

BIOLOGICAL SCIENCES

The programs in Biology (<https://www.bethel.edu/undergrad/academics/biology/>) provide a broad background in the biological sciences with opportunity for greater depth of study and experience in selected areas. The upper level curriculum is organized into environmental, organismic, and cell-molecular areas of study, while the 100-level courses are integrated across these three sub-disciplines. Lectures and laboratories are designed to coordinate closely in content and provide meaningful laboratory experiences, especially in experimentation.

Students are prepared for a variety of graduate or career opportunities. Upon graduation, students majoring in biology typically attend graduate, medical, or dental schools, pursue careers in medical technology, or allied health areas, do laboratory research, or engage in environmental science careers in government and private industry.

Advanced Placement: The biological sciences programs require a score of 4 or better on the AP exam in order for the exam to be used to fulfill course requirements in the majors. Students with a score of 3 will receive elective credit or receive credit toward General Education requirements. Students should consult the program personnel with questions on AP exams and requirements for majors.

Majors in Biological Sciences

- B.A. in Biology (<http://catalog.bethel.edu/arts-sciences/academic-programs-departments/biological-sciences/biology-ba/>)
- B.S. in Biochemistry/Molecular Biology (<http://catalog.bethel.edu/arts-sciences/academic-programs-departments/biochemistry-molecular-biology/>)
- B.S. in Biology (<http://catalog.bethel.edu/arts-sciences/academic-programs-departments/biological-sciences/biology-bs/>)
- B.S. in Environmental Science (<http://catalog.bethel.edu/arts-sciences/academic-programs-departments/environmental-studies/>)
- B.S. in Neuroscience (<http://catalog.bethel.edu/arts-sciences/academic-programs-departments/multidisciplinary/bs-neuroscience/>)

Minor in Biological Sciences

- Biology (<http://catalog.bethel.edu/arts-sciences/academic-programs-departments/biological-sciences/biology-minor/>)

BIO 100 • Principles of Biology 3 Credits

Basic principles of modern biology. Topics include the scientific method, biology of the cell, genetic principles, anatomy and physiology of humans, plant biology, and environmental biology.

Corequisites: Concurrent registration in BIO 100D is required. *Offered:* Occasionally.

BIO 100D • Principles of Biology Lab 1 Credit

Laboratory experience accompanying BIO 100.

Corequisites: Concurrent registration in BIO 100 is required. *Offered:* Occasionally.

BIO 104 • Human Biology 3 Credits

Study of the biological aspects of the human species. Includes basic molecules of life, human cell biology, tissue types, anatomy and physiology of the 10 systems, human embryology and development, human genetics, nutrition, disease, and health.

Corequisites: Concurrent registration in BIO 104D is required. *Offered:* Fall, Spring.

BIO 104D • Human Biology Lab 1 Credit

Laboratory experience accompanying BIO 104.

Corequisites: Concurrent registration in BIO 104 is required. *Offered:* Fall, Spring.

BIO 105 • Medical Terminology 2 Credits

Study of medical terms. Students study material independently and take proctored examination to demonstrate knowledge of medical language.

Prerequisites: Consent of instructor. Offered: Fall, Spring.

BIO 114D • Introduction to Biodiversity, Ecology, and Adaptation 4 Credits

An introduction to the diversity, interrelationships, and origins of living organisms. Focuses on three themes: an overview of the kinds and diversity of organisms found in six kingdoms, the interaction of organisms with each other and their environment, and the change of organisms through time.

Offered: Occasionally.

BIO 120 • Introduction to Molecular and Cellular Biology 3 Credits

An introduction to cellular and subcellular aspects of living organisms. Includes a study of basic chemistry, biological molecules, cells, enzymes, metabolism, classical genetics, and molecular genetics.

Corequisites: Concurrent registration in BIO 120D is required. Offered: Fall, Spring. Special Notes: This course is intended for nursing and other science related majors.

BIO 120D • Introduction to Molecular and Cellular Biology Lab 1 Credit

Laboratory experience accompanying BIO 120.

Corequisites: Concurrent registration in BIO 120 is required. Offered: Fall, Spring.

BIO 122 • Introduction to Organismic Biology 3 Credits

An introduction to how living things work. Focuses on two main themes: the correlation between structure and function, and the capacity of organisms to adjust their internal environment in response to short and long-term fluctuations in the external environment.

