

professional journals. Corequisite: PSYC434.
Prerequisite: BHSC230 and PSYC432.

SOCI/PSYC434 ? (3)
(merges PSYC354, part of PSYC429)
Research Methods IV: Advanced Statistical Analysis and SPSS

A study on advanced parametric and non-parametric techniques such as two-way ANOVA, regression and power. The utilization of SPSS in the analysis and interpretation of statistical data. An analysis of professional journals and reports with an emphasis on the statistical reasoning. Corequisite: PSYC/SOCI433. Prerequisite: BHSC230 and PSYC/SOCI432.

SOCI440 ? (3)
Sociology of the Family

The family as a social institution, its biological and cultural foundations, and its historic development and changing structure and function. The interaction of marriage and parenthood and some disorganizing factors in contemporary society examined.

SOCI460 ? (3)
Death and Grief in Contemporary Society

The study of cultural and societal perspectives on death and personal and interpersonal dynamics of death and dying.

SOCI470 ? (3)
Demography

Overview of the world's population; spatial dimensions of human populations; fertility concepts, measurements, trends, levels, and explanations; mortality and migration; population structures, life chances; population growth, economic development, and the environment.

SOCI474 ? (3)
Social Thought and Theory

The roots of self-conscious social thought and the rise of sociology and anthropology as scientific disciplines in the 19th century. Major theoretical orientations in their fields, proponents, and impact on present-day sociology and anthropology are reviewed. Normally offered odd years.

SOCI480 (1-8)
Field Experience

Supervised field placement in a human services setting is approved in advance by the department chair. A minimum of 30 hours of fieldwork is required for each credit. Open only to departmental majors. Repeatable 3 times until 9 credits have been accumulated.

SOCI488 V (3)
The City in the Industrialized World

Distance education course. The structure and development of the modern urban community with emphasis on ecological and demographic features of urban life. Normally offered even years.

SOCI495 (1-3)
Independent Study/Readings/Research/Project in Sociology

Individual assignments and/or reports and/or individualized research in sociology are set up on a contract basis with no more than 3 credits per semester. Students may repeat or take any combination of departmental independent study courses for up to 6 credits. Consult staff before registering.

SOCI520 (2)
Concepts of Community Development

A study of the special problems of developing countries from the perspectives of anthropology, demography, geography, political economy and misology. Also includes techniques needed to promote community as well as individual capacity building.

SOCI530 (2)
Community Needs Assessment & Capacity Mapping

Introduction to various methods for assessing community needs and mapping community capacity to address those needs.

SOCI535 (2)
Program Planning, Budgeting & Grantsmanship

Building on assessment and capacity mapping, the related topics of program planning, budgeting and grant-writing are presented. Hands-on experience is sought, linking classroom instruction and real community situations.

SOCI545 (2)
Program Implementation and Evaluation

Strategies for implementation. Review of various methods of evaluation with emphasis on measuring outcomes and assessing quality in community program development.

SOCI580 (1)
Seminar in Community Development Leadership

Topics include philosophical and spiritual foundations, profiles in leadership, strategic planning, grantsmanship, networking and interagency relations, managing volunteers, program evaluation. Offered over 2 semesters.

SOCI698 (1-3)
Project

Open only to students in the MSA in Community Development.

BIOLOGY

Price Hall, Room 216
(616) 471-3243
biology@andrews.edu
http://www.biol.andrews.edu

Faculty
David A. Steen, *Chair*
Gordon J. Atkins
Bill Chobotar
H. Thomas Goodwin
James L. Hayward
Timothy G. Standish
John F. Stout
Dennis W. Woodland
Robert E. Zdor

Academic Programs	Credits
BS: Biology	
Biomedical	41
Botany	45
Molecular Biology	39-40
Neurobiology	41
Special	45
Zoology	45
Minor in Biology	22
MS: Biology	30
MAT in Biology	

Each degree offered by the Biology Department includes a common core curriculum and additional courses tailored to students' special needs.

Highly motivated students may compete for the Biology Undergraduate Research Traineeship (BURT) program. For full details, consult the Biology Department.

Undergraduate Programs

Bachelor of Science

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

Biology Core—24

BIOL165, 166, 348, 371, 372, 449, 451, 452.

Cognate Core—24 or 26

CHEM131, 132, 231, 232, 241, 242;
PHYS141, 142 or 241, 242, 271, 272.

