

BIOA – BIOLOGY AT AU SABLE*Department of Biology (CAS)*

BIOL A 302 Limnology Water Resources Lake Ecology and Management (2-6-4), summer, on demand. Field study of lakes and other freshwater systems with applications to planning and management. Includes an introduction to limnology and investigation of representative lakes, streams, and wetlands of the region and compares the North American Great Lakes with the other great lakes of the world and their stewardship. ~~Field study of lakes and streams with applications to planning management. Includes an introduction to limnology and investigation of representative lakes and streams of the region.~~ Laboratory graded and credited with the course. Prerequisites: BIOL 221/223 or 222/224, CHEM 111/112 or 131/133, CHEM 113/114 or 132/134. Course offered at Au Sable Institute. Travel to site required.

BIOL A 305 Ornithology Field Ecology of Birds (2-6-4), summer, on demand. Biology, behavior, ecology and identification of birds. Work is primarily conducted in the field and covers the major habitats of northern lower Michigan, including wetlands, lakes, rivers, forests, dunes, and open field communities. Emphasis will be placed on identification of the spring bird fauna of northern lower Michigan by sight and by call. Laboratory graded and credited with the course. Prerequisite: BIOL 221/223 or 222/224. Course offered at Au Sable Institute. Travel to site required.

BIOL A 311 Field Botany (2-6-4), summer, on demand. Field and lab identification, systematics, natural history, and ecology of vascular plants as components of natural communities. Ecological features, including stratification, history, plant zonation, adaptation, and animal interactions are examined. Relationships of plant families and higher groups are covered. Project and/or plant collection required. ~~Field identification and ecology of vascular plants as components of natural communities in Michigan. Emphasis is placed upon on sight examination of plants in communities such as bog, dune, forest marsh, meadow, and swamp. Plants difficult to study under field conditions are brought to the laboratory for microscopical examination and identification. Ecological features such as community stratification and plant zonation along ecological gradients are examined.~~ Laboratory graded and credited with the course. Prerequisite: BIOL 221/223 or 222/224. Course offered at Au Sable Institute. Travel to site required.

BIOA 322 Aquatic Biology (2-6-4), summer, on demand. Ecology, identification, systematics, culture, and care of aquatic plants and animals, and adaptations to freshwater environments. Aquatic life is studied in lakes, ponds, bogs, marshes, and streams and in the laboratory. The course assesses human impacts on aquatic species and ecosystems, presents procedures for the stewardship of aquatic habitats, and introduces aquatic restoration ecology. Laboratory graded and credited with the course. Prerequisite: BIOL 221/223 or 222/224. Course offered at Au Sable Institute. Travel to site required.

BIOA 345 Wildlife Ecology (2-6-4), summer, on demand. This course covers the ecology, conservation, and stewardship of wildlife species and their habitats. The main components of the course includes growth and structure of natural and managed populations, environmental and human social factors affecting wildlife communities, and wildlife conservation. The course is set in the context of the historical development of the field from management, to ecology, and to the land ethic of Leopold. It also includes discussions of how to apply this information for management and stewardship of non-game and endangered species, and long-term prospects of wildlife in changing environmental, climatic, and social contexts. Laboratory graded and credited with the course. Prerequisite: BIOL 221/223 or 222/224. Course offered at Au Sable Institute. Travel to site required.

BIOA 355 Watersheds in Global Development (2-6-4), summer, on demand. This course covers the principles of watershed ecology, including principles and practice of community-based water monitoring and watershed management for developing and developed countries and data access and analysis using an online relational database and data-to-

action strategies. Designed for students in science and public policy, including students interested in missions and development and agencies involved in environmental assessment and community development. Includes EPA certification with demonstrated proficiency in specific watershed stewardship skill. Laboratory graded and credited with the course. Prerequisite: BIOL 221/223 or 222/224. Course offered at Au Sable Institute. Travel to site required.

BIOA 362 Environmental Applications for Geographic Information Systems (2-6-4), summer, on demand. Theory and application of spatial analysis for applied social and ecological problem-solving. This course combines GPS field data collection; ArcGIS use for storage, processing, interpretation, and presentation of data; location and integration of existing source information; and remote sensing integration with GIS applications. The course is designed around an environmental project to apply GIS techniques for real-world problem-solving in protecting and restoring ecosystems. Laboratory graded and credited with the course. Prerequisite: BIOL 221/223 or 222/224. Course offered at Au Sable Institute. Travel to site required.