Corequisites: Concurrent registration in BIO 122D is required. Offered: Fall, Spring.

BIO 122D • Introduction to Organismic Biology Lab 1 Credit

Laboratory experience accompanying BIO 122.

Corequisites: Concurrent registration in BIO 122 is required. Offered: Fall, Spring.

BIO 124 • Integrative Biology: Genes, Cells, Change 3 Credits

In a complex world, understanding challenges like infectious disease or environmental change requires a fundamental knowledge of biology. Using relevant examples, students explore molecules, DNA, biotechnology, evolution, populations, ecosystems, disease, and human systems (e.g. digestive, immune) to gain a perspective on global health and personal responsibility to life.

Prerequisites: Major in biology, environmental science, biochemistry/molecular biology, neuroscience, OR a Minor in biology. Corequisites: Concurrent registration in BIO 124D is required. Offered: Fall, Spring.

BIO 124D • Integrative Biology: Genes, Cells, Change Lab 1 Credit

Laboratory experience accompanying BIO 124.

Corequisites: Concurrent registration in BIO 124. Offered: Fall, Spring.

BIO 128 • Integrative Biology: Metabolism, Energy, Biodiversity 3 Credits

Living organisms face challenges requiring them to either adapt, move, acclimate, or perish.

Through real-world examples, students will gain a fundamental understanding of homeostasis, enzymes, metabolism, energy flow, movement, human systems (e.g., circulatory, nervous, excretory), photosynthesis, cellular respiration, extinction, biodiversity, transformation of matter, and acclimation.

Prerequisites: Major in biology, environmental science, biochemistry/molecular biology, neuroscience, OR a Minor in biology. Corequisites: Concurrent registration in BIO 128D is required. Offered: Fall, Spring.

BIO 128D • Integrative Biology: Metabolism, Energy, Biodiversity Lab 1 Credit

Laboratory experience accompanying BIO 128.

Corequisites: Concurrent registration in BIO 128. Offered: Fall, Spring.

BIO 132 • The Science of Birds 3 Credits

An overview of the Minnesota avifauna and bird biology. Bird identification is discussed and practiced in the field. Selected topics from bird biology (e.g., migration, flight, reproduction, behavior, food, and conservation) are presented through lectures, numerous slide shows, and videos. Topics provide an introduction to the prevailing themes in modern biology.

Corequisites: Concurrent registration in BIO 132D is required. Offered: Occasionally spring.

BIO 132D • The Science of Birds Lab 1 Credit

Laboratory experience accompanying BIO 132.

Corequisites: Concurrent registration in BIO 132 is required. Offered: Occasionally spring.

BIO 214 • Human Anatomy 3 Credits

Detailed study of the anatomy and histology of the human body in relation to its functional systems. Laboratory includes human cadaver prosections.

Prerequisites: One of the following: BIO 104/BIO 104D, BIO 120/BIO 120D, BIO 122/BIO 122D, BIO 124/BIO 124D, BIO 128/BIO 128D. Corequisites: Concurrent registration in BIO 215 is required. Special Notes: Not open to students who have taken BIO 238/BIO 239 except by department consent. Offered: Fall, Spring.

BIO 215 • Human Anatomy Lab 1 Credit

Laboratory experience accompanying BIO 214.

Corequisites: Concurrent registration in BIO 214 is required. Offered: Fall, Spring.

BIO 216 • Human Physiology 3 Credits

Integration of basic principles of cell biology and mechanisms of physiology to the functions of the major organ systems of the human body; centered around the theme of homeostasis.

Prerequisites: BIO 214/BIO 215 and one of the following: BIO 104/BIO 104D, BIO 120/BIO 120D, BIO 218.

Corequisites: Concurrent registration in BIO 217 is required. Special Notes: Not open to students who have taken BIO 238/BIO 239 except by department consent. (A course in chemistry is a recommended prerequisite.) Offered: Fall, Spring.

BIO 217 • Human Physiology Lab 1 Credit

Laboratory experience accompanying BIO 216.

Corequisites: Concurrent registration in BIO 216 is required. Offered: Fall, Spring.

