

BIOLOGICAL SCIENCES

Faculty

Chair: Wendy Billock, Ph.D.

Associate Professors: Billock, Havoonyan, Tresser, Varamini

Assistant Professors: Arojo, Kim, J., Lee, Ng, Sun

Courses

Biological Sciences (BIOS)

BIOS 100 - Biological Principles: Lecture Credits 3

A survey of biological principles including: the cell, zoology, ecology, human anatomy, genetics, and origin of life theories. **Notes:** No lab is required, but BIOS 110 is the lab course designed to accompany this course. BIOS 100 without the lab (110) will not receive transfer credit at most other universities. Approved for Core Curriculum Science credit. Cannot be taken to fulfill elective requirements for these majors: Bio Sci: Secondary Instruction (BISI), Human Biology (BIHB), Biological Science (BIOS), Biochemistry (BCHM) or Environmental Science (BIES). **Grade Mode:** A.

Restrictions: Must not be a Major in Biological Science (BIOS), a Major in Environmental Science (BIES), a Major in Biochemistry (BCHM), a Major in Bio Sci:Secondary Instruction (BISI) or a Major in Human Biology (BIHB); and must be Undergraduate Level.

BIOS 103 - Introduction to Environmental Science Credits 3

An interdisciplinary approach to the study of the environment using concepts from ecology, biology, chemistry, geology, the social sciences and Scripture to understand the interplay of natural resources, how humans are affecting the environment, and how to deal with environmental problems. **Notes:** Approved for Core Curriculum Science credit. **Grade Mode:** A.

Restrictions: Must be Undergraduate Level.

BIOS 110 - Observational Biology Laboratory Credits 2

Observational and investigative approach to surveying a range of biological organisms and examining selected human systems. **Notes:** Three hours lab, one hour lecture/discussion designed to be taken with BIOS 100. Cannot be taken to fulfill elective requirements for these majors: Bio Sci: Secondary Instruction (BISI), Human Biology (BIHB), Biological Science (BIOS), Biochemistry (BCHM) or Environmental Science (BIES). **Grade Mode:** A.

Restrictions: Must not be a Major in Biological Science (BIOS), a Major in Environmental Science (BIES), a Major in Biochemistry (BCHM), a Major in Bio Sci:Secondary Instruction (BISI) or a Major in Human Biology (BIHB); and must be Undergraduate Level.

Fee: Lab \$95.

BIOS 111 - Fundamentals of Cellular and Molecular Biology Credits 3

Introductory course for majors emphasizing the principles of cellular and molecular biology, genetics, and development. **Grade Mode:** A.

Corequisites: BIOS 113.

Restrictions: Must be Undergraduate Level.

BIOS 112 - Fundamentals of Organismal Biology Credits 3

Introductory course for biological science majors emphasizing the principles of systematics and biodiversity, population genetics and origins theories, ecology, and anatomy and physiology. **Grade Mode:** A.

Corequisites: BIOS 114.

Restrictions: Must be Undergraduate Level.

BIOS 113 - Fundamentals of Cellular and Molecular Biology Laboratory Credit 1

This laboratory accompanies BIOS 111 and is divided between observational and experimental approaches, with emphasis on the collection and interpretation of quantitative data. Frequent lab discussion of relevant issues and literature will be included. **Grade Mode:** A.

Corequisites: BIOS 111.

Restrictions: Must be Undergraduate Level.

Fee: \$95.

BIOS 114 - Fundamentals of Organismal Biology Laboratory Credit 1

This laboratory, which accompanies BIOS 112, will involve dissection as well as experimentation. A field project involving the La Mirada Creek is included. **Grade Mode:** A.

Corequisites: BIOS 112.

Restrictions: Must be Undergraduate Level.

Fee: \$95.

BIOS 120 - Current Topics in Biology Credits 3

Selected topics of current interest and concern are studied. Sections are offered each year upon sufficient demand. Topics are the following:

- Human Biology: Selected body systems and/or diseases will be studied in detail.
- Marine Biology: An overview of marine biology with an emphasis on local marine species and conservation. Topics include seaweed, invertebrate animals, fish, marine mammals, and the impact of humans.
- Zoology: This course provides a broad overview of invertebrate and vertebrate animal species with an emphasis on comparative anatomy and ecology.