BIOA 471 Conservation Biology (2-6-4), summer, on demand. Principles of conservation biology with applications to sustainable human society and biospheric integrity. An integrative approach to biology and society that interrelates population biology, ecological principles, biogeochemical cycles, ecosystem functions, and human society in the context of biospheric degradation. The course develops a stewardship perspective rooted in biological principles and directed at conservation of plant and animal species, biotic communities, ecosystems, and human society. Included are topics of human development, poverty, and economic growth. Prerequisites: BIOL 221/223 or 222/224, and BIOL 362. Course offered at Au Sable Institute. Travel to site required.

BIOL - BIOLOGY*Department of Biology (CAS)*

BIOL 101 Biology - Human Perspective (3-0-3), fall, spring, summer. A conceptual investigation of biological principles from the human perspective - including historical, theoretical, ethical, and practical aspects. May be used to satisfy Science University Requirements. For non-biology majors.

BIOL 112 General Biology I (3-0-3), fall, spring. A consideration of the diversity of life, emphasizing organism classification, structure and function in plants and animals. Concurrent enrollment in BIOL 114 required. A grade of "C" or better must be achieved to enroll in subsequent Biology courses. May be used to satisfy University Requirements.

BIOL 113 General Biology II (3-0-3), fall, spring. A consideration of the unity of life, emphasizing chemical and cellular organization, energy transfer through living systems, genetics, cellular information flow, ecology, and evolution/speciation. Concurrent enrollment in BIOL 115 required. Prerequisite: A grade of "C" or better in BIOL 112 and BIOL 114. A grade of "C" or better must be achieved to enroll in subsequent Biology courses. May be used to satisfy University Requirements.

BIOL 114 General Biology I Laboratory (0-3-1), fall, spring. Laboratory experiences considering the diversity of life. Concurrent enrollment in BIOL 112 required. A grade of "C" or better must be achieved to enroll in subsequent Biology courses. May be used to satisfy University Requirements.

BIOL 115 General Biology II Laboratory (0-3-1), fall, spring. Laboratory experience considering the unity of life. Concurrent enrollment in BIOL 113 required. Prerequisite: A grade of "C" or better in BIOL 112 and BIOL 114. A grade of "C" must be achieved to enroll in subsequent Biology courses. May be used to satisfy University Requirements.

BIOL 203 Basic Biology for Teachers (2-2-3), spring, even years. Survey of the plant and animal kingdoms and life processes; interactions with the environment and ecosystems and the ecology of life; includes laboratory work. Laboratory graded and credited with the course. For non-biology majors; only for students seeking teacher certification in an

area other than biology. Prerequisite: MATH 237 or Math ACT score of 20 or Math SAT score of 500. May be used to satisfy University Requirements.

BIOL 221 Animal Biology (3-0-3), fall, spring. A study of the comparative structure, physiology, and development of invertebrates and vertebrates. Concurrent enrollment in BIOL 223 required. Prerequisites: BIOL 112/114 and BIOL 113/115.

BIOL 222 Plant Biology (3-0-3), fall. A study of the historical, physiological, taxonomic, and ecological aspects of plants as well as

their anatomic, reproductive, and adaptive responses to world environments. Concurrent enrollment in BIOL 224 required. Prerequisites: BIOL 112/114 and BIOL 113/115.

BIOL 223 Animal Biology Laboratory (0-3-1), fall, spring. Laboratory and dissection experiences to understand the comparative structure, physiology, and development of invertebrate and vertebrate animals. Concurrent enrollment in BIOL 221 required. Prerequisites: BIOL 112/114 and BIOL 113/115.

BIOL 224 Plant Biology Laboratory (0-3-1), fall. Laboratory experiences using scientific methods to understand the anatomy, physiology, and practical aspects of plants. Concurrent enrollment in BIOL 222 required. Prerequisites: BIOL 112/114 and BIOL 113/115.

BIOL 291 Anatomy and Physiology I (3-0-3), fall. A systems approach to human anatomy and physiology emphasizing the musculoskeletal, nervous, and endocrine systems. Concurrent enrollment in BIOL 293 required. Prerequisites: ACT Natural Sciences, 20 or above/950 or above on SAT; or a grade of "C" or better in BIOL 101. For non-biology majors. May be used to satisfy University Requirements.

BIOL 292 Anatomy and Physiology II (3-0-3), spring. A systems approach to human anatomy and physiology emphasizing the circulatory, respiratory, digestive, and genitourinary systems. Concurrent enrollment in BIOL 294 required. Prerequisites: BIOL 291 and 293. For non-biology majors. May be used to satisfy University Requirements.