General Education Cognates

RELT340, PSYC101.

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

Botany Emphasis—21

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—21

Upper-division biology courses; must include a zoology course (ZOOL 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—17

Must include ZOOL315, 464, 465, BIOL475; PHTH 417 and 427. BCHM421 must be included in the *cognate core*.

Molecular Biology Emphasis—15-16

Must include BIOL418, 419, 445, 447, and two of the following four courses: BIOL475; BIOL444, 446; ZOOL315; BOT470 or ZOOL464. BCHM421 must be included in the *cognate core*.

Neurobiology Emphasis—17

Upper-division biology courses; must include a zoology course (ZOOL 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—21

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 21 are to be selected from courses in biology or other disciplines in consultation with a Biology Department adviser. 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 study programs a summer of study at the Rosario Beach Marine Station at Anacortez, Washington. During the 8-week

summer session, students may earn 6 to 8 credits.

Master of Science

In addition to the general requirements for admission to and enrollment in graduate degree programs outlined in this bulletin on pp. 33-34, 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.

Master of Arts in Teaching

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. 172.

Courses

(Credits)

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 major or minor.

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 includes more detailed anatomy using human cadavers. One lab per week. 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, how organisms interact with their environment, and the application of ecological principles 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. *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)

(merges BIOL155, 156, 157)

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: BIOL165, and completion of or simultaneous enrollment in CHEM131. *Fall*

BIOL372

\$(3)

Genetics, Cellular and Molecular Biology II

Information from molecular biology, biochemistry, biophysics, physical chemistry, and electron microscopy are integrated to present the cell as a functional unit. Labs provide experience

in the collection and analysis of quantitative data about cells. Prerequisite: BIOL166, and completion of or simultaneous enrollment in CHEM132. *Spring*

BIOL449 (3)
Historical and Philosophical Biology
Examination of biological, paleontological, and geological concepts central to the study of historical events in biological systems. Considers the interactions of data, theories, and extra scientific concepts in historical biology, within the particular context of a biblical world view. Weekly: 2 lectures and 1 lab. Prerequisite: BIOL166. *Spring*

BIOL451, 452 (1,1)
(merges BIOL461, 462, 463)
Questions in Biology: Analysis, Evaluation and Answers
Lectures, discussions, and individual work centered around asking and answering important questions in the life sciences: research in biology, discussions on important issues in origins; discussions on major topics in bioethics. Attendance at monthly research seminars required. Open to senior Biology majors. BIOL451: *Fall*; BIOL452: *Spring*

ELECTIVES

(Elective courses offered at the Marine Biological Station may be included under these electives.)

Group A: Environmental Biology

BIOL479 ? (3,5)
Marine Ecology
(offered only at Marine Station)
A study of interspecific, intraspecific, and community relationships demonstrated by marine organisms. *Summer*

BIOL487 \$? (4)
Biogeography
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: 3 lectures and 1 conference period. *Spring*

BOT450 \$? (4)
Medical Botany
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 ? (3,5)
Marine Botany
(offered only at Marine Station)
A systematic study of marine plants found in Puget Sound, with a survey of marine plants from other areas. *Summer*

BOT475 \$ Alt ? (4)
(merges BOT435, 474)
Biodiversity of Vascular Plants
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 \$? (3-4)
Vertebrate Zoology
Covers the various specialties of vertebrate biology, including herpetology, ornithology, and mammalogy. Repeatable in the different specialized areas. Open to non-science majors. Weekly: 2 lectures and 1 or 2 labs. *Vertebrate Zoology: Mammalogy* and *ZOOL454 Vertebrate Zoology: Ornithology* both qualify as "S" courses for General Education Service Learning. *Fall* or *Spring*

ZOOL458 ? (3,5)
Marine Invertebrates
(offered only at Marine Station)
Biology of 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 \$? (3-4)
Entomology
Study of the fundamental aspects of insect biology. Weekly: 2 lectures and 1-2 labs. *As scheduled*

Group B: Morphological Biology

BIOL428 \$? (3)
Paleobiology: History of Life
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*

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

ZOOL315 \$ (3)
Animal Development
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 \$ (1)
Human Embryology
Acquaints students with the process of human development and embryology. Prerequisite: BIOL166. Prior or concurrent registration with ZOOL315 recommended. Weekly: 1 lecture. *Spring*