BIO 218 • Biology in a Changing World 3 Credits

Through the exploration of interactions between genes and their environments, students articulate integrative topics (e.g., evolution, transformation of matter and energy, information flow, systems and structure/function), identify career options and desired skill sets, make a growth plan and articulate an intellectual autobiography, including faith integration.

Prerequisites: BIO 124/BIO 124D and BIO 128/BIO 128D. Offered: Fall, Spring.

BIO 234 • Microbiology 3 Credits

Microorganisms and viruses with respect to their structure, physiology, genetics, identification, control, host-microbe relationships, and exploitation by humans. Topics include pathogenic organisms, the infectious diseases they cause, and the events and products of vertebrate immune responses.

Prerequisites: BIO 218 (may be taken concurrently) or BIO 120/BIO 120D and One course in chemistry (A second course in chemistry is recommended). Corequisites: Concurrent registration in BIO 235 is required. Offered: Fall, Spring.

BIO 235 • Microbiology Lab 1 Credit

Laboratory experience accompanying BIO 234.

Corequisites: Concurrent registration in BIO 234 is required. Offered: Fall, Spring.

BIO 238 • Human Anatomy and Physiology 3 Credits

Anatomy and physiology of the human body, with a major emphasis on the principle of homeostasis.

Prerequisites: One of the following: BIO 104/BIO 104D, BIO 120/BIO 120D, BIO 122/BIO 122D, BIO 218, (may be taken concurrently). Corequisites: Concurrent registration in BIO 239 is required. Special Notes: A course in chemistry is a recommended prerequisite. Not open to students who have taken BIO 214/BIO 215 or BIO 216/BIO 217. Offered: Spring.

BIO 239 • Human Anatomy and Physiology Lab 1 Credit

Laboratory experience accompanying BIO 238.

Corequisites: Concurrent registration in BIO 238 is required. Offered: Spring.

BIO 316 • Wildlife Ecology and Management 3 Credits

Analysis of terrestrial vertebrate populations, communities, and habitats. Exploration of how these analyses are applied to the manipulation, exploitation, protection, and restoration of animal populations and communities.

Prerequisites: BIO 218 (may be taken concurrently) and Junior or senior standing. Corequisites: Concurrent registration in BIO 317 is required. Special Notes: Carries cross-credit in environmental science. Offered: Spring, even # years.

BIO 317 • Wildlife Ecology and Management Lab 1 Credit

Laboratory experience accompanying BIO 316. Includes some outdoor and off-campus investigations.

Corequisites: Concurrent registration in BIO 316 is required. Offered: Spring, even # years.

BIO 318KZ • Ecology in the Tropics: Natural History and Future Prospects 4 Credits

Travel in Ecuador or Kenya surveying the land, climate, plants, animals, homes, transportation, and industries, noting especially the impact of human presence. Ecuador includes the Amazon rainforest, Andean cloud forests, volcanic mountains, highlands, towns, cities, and the Galapagos Islands. Kenya includes Nairobi, African savanna, the Rift Valley, and Masai Mara.

Prerequisites: Laboratory Science (D) course and Mathematics (M) course. Offered: January. Special Notes: Carries cross-credit in environmental science and general studies.

BIO 326 • Vertebrate Histology 3 Credits

Microscopic structure of cells, tissues, and organs in vertebrate animals with special emphasis on the way structural units are integrated. At all times efforts are made to correlate structure with specific physiological functions.

Prerequisites: BIO 214/BIO 215 or BIO 218. Corequisites: Concurrent registration in BIO 327 is required. Offered: Occasionally.

BIO 327 • Vertebrate Histology Lab 1 Credit

Laboratory experience accompanying BIO 326.

Corequisites: Concurrent registration in BIO 326 is required. Offered: Occasionally.

BIO 328 • Invertebrate Biology 3 Credits

A survey of invertebrate groups from protozoa to prochordates with emphasis on organizational, functional, and ecological significance. Special attention is given to the morphology, life histories, and physiology of invertebrates within the context of survival in specialized environments.

Prerequisites: BIO 218 (may be taken concurrently). Corequisites: Concurrent registration in BIO 329 is required. Offered: Spring, odd # years.

BIO 329 • Invertebrate Biology Lab 1 Credit

Laboratory experience accompanying BIO 328.

Corequisites: Concurrent registration in BIO 328 is required. Offered: Spring, odd # years.

