound, with a survey of marine plants from other areas. *Summer*

**BOT475 Biodiversity of Vascular Plants**  g $ (4)
A taxonomic and morphological study of vascular plants emphasizing the plants found in the Great Lakes area. Field trips. Weekly: 3 lectures and 1 lab. Open to non-science majors. *Fall*

**ZOOL454 Vertebrate Zoology**  S g $ (3-4)
Covers the various specialties of vertebrate biology, including herpetology, ornithology, and mammalogy. Repeatable in different areas. Open to non-science majors. Weekly: 2 lectures and 1 or 2 labs. *Vertebrate Zoology: Mammalogy (Fall, even years)* and *Vertebrate Zoology: Ornithology (Spring, even years)* both qualify as “S” courses for General Education Service Learning.

**ZOOL458 Marine Invertebrates (offered only at Marine Station)**  g (3.5)
Biological invertebrates studied in the marine environment of Puget Sound. A survey of the various phyla is conducted by studying the living animals in the field, and by tide pool observation, dredging, and scuba diving. A project on a specific group or species is required. *Summer*

**ZOOL459 Entomology**  g $ (3-4)
Study of the fundamental aspects of insect biology. Weekly: 2 lectures and 1-2 labs. *As scheduled*

**Group B: Morphological Biology**

**BIOL428 Paleobiology**  g $ (3)
Covers various specialties including History of Life; Vertebrate Paleontology; Paleobiology of Dinosaurs. Origins, history, adaptations, diversity, and paleoecology of ancient organisms as documented by the fossil record. Repeatable in different areas. Weekly: 2 lectures and 1 lab. Prerequisites: BIOL166. *Fall* (odd years)

**BOT430 Plant Anatomy**  g $ (3)
A study of cell and tissue structure and organ development in vascular plants. Weekly: 2 lectures and 1 lab. *As scheduled*

**ZOOL315 Animal Development**  S $ (3)
A study of the cellular and tissue-level events that result in the development of integrated organisms. Vertebrate development is emphasized in the lab using frog and chick models. Weekly: 2 lectures and 1 lab. Prerequisite: BIOL166. *Spring*

**ZOOL316 Human Embryology**  (1)
Acquaints students with the process of human development and embryology. Prerequisite: BIOL166. Prior or concurrent registration with ZOOL315 recommended. Weekly: 1 lecture. *Spring*

**ZOOL465 Histology**  g $ (3)
Microscopic anatomy, cytology, ultrastructure of tissues and organ systems are correlated with function. Emphasis on normal tissues of vertebrates. Weekly: 2 lectures and 1 lab. *Spring*

**Group C: Functional Biology**

**BIOL418 Immunology**  g (2)
Topics include organs and cells of the immune system, antigens,
Immunoglobulins, the MHC, antibody diversity, tolerance and memory, complement, cell-mediated immunity, regulation, hypersensitivity, autoimmune diseases, transplantation, and tumor immunology. Weekly: 2 lectures. Prerequisites: BIOL166. Spring

**BIOL419 Immunology Lab**
A theoretical and practical study of techniques used in modern immunology. Includes immunosorbent methods; isolation and detection of immunoglobulin molecules in immune serum by SDS-PAGE, western blotting, and immunofluorescence antibody (IFA) methods; enzyme-linked immunosorbant assay (ELISA), in vitro phagocytosis. Weekly: 1 lab. Pre- or corequisite: BIOL418. Spring

**BiOL445 Molecular Genetics**
An advanced consideration of the structure, function, and manipulation of nucleic acids and application of molecular information in other disciplines. Weekly: 2 lectures and 1 lab. Prerequisites: BIOL371. Spring

**BOT470 Plant Physiology**
Study of plant functions including water relations, metabolic pathways, growth regulators, and photomorphogenesis. Weekly: 2 lectures and 1 lab. Prerequisites: BIOL166; CHEM131. As scheduled

**ZOOl464 Systems Physiology**
Functional processes used by animals in adjusting to their external environment and controlling their internal environment. Labs involve the firsthand analysis of selected aspects of the major functional systems. Weekly: 3 lectures and 1 lab. Prerequisite: BIOL166, CHEM131. Fall

**ZOOl484 Animal Behavior**
Behavior of animals including considerations of social interactions, learning processes, instinct, motivation, experimental methods, and the analysis of behavior patterns characteristic of various species. Weekly: 2 lectures and 1 lab. Prerequisite: BIOL166. Spring (odd years)