Notes: Approved for Core Curriculum Science credit. May not be used to fulfill elective requirements for BIOS, BIES, BISI, or BIHB majors. **Grade Mode:** A.

Restrictions: Must not be Biological Science (BIOS), Environmental Science (BIES), Bio Sci:Secondary Instruction (BISI) or Human Biology (BIHB); and must be Undergraduate Level.

BIOS 121 - Nutrition Credits 3

A detailed study of the basic nutritional needs of humans: water, carbohydrates, lipids, proteins, vitamins and minerals. Also included is a coverage of certain nutritional issues such as health foods, megavitamins, obesity and food additives, as well as computer-aided personal diet-analysis assignment. **Notes:** Approved for Core Curriculum Science credit. **Grade Mode:** A.

Restrictions: Must be Undergraduate Level.

BIOS 130 - Seminar in Biological Science Credits 1-2

Online course in which students discuss current topics in biology through weekly literature searches and interactive online postings. **Notes:**

Cannot be taken to fulfill elective requirements for these majors: Bio Sci: Secondary Instruction (BISI), Human Biology (BIHB), Biological Science (BIOS), Biochemistry (BCHM) or Environmental Science (BIES). **Grade Mode:** A.

Restrictions: Must not be a Major in Biological Science (BIOS), a Major in Environmental Science (BIES), a Major in Biochemistry (BCHM), a Major in Bio Sci:Secondary Instruction (BISI) or a Major in Human Biology (BIHB); and must be Undergraduate Level.