BIO 330 • Ecology 3 Credits

Structure and function of wild nature. Topics include interrelationships of organisms with their environments, factors that regulate such interrelationships, and various roles that humans play in modifying patterns and processes of nature at organism, community, and ecosystem levels.

Prerequisites: BIO 218 (may be taken concurrently). Corequisites: Concurrent registration in BIO 331 is required. Special Notes: This is a designated research course. This course carries cross credit in environmental science. Offered: Fall, odd # years.

BIO 331 • Ecology Lab 1 Credit

Laboratory experience accompanying BIO 330.

Corequisites: Concurrent registration in BIO 330 is required. Offered: Fall, odd # years.

BIO 332 • Genetics 3 Credits

Principles that control inheritance, with examples chosen from plant and animal research, population genetics, cytogenetics, molecular genetics, and current work on human genetics.

Prerequisites: BIO 218 (may be taken concurrently) or BIO 120/BIO 120D and Two courses in chemistry.

Corequisites: Concurrent registration in BIO 333 is required. Offered: Fall.

BIO 333 • Genetics Lab 1 Credit

Laboratory experience accompanying BIO 332.

Corequisites: Concurrent registration in BIO 332 is required. Offered: Fall.

BIO 338 • Endocrinology 3 Credits

Processes by which hormones exert control over many aspects of reproduction, development, growth, metabolism, and behavior. Topics include the chemical nature of hormones, receptors and signaling pathways, morphology and histology of endocrine organs, regulation of hormone synthesis and secretion, and mechanism of action in target tissues.

Prerequisites: BIO 218 (may be taken concurrently) or NSC 130/NSC 130D or BIO 120/BIO 120D and BIO 122/

BIO 122D. *Corequisites:* Concurrent registration in BIO 339 is required. Offered: Fall, even # years. *Special*

Notes: A course in physiology is a recommended prerequisite.

BIO 339 • Endocrinology Lab 1 Credit

Laboratory experience accompanying BIO 338. Work is largely experimental, using bioassay procedures.

Corequisites: Concurrent registration in BIO 338 is required. Offered: Fall, even # years.

BIO 342 • Aquatic Biology 3 Credits

Biological and physical aspects of natural, freshwater ecosystems, including fish and other aquatic animals, aquatic plants, algae, and their interrelationships with each other and the unique aqueous environment in which they live.

Prerequisites: BIO 218 (may be taken concurrently). *Corequisites:* Concurrent registration in BIO 343 is required. Offered: Fall, even # years.

BIO 343 • Aquatic Biology Lab 1 Credit

Laboratory experience accompanying BIO 342. Includes some outdoor and off-campus investigations.

Corequisites: Concurrent registration in BIO 342 is required. Offered: Fall, even # years.

BIO 346 • Animal Behavior 3 Credits

Behavior from primitive invertebrates to advanced mammals, highlighting trends in behavior systems. Natural setting studies in the ethology tradition, comparative psychology studies, and biosociological principles with their implications for human social systems.

Prerequisites: PSY 100 or BIO 218 (may be taken concurrently); Junior or senior standing. *Corequisites:*

Concurrent registration in BIO 347 is required. *Special Notes:* Carries cross-credit in psychology. Offered: Fall, even # years.

BIO 347 • Animal Behavior Lab 1 Credit

Laboratory experience accompanying BIO 346.

Corequisites: Concurrent registration in BIO 346 is required. Offered: Fall, even # years.

BIO 350 • Clinical Pathophysiology 3 Credits

An exploration of disease processes exploring the functional and structural changes that accompany a particular injury, disease, or syndrome, as well as the differences in physiologic response to health and illness in diverse populations across the lifespan from a healthcare perspective.

Prerequisites: Acceptance into the nursing program or Consent of instructor. *Corequisites:* Concurrent registration in NUR 202. Offered: Spring.

BIO 354 • Cell Biology 3 Credits

The molecular organization and function of cells and their organelles. Exploration of how cell biology information is obtained experimentally.

Prerequisites: CHE 224/CHE 225; BIO 218 (may be taken concurrently) or BIO 332/BIO 333 or both PSY 100 and NSC 130/NSC 130D. *Corequisites:* Concurrent registration in BIO 355 is required. *Special Notes:* This is a designated research course. Offered: Spring.