**Group D: Other Electives**

**BIOL444 Electron Microscopy in Biological Investigations**
The theory, functions, and use of the transmission and scanning electron microscopes. Weekly: 1 lecture. Spring (odd years)

**BIOL446 Electron Microscopy Laboratory**
Lab preparation of tissues for transmission and scanning electron microscopy with hands-on experience with the ultramicrotome and both T.E.M. and S.E.M. instruments. Acceptable photographs with interpretations required with lab reports on appropriate research projects. Prerequisite: Prior or concurrent registration in BIOL444. Spring (odd years)

**BIOL447 Tissue Culture**
Study of theory, application, and techniques useful for propagating tissues in the research laboratory. Topics include sterile techniques, nutrition, media preparation, establishment and maintenance of primary and secondary cultures, enumeration, and analysis.

Weekly: 2 lectures and 1 lab. Prerequisite: BIOL166. Pre- or corequisite: CHEM231. Spring (even years)

**BIOL475 Biology of Bacteria**
Study of the properties of bacteria that illustrate their function and relationship to other living systems. Topics include structure and function, classification, and interaction with the environment. Weekly: 2 lectures and 1 lab. Prerequisites: BIOL166. Organic Chemistry background recommended. Fall

**ZOOl425 Parastology**
Emphasis on better known parasites of humans and animals. Attention given to ecological factors concerned with host-parasite contact, pathogenicity and pathology, and treatment and effect on parasitized populations. Weekly: 2 lectures and 1 lab. Prerequisites: BIOL166. Fall

**ZOOl475 Neurobiology**
The neural basis of behavior, with some emphasis on the human nervous system, including cellular and molecular approaches to neuron function, development of neurons and circuits, and neuroendocrine mechanisms. Labs develop skills in electrophysiology and neuroanatomy. Weekly: 2 lectures and 1 lab. Prerequisite: BIOL166. Fall

**RESEARCH AND SPECIALIZED STUDIES**

**BIOL405 Topics in __________**
Investigates various specialties of biology. Repeatable in different areas. Fall, Spring, Summer

**BIOL495 Independent Readings/Research**
Independent readings or research in biology under the direction of the instructor. Consent of instructor required. Fall, Spring, Summer

**GRADUATE**

**BIOL516 Behavior of Marine Organisms**
Study of inter- and intra-specific behavior of marine animals and their behavioral response to the physical environment. Involves lab experience, field observation, and a research project. Instructor’s permission required. Summer

**BIOL550 Issues in Origins and Speciation**
A comparative survey of the assumptions, attitudes, methods, and conclusions of science and religion in the handling of data. Attention is given to current scientific data and their relationship to an understanding of earth history and the present diversity of life. Spring

**BOT515 Plant Cell Biology**
Functional activities of plant tissues provide the basis for this study of the ultrastructure of a variety of plant cell types. Attention is given to the cytoskeleton and other organelles involved in plant cell morphogenesis. Weekly: 2 lectures and 1 lab. Prerequisite: BOT470. As scheduled
CHEMISTRY AND BIOCHEMISTRY

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Faculty
G. William Mutch, Chair
David E. Alonso
Getahun Merga
Desmond H. Murray
D. David Nowack
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Peter A. Wong

Academic Programs

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<td>BS: Biochemistry 34</td>
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Students who plan to major in chemistry or biochemistry are expected to have entrance credit in the preparatory subjects of chemistry and mathematics (including algebra and trigonometry); a background in physics is desirable. Those who do not have entrance credit or equivalent training in these subjects, particularly mathematics, may not fulfill the department graduation requirements in four years.

Students are encouraged to plan early for an on-campus or off-campus research experience required of all students in the Bachelor of Science degree programs in chemistry and strongly recommended for those in the Bachelor of Science degree program in biochemistry. This experience may take the form of a cooperative educational-research experience or research in an academic, industrial, or governmental laboratory setting. Interested students should consult the department chair.

AMERICAN CHEMICAL SOCIETY CERTIFICATION

Students desiring American Chemical Society certification must
• Complete the required courses for the (ACS) Bachelor of Science degree in chemistry as spelled out in this bulletin
• Achieve a minimum GPA of 3.00 in all chemistry courses taken at Andrews University
• Satisfactorily complete a research or cooperative educational experience in chemistry
• Pass at least one advanced course selected from the following: CHEM470, 474 or 475.

A complete statement of certification requirements is available from the department chair.