- BIOS 200 - Sophomore Writing Seminar** **Credit 1**
 Writing for competency in the biological sciences. Students will get instruction and practice in science writing for the biological sciences as well as the two portions of the writing competency requirement. At the end of the course, students will take the timed writing portion of the writing competency requirement. **Notes:** This course is required for all biological sciences, human biology and environmental science majors. It is highly recommended that this course be taken during the student's sophomore year, but it may be taken later. **Grade Mode:** A.
Prerequisites: BIOS 103 or BIOS 111; BIOS 112, and ENGL 100 or ENGL 112.
Restrictions: Must not be Freshman Class; and must be Undergraduate Level.
Fee: Lab \$95.
- BIOS 222 - Botany** **Credits 4**
 The study of the organs, tissues, functions and responses to environment of typical flowering plants and the morphology and life history of the major lower plant groups. Field work required, including collection and classification of native plants for the Biola Herbarium. **Lecture/Lab Hours:** Three hours lecture, four hours laboratory. There will be some Saturday field trips. **Grade Mode:** A, N.
Prerequisites: BIOS 100 and BIOS 110; or BIOS 112 and BIOS 114.
Restrictions: Must be Undergraduate Level.
Fee: Lab \$95.
- BIOS 236 - Principles of Human Anatomy and Physiology** **Credits 4**
 An introduction to the structure and the function of the systems of the human body. Integration and interaction of these systems in maintaining homeostasis will be a point of focus. Laboratories will provide students the opportunity to observe and interact with human anatomical structures as well as perform relevant physiological experiments. **Grade Mode:** A, N.
Restrictions: Must not be Freshman Class; Kinesiology (KHPE), Biological Science (BIOS), Environmental Science (BIES), Biochemistry (BCHM), Nursing (NURS) or Human Biology (BIHB); and must be Undergraduate Level.
Fee: \$95.
- BIOS 254 - Human Anatomy** **Credits 4**
 An introduction to the basic structure and function of the human body. Laboratory emphasis varies from section to section to meet the needs of the different majors. **Lecture/Lab Hours:** Three hours lecture, one hour pre-lab, three hours laboratory. **Notes:** Cadavers are used. **Grade Mode:** A, N.
Restrictions: Must be Undergraduate Level.
Fee: Lab \$95.
- BIOS 281 - Physiology** **Credits 4**
 A study of the basic concepts of physiological regulation from the level of the cell to the integrated intact organism including neural, muscular, and neuro-endocrine regulatory systems. Laboratory includes human systems analysis and electrophysiology. **Lecture/Lab Hours:** Three hours lecture, one hour pre-lab, three hours laboratory. **Grade Mode:** A, N.
Prerequisites: CHEM 105 or CHEM 120.
Restrictions: Must not be Freshman Class; and must be Undergraduate Level.
Fee: Lab \$95.
- BIOS 282 - Microbiology** **Credits 4**
 A study of microbial organisms with emphasis on bacteria and viruses, including their morphology, physiology, metabolism and genetics; host parasite interactions; humoral and cell-mediated immunity. Laboratory practice in handling microorganisms, including identification and culture techniques. **Lecture/Lab Hours:** Three hours lecture, four hours laboratory. **Grade Mode:** A, N.
Restrictions: Must be Undergraduate Level.
Fee: Lab \$95.
- BIOS 290 - Natural History of Marine Mammals** **Credit 1**
 Biology and natural history of marine mammals with special emphasis on California species. **Grade Mode:** A.
Restrictions: Must be Undergraduate Level.
- BIOS 302 - Vertebrate Biology** **Credits 4**
 The biology of vertebrates, stressing structure and function. Laboratory dissection of representative vertebrates emphasizes comparative anatomy. **Grade Mode:** A, N.
Prerequisites: BIOS 100 and BIOS 110; or BIOS 112 and BIOS 114.
Restrictions: Must be Undergraduate Level.
Fee: \$95.
- BIOS 303 - Ecological Agriculture** **Credits 4**
 Environmental analysis of natural resources in relation to people and policy. Focus is on ethnobotany, ecological agriculture, and land stewardship. Employs a discussion format both in classroom and field settings. Emphasis on grappling with difficult practical and ethical problems. **Notes:** Au Sable offering. **Grade Mode:** A.
Restrictions: Must be Undergraduate Level.
- BIOS 305 - Global Development and Ecological Sustainability** **Credits 3-4**
 Environmental analysis and natural resources analysis in relation to society and developmental issues. Focus on ecological sustainability and sustainable society in the context of various factors that are bringing environmental degradation and impoverishment of people and cultures. Topics include tropical agriculture, hunger, poverty, international debt, appropriate technology, relief programs, missionary earthkeeping, conservation of wild nature, land tenure and land stewardship. Employs a discussion format grappling with difficult practical and ethical problems and issues that require deep and personal thought. **Notes:** Biola or Au Sable offering. **Grade Mode:** A.
Restrictions: Must be Undergraduate Level.
- BIOS 306 - Land Resources** **Credits 4**
 Systems level perspective on landforms and ecosystems. Includes analysis and interpretation of field data, remotesensing data derived from satellites and aircraft and geological information systems (GIS). Field trips to and analysis of forests, wetlands, lakeshores, and rivers. Includes application to policy and land use planning. **Notes:** Au Sable offering. **Grade Mode:** A.
Restrictions: Must be Undergraduate Level.
- BIOS 307 - Lake Ecology and Management** **Credits 4**
 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 other great lakes of the world and their stewardship. **Notes:** Au Sable offering. **Grade Mode:** A.
Restrictions: Must be Undergraduate Level.

BIOS 308 - Biochemistry**Credits 3**

Biochemistry explores the chemical processes occurring at the cellular and molecular level of living organisms. It covers a range of scientific disciplines including animal and plant physiology, microbiology, ecology, developmental biology as well as the fields of medicine, nutrition and pharmaceutical research. This course will survey the basic structural properties of amino acids, proteins, nucleic acids as well as the common anabolic and catabolic pathways in plant and animal cells. Real-world applications in nutrition, diseases, metabolic disorders, pharmaceuticals and supplements will be discussed. **Lecture/Lab Hours:** 3 hour lecture.

Notes: Please note this is a one-semester survey course designed to meet the requirements of non-premed (MD/DO) schools including but not limited to Physicians Assistant (PA), Physical Therapy (PT), Occupational Therapy (OT), Dentistry (DDS/DMD), and Optometry (OD) schools. Cannot be combined with BIOS 411/CHEM 411 General Biochemistry I or BIOS 412/CHEM 412 General Biochemistry II for credit. **Grade Mode:** A.

Prerequisites: CHEM 301 and CHEM 311 or CHEM 321 and CHEM 322. **Restrictions:** Must not be Pre-Medical Studies (BCPM) or Biochemistry (BCHM); and