BIOL 293 Anatomy and Physiology I Laboratory (0-3-1), fall. Laboratory study of topics covered in BIOL 291. Concurrent enrollment in BIOL 291 required. For non-biology majors. May be used to satisfy University Requirements.

BIOL 294 Anatomy and Physiology II Laboratory (0-3-1), spring. Laboratory study of topics covered in BIOL 292. Concurrent enrollment in BIOL 292 required. For non-biology majors. May be used to satisfy University Requirements.

~~**BIOL 303 Limnology Water Resources** (2-6-4), summer, on-demand. Field study of lakes and streams with applications to planning management. Includes an introduction to limnology and investigation of representative lakes and streams of the region. Laboratory graded and credited with the course. Prerequisites: BIOL 221/223 or 222/224, CHEM 111/112 or 121/122, CHEM 113/114 or 132/134. Course offered at Au Sable Institute. Travel to site required.~~

~~**BIOL 305 Ornithology** (2-6-4), summer, on-demand. Biology, behavior, ecology and identification of birds. Work is primarily conducted in the field and covers the major habitats of northern lower Michigan, including wetlands, lakes, rivers, forests, dunes, and open field communities. Emphasis will be placed on identification of the spring bird fauna of northern lower Michigan by sight and by call. Laboratory graded and credited with the course. Prerequisite: BIOL 221/223 or 222/224. Course offered at Au Sable Institute. Travel to site required.~~

BIOL 308 Global Healthcare (3-0-3), Summer, even years. A study of healthcare delivery systems, quality of healthcare, and the impact of socioeconomic factors and culture on the delivery of healthcare through readings, discussion and interviews. Field experience will be gained through service-learning activities and observation within a medical community. Co-requisite: Participation in required shadowing, observation, and service components. Prerequisite: Sophomore standing. Same as CHEM 308, COMP 308.

~~**BIOL 311 Field Botany** (2-6-4), summer, on-demand. Field identification and ecology of vascular plants as components of natural communities in Michigan. Emphasis is placed upon on-site examination of plants in communities such as bog, dune, forest, marsh, meadow, and swamp. Plants difficult to study under field conditions are brought to the laboratory for microscopic examination and identification. Ecological features such as community stratification and plant zonation along ecological gradients are examined. Laboratory~~

~~graded and credited with the course. Prerequisite: BIOL 221/223 or 222/224. Course offered at Au Sable Institute. Travel to site required.~~

BIOL 312 Cell Biology (3-0-3), fall, spring. Survey of cell structure and function with an emphasis on cellular energy-related events, proteins, and nucleic acids. Lecture may be taken without the lab. Prerequisites: CHEM 114 or 134; BIOL 112/114, 113/115 and BIOL 221/223 or 222/224.

BIOL 313 Cell Biology Laboratory (0-3-1), spring. Laboratory study of cell structure and function with emphasis on energy-related events, proteins, and nucleic acids. Prerequisites: CHEM 114 or 134, BIOL 112/114, 113/115 and 221/223 or 222/224.

~~**BIOL 315 Woody Plants** [1](2-6-4), summer, on demand. Taxonomy, ecology, management, and stewardship of trees and shrubs. Presents the systematic botany of local woody flora including identification by foliage, twigs, wood, and bark, and trees of major economic and ecological importance worldwide. Given in the context of ethical and global questions of deforestation, global warming trends, old growth forest values, lumbering forest ecosystem restoration, and land stewardship. Laboratory graded and credited with the course. Prerequisite: BIOL 221/223 or 222/224. Course offered at Au Sable Institute. Travel to site required.~~

~~**BIOL 322 Aquatic Biology** (2-6-4), summer, on demand. Ecology, identification, systematics, culture, and care of aquatic plants and animals, and adaptations to freshwater environments. Aquatic life is studied in lakes, ponds, bogs, marshes, and streams and in the laboratory. The course assesses human impacts on aquatic species and ecosystems, presents procedures for the stewardship of aquatic habitats, and introduces aquatic restoration ecology. Laboratory graded and credited with the course. Prerequisite: BIOL 221/223 or 222/224. Course offered at Au Sable Institute. Travel to site required.~~

BIOL 330 Neurobiology (2-3-3), on demand. A consideration of the following topics: the neurophysiology of synaptic transmission, how sensory input is perceived and motor output is transmitted, and the location and function of the cranial nerve nuclei. Laboratory graded and credited with the course. Prerequisite: BIOL 312.

BIOL 332 Mind and Wellness (1-0-1), fall. An investigation into the influences on health - physical, emotional and spiritual, with examples drawn from the Asian and Hispanic cultures. Prerequisites: BIOL 112/114, 113/115.

BIOL 351 Genetics (3-0-3), fall. Fundamental principles of genetics in plants and animals. Physical basis of inheritance, expression and interaction of genes, linkage, sex linkage, and the chemical nature of genetic material. Lecture may be taken without the lab. Prerequisites: BIOL 112/114, 113/115.

BIOL 353 General Microbiology (3-0-3), fall, on demand. Principles of general microbiology including immunology, pathogenic microbiology, environmental, and industrial microbiology. Concurrent enrollment in BIOL 354 required. For non-biology majors.

BIOL 354 General Microbiology Lab (0-3-1) The study of cultivation and characterization of microorganisms, their identification, and microbiology of the environment. Concurrent enrollment in BIOL 353 required. For non-biology majors.

BIOL 355 Microbiology (3-0-3), spring. A study of the cellular structure, metabolic pathways, regulatory, and genetic exchange mechanisms of microorganisms and how these relate to microbial roles in the biosphere, industry, and disease processes. Concurrent enrollment in BIOL 357 required. Prerequisite: BIOL 312 or CHEM 223. For biology and biochemistry majors.

BIOL 357 Microbiology Laboratory (0-3-1), fall, spring, on demand. The study of cultivation and characterization of microorganisms, their identification, and the microbiology of the environment. Concurrent enrollment in BIOL 355 required. For biology and biochemistry majors.

BIOL 362 Ecology (3-0-3), fall, summer, even years. Ecological concepts, methods of vegetational and animal population analysis and biomes of the world. Lecture may be taken without the lab. Prerequisite: BIOL 221/223 or 222/224.

BIOL 364 Ecology Laboratory (0-3-1), fall. Introduction to sampling methods of plant and animal populations and communities, and how they interact with their environment. Prerequisite: BIOL 221/223 or 222/224. Special travel fee.

BIOL 370 Field Biology (3-3-4), summer, odd years. Sampling methods and field techniques applicable to the biota of the southwest. Collection, identification, and natural history including soils, geology, population and community analysis and dynamics. Laboratory graded and credited with the course. Special travel fee.

~~**BIOL 377 Marine Invertebrates** [2](2-6-4), summer, on demand. A study of invertebrate taxonomy, ecology, life histories, and economic importance. Field methods are stressed. Laboratory graded and credited with the course. Prerequisite: BIOL 221/223 or 222/224. Course offered at Au Sable Institute. Travel to site required.~~

BIOL 380 General Mammalogy (3-3-4), spring, even years. Principles of ecology, evolution, classification, biogeography, economic importance, and conservation of mammals. Laboratory graded and credited with the course. Prerequisite: BIOL 221/223 or 222/224. Special travel fee.

BIOL 399 Biology Research (3-0-3)*, fall. Students perform biological research under the supervision of a faculty member for 1-3 credit hours. A poster or presentation suitable for presentation at a scientific meeting or paper incorporating results of the research, written in the format of scientific publications, is required for completion of the course. Special laboratory fee. Prerequisite: Instructor approval.

BIOL 401 Secondary Science Teaching Methods (3-0-3), fall, spring. A study of teaching strategies and curriculum development for the secondary sciences. Presents the Texas Essential Knowledge and Skills, College and Career Readiness Standards, and classroom management and discipline for the science laboratory environment. Must be taken concurrently with EDUC 412 and 432. Should be taken before student teaching. Prerequisite: 16 hours of science from appropriate secondary science teaching degree plan.

BIOL 403 Marine Biology (3-3-4), spring, odd years. A field course in Florida or Honduras. A study of the open ocean and the intertidal zones. Prerequisite: Consent of instructor. Laboratory graded and credited with the course. Special travel fee. Travel during spring break required.

BIOL 425 Behavioral Biology: Theory and Methods (3-1-4), spring, odd years. Discover how an organism's behavior permits adaptation to its environment. Behavioral ecology and ethological methods will be learned to understand how behavior permits homeostasis and adaptation. An introduction into sociobiological theory and a critique as it relates to human behavior will be explored. Laboratory graded and credited with the course. Special travel fee; out of town travel. Prerequisites: BIOL 362.

BIOL 448 Biology of Aging (3-0-3), summer. Survey of the human anatomy and physiology with implications of normal and abnormal age-related changes. Same as GERO 448/548.