BIO 355 • Cell Biology Lab 1 Credit

Laboratory experience accompanying BIO 354.

Corequisites: Concurrent registration in BIO 354 is required. Offered: Spring. Special Notes: This is a designated research course.

BIO 358 • Neurobiology 3 Credits

Nervous system of animals and humans from the sub cellular to organismic and behavioral levels. Includes significant attention to the senses as well as mechanisms of neuronal communication, plasticity, and memory.

Prerequisites: BIO 218 (may be taken concurrently) or PSY 100 and NSC 130/NSC 130D; Junior or senior standing. Corequisites: Concurrent registration in BIO 359 is required. Offered: Fall. Special Notes: Carries cross-credit in neuroscience.

BIO 359 • Neurobiology Lab 1 Credit

Laboratory experience accompanying BIO 358.

Corequisites: Concurrent registration in BIO 358 is required. Offered: Fall. Special Notes: Carries cross-credit in neuroscience.

BIO 362 • Developmental Biology 3 Credits

Developmental biology asks "How does a single fertilized egg give rise to all the different cell, tissue, and organ types of the adult organism?" Developmental processes resulting in different cell, organ, and tissue types and the mechanisms underlying those processes studied at the cellular, genetic, molecular, and biochemical levels.

Prerequisites: BIO 120/BIO 120D or BIO 124/BIO 124D; BIO 218 (may be taken concurrently) or 8 credits of BIO courses not including BIO 124/BIO 124D and BIO 128/BIO 128D; Two courses in chemistry. Corequisites: Concurrent registration in BIO 363 is required. Special Notes: This is a designated research course. Offered: Spring, even # years.

BIO 363 • Developmental Biology Lab 1 Credit

Laboratory experience accompanying BIO 362. Includes surgical manipulation of living organisms to elucidate developmental principles.

Corequisites: Concurrent registration in BIO 362 is required. Offered: Spring, even # years. Special Notes: This is a designated research course.

BIO 368 • Structure and Development of Vertebrates 3 Credits

An integrated and systematic approach to descriptive embryology and comparative anatomy of vertebrate species.

Prerequisites: BIO 218 (may be taken concurrently). Corequisites: Concurrent registration in BIO 369 is required. Offered: Fall, odd # years.

BIO 369 • Structure and Development of Vertebrates Lab 1 Credit

Laboratory experience accompanying BIO 368.

Corequisites: Concurrent registration in BIO 368 is required. Offered: Fall, odd # years.

BIO 372 • Plant Taxonomy and Ecology 3 Credits

Identification and distribution of flowering plants, including field work, keying, and laboratory preservation. Biogeography and factors important in plant distribution.

Prerequisites: BIO 218 (may be taken concurrently). Corequisites: Concurrent registration in BIO 373 is required. Offered: Fall, odd # years.

BIO 373 • Plant Taxonomy and Ecology Lab 1 Credit

Laboratory experience accompanying BIO 372. Course includes outdoor and off-campus activities.

Corequisites: Concurrent registration in BIO 372 is required. Offered: Fall, odd # years.

BIO 376 • Animal Physiology 3 Credits

Comparative physiology of animal nerves, muscles, hormones, circulation, respiration, excretion, digestion, and the way those systems function intact with processes of feeding, energetics, osmoregulation, metabolism, locomotion, biomechanics, and temperature regulation necessary for an organism's survival.

Prerequisites: Two courses in chemistry and BIO 218 (may be taken concurrently) or both PSY 100 and NSC 130/NSC 130D. *Corequisites:* Concurrent registration in BIO 377 is required. *Offered:* Spring, even # years.

BIO 377 • Animal Physiology Lab 1 Credit

Laboratory experience accompanying BIO 376.

Corequisites: Concurrent registration in BIO 376 is required. *Offered:* Spring, even # years.

BIO 380 • Environmental Plant Biology 3 Credits

Explores the significant roles plants play in the environment: driving and responding to carbon, water availability, nutrient levels, and light. The influence of abiotic factors on photosynthetic pathways, productivity, and the movement of matter and energy reveal how plants respond to rapid environmental changes. Includes work with data and statistics.

Prerequisites: BIO 218 (may be taken concurrently) and One semester of chemistry. *Corequisites:* Concurrent registration in BIO 383 is required. *Special Notes:* This is a designated research course. *Offered:* Spring, odd # years.