ZOOL465 \$? (3)
Histology
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 ? (2)
Immunology
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 \$? (1)
Immunology Lab
A theoretical and practical study of techniques used in modern immunology. Includes immunoserological methods; isolation and detection of immunoglobulin molecules in immune serum by SDS-PAGE, western blotting, and immunofluorescence antibody (IFA) methods; enzyme-linked immunosorbent assay (ELISA), in vitro phagocytosis. Weekly: 1 lab. Pre- or corequisite: BIOL418. *Spring*

BIOL445 \$? (3)
Molecular Genetics
An advanced consideration of the structure, function, alteration, and manipulation of nucleic acids. Weekly: 2 lectures and 1 lab. Prerequisites: BIOL371. *Spring*

BOT470 \$ Alt ? (3)
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 \$? (3)
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 \$ Alt ? (3)
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. *As scheduled*

Group D: Other Electives

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

BIOL446 \$? (2)
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*

BIOL447 \$? (3)
Tissue Culture
Study of theory, application, and techniques useful for

propagating tissues in the research lab. 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*

BIOL475 \$? (3)**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 two 2-hour labs. Prerequisites: BIOL166. Organic Chemistry background recommended. *Fall*

ZOOL425 \$? (3)**Parasitology**

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 \$? (3)**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 (1-4)**Topics in _____**

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

BIOL495 (1-4)**Independent Readings/Research**

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

GRADUATE

BIOL516 (4)**Behavior of Marine Organisms****(offered only at Marine Station)**

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 (3)**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 \$ Alt (3)**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. *Spring*

BOT525 \$ Alt (3)**Molecular Laboratory Techniques**

Acquaints students with modern lab techniques of molecular biology. The manipulation and study of nucleic acids and proteins using model systems involving plant-microbe interactions. *Fall*

BOT530 \$ Alt (3)**Advanced Systematic Botany**

Literature and philosophy of plant classification, processes of speciation in higher plants, sources and interpretation of data, biosystematic methods, and plant nomenclature. Weekly: 2 lectures and 1 lab. Prerequisite: BOT475. *Spring*

ZOOL500 \$ Alt (3)**Protozoology**

Protozoa, including morphology, physiology, systematics, ecology, reproduction, and host-parasite relationships; emphasis on the parasitic protozoa, but free-living forms also considered; current problems encountered in protozoan research and methods of studying protozoa. Weekly: 2 lectures and 1 lab. Prerequisite: ZOOL425. *Fall*

ZOOL520 Alt (2)**Molecular and Developmental Neurobiology**

A seminar course that deals in depth with current and relevant issues in the areas of molecular and developmental neurobiology. Offered alternate years. *Spring*

ZOOL565 \$ Alt (3)**Environmental Physiology**

Study of the physiological responses of animals to their environments. Topics include environmental periodicities and biological clocks, thermal budgets, water balances, and adaptations to extreme environments. Weekly: 2 lectures and 1 lab/problem session. *As scheduled*

BIOL590 (1-4)**Topics in _____**

Investigates various specialties of biology. Repeatable in different areas. *As scheduled*

BIOL648 (1-4)**Workshop****BIOL681, 682** (1, 1)**(merges BIOL691, 692, 693)****Research Methods and Biology Seminar**

Use of biological literature and methods in current research. Reports are made by each student to the group on topics from current literature and on specific problems in biology. Participation once per week for 2 semesters is required. BIOL681: *Fall*; BIOL682: *Spring*

BIOL697 (1-4)**Research in Biology**

Repeatable to 4 credits. *Arranged*

BIOL699 (3)**Master's Thesis**

Repeatable to 6 credits. *Arranged*

CHEMISTRY AND BIO-CHEMISTRY

Halenz Hall, Room 225
(616) 471-3247 or 471-3248
chemistry@andrews.edu
<http://www.andrews.edu/CHEM/>

Faculty

G. William Mutch, *Chair*
David E. Alonso
Desmond H. Murray
D. David Nowack
Steven E. Warren
Robert A. Wilkins
Peter A. Wong

Academic Programs	Credits
BS: Chemistry	38
BS: Chemistry (Approved by the American Chemical Society (ACS) Committee on Professional Training)	44
BS: Biochemistry	34
Minor in Chemistry	20

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 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 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, and 475.

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