BIOL 454 Immunology (3-0-3), fall. The cellular and molecular mechanisms inherent in immunology. Prerequisite: BIOL 312.

~~**BIOL 471 Conservation Biology** (2-6-4), summer, on demand. Principles of conservation biology with applications to sustainable human society and biospheric integrity. An integrative approach to biology and society that interrelates population biology, ecological principles, biogeochemical cycles, ecosystem functions, and human society in the context of biospheric degradation. The course develops a stewardship perspective rooted in biological principles and directed at conservation of plant and animal species, biotic communities, ecosystems, and human society. Included are topics of human development, poverty, and economic growth. Prerequisites: BIOL~~

~~221/223 or 222/224, and BIOL 362. Course offered at Au Sable Institute. Travel to site required.~~

BIOL 472 Biochemistry I (3-0-3), fall. Discusses the chemistry, structural aspects, and properties of amino acids, peptides, proteins, vitamins, carbohydrates, lipids, and nucleic acids. Prerequisite: CHEM 324. Same as CHEM 453.

BIOL 475 Molecular Genetics (3-0-3), spring. A study of the molecular interactions that take place during mitosis, meiosis, cell activation and inactivation, gene activation and inactivation, transcription, reverse transcription, translation, organelle synthesis and formation, morphogenetic cell movement, membrane synthesis. Prerequisite: BIOL 312 or CHEM 454 or BIOL 472 or concurrent enrollment.

BIOL 476 Biotechnology Laboratory (0-6-2), spring. Explores the advancement of recombinant DNA technology. Experimental tasks include isolation, amplification, mapping, sequencing, cloning and fingerprinting of DNA, genome analysis, genetic testing, cell culture, and antigen detection. Prerequisite: BIOL 312.

~~**BIOL 477 Plant Ecology** [3](2-6-4), summer, on demand. Interrelationships between plants and their physical and biotic environments, plant-animal interactions, plant community composition and development, and modern methods of ordination and quantitative analysis with applications to conservation and stewardship. Laboratory graded and credited with the course. Prerequisites: BIOL 221/223 or 222/224, and BIOL 362. Course offered at Au Sable Institute. Travel to site required.~~

BIOL 480 Histology (2-3-3), spring. Detailed microscopic anatomy of the tissues and organs of higher vertebrates. Laboratory graded and credited with the course. Prerequisite: BIOL 312.

BIOL 481 Plant Systematics (3-3-4), spring, even years. Introduction to the principles and methods of biological classification with emphasis on the local flora. Field and laboratory work consist of collection and identification of plant specimens and phylogenetic analysis of plant DNA. Laboratory graded and credited with the course. Prerequisites: BIOL 112/114 and BIOL 113/115.

BIOL 483 Biostatistics (3-0-3), spring, even years. An introduction to experimental design, including common techniques in descriptive and inferential statistics.

BIOL 484 Developmental Biology (3-0-3), spring, odd years. A study of molecular events which begin with meiosis and fertilization and continue through the development and growth of the human embryo and fetus. Prerequisite: BIOL 312.

BIOL 491 Human Anatomy (3-0-3), spring. Human biology, stressing morphology of the body using a systemic and regional approach. Prerequisites: BIOL 112/114 and BIOL 113/115. Concurrent enrollment in BIOL 493 required.

BIOL 492 Physiology (3-0-3), fall, on demand. Study of normal functional needs and environmental challenges of vertebrates and invertebrates. Lecture may be taken without the lab. Prerequisites: BIOL 112/114 and BIOL 113/115.

BIOL 493 Human Anatomy Laboratory (0-3-1), spring. Laboratory study of the human body using visualization and dissection. Concurrent enrollment in BIOL 491 required.

BIOL 495 Physiology Laboratory (0-3-1), fall, on demand. Laboratory investigation of animal function including measurements and data collection. Prerequisites: BIOL 112/114 and BIOL 113/115.

BIOL 497 Seminar in Biology (3-0-3), fall, spring, Maymester, on demand. Discussions where students critically analyze, reflect, and write about biology from the perspective of a Christian Worldview. Prerequisite: senior year biology major or health professions concentration. **A capstone and writing-intensive course.**

BIOL 498 Cancer Biology (3-0-3), fall. Exposes students to all aspects of cancer studies including cancer causation, pathology, epidemiology,

genetics, metastasis, detection, treatments and preventions. The biology of cancer cells is emphasized and analyzed at the molecular level with the introduction of classical and modern experimental details. Prerequisite: BIOL 312.