BIO 383 • Environmental Plant Biology Lab 1 Credit

Laboratory experience accompanying BIO 380. Includes some outdoor and off-campus investigations.

Corequisites: Concurrent registration in BIO 380 is required. *Offered:* Spring, odd # years. *Special Notes:* This is a designated research course.

BIO 384 • Immunology 3 Credits

Study of the molecular and cellular mechanisms that allow organisms to recognize, control, and eliminate "nonself" entities such as bacterial pathogens, foreign tissue grafts, and even transformed (cancerous) cells.

Prerequisites: Two semesters of chemistry and either BIO 218 (may be taken concurrently) or BIO 120/BIO 120D and BIO 122/BIO 122D. (One of the following: BIO 234/BIO 235, BIO 332/BIO 333, BIO 354/BIO 355 is strongly recommended). *Corequisites:* Concurrent registration in BIO 387 is required. *Special Notes:* This is a designated research course. *Offered:* Fall, odd # years.

BIO 387 • Immunology Lab 1 Credit

Laboratory experience accompanying BIO 384.

Corequisites: Concurrent registration in BIO 384 is required. *Offered:* Fall, odd # years. *Special Notes:* This is a designated research course.

BIO 396 • Molecular Biology 3 Credits

Modern advanced molecular genetic research. Topics include regulation of gene expression during development, molecular biology of cancer, animal virology, eukaryotic gene organization, and methods in gene manipulation.

Prerequisites: BIO 332/BIO 333; One additional biology course; CHE 224/CHE 225; CHE 226/CHE 227.

Corequisites: Concurrent registration in BIO 397 is required. *Special Notes:* This is a designated research course. *Offered:* Spring.

BIO 397 • Molecular Biology Lab 1 Credit

Laboratory experience accompanying BIO 396. Consists of research projects utilizing recombinant DNA/genetic engineering techniques.

Corequisites: Concurrent registration in BIO 396 is required. *Offered:* Spring. *Special Notes:* This is a designated research course.

BIO 399 • Introduction to Research 1 Credit

An introduction to research methodology in the biological sciences, with experience in the use of biological literature and an examination of how to distinguish and evaluate different types of scientific writing and presentations. Experience in the development of a research proposal.

Prerequisites: BIO 218 and major in biology or biochemistry/molecular biology; Junior standing. *Special Notes:* Carries cross-credit in environmental studies. *Offered:* Fall, Spring.

BIO 409 • Advanced Human Gross Anatomy 4 Credits

For the undergraduate pre-health professions student. A regional approach to the study of anatomy through the supervised and directed student dissection of human cadavers. Identification of detailed structures and understanding of their significance to the body.

Prerequisites: BIO 214/BIO 215 or Consent of instructor. Offered: January.

BIO 481 • Internship in Biology 3-4 Credits

A learning/practicing experience in which the student applies biological understanding and skills in an off-campus professional setting.

Prerequisites: Major or minor in biology and Junior or senior standing. Offered: Fall, Spring.

BIO 495 • Biology Seminar 2 Credits

Readings and discussions of topics that relate biology to one's Christian faith.

Prerequisites: BIO 399; Senior standing. Offered: Fall, Spring.

BIO 496 • Biology Research 1 Credit

Students collect original data through independent laboratory research or field research under the supervision of a faculty member.

Prerequisites: BIO 399; Completion or co-completion of a tagged research course; Consent of instructor.

Special Notes: May be repeated once for credit. This course carries cross credit with environmental science.

Offered: Fall, Spring.

BIO 497 • Advanced Biology Research 1 Credit

Working under the supervision of a faculty mentor, students analyze the results of their original research completed in BIO 496 and write up their findings in a formal scientific paper. Results are presented in class and sometimes outside venues.

Prerequisites: BIO 496 and Consent of instructor. Offered: Fall, Spring.

BIO 499 • Biology Symposium 0 Credit

The presentation of scientific research and literature. Culminates in a departmental symposium in which students present their original research or literature review.

Prerequisites: BIO 497 or BIO 481 and Consent of instructor. Special Notes: Carries cross-credit in environmental studies. Offered: Fall, Spring. Special Notes: This course is graded on an S/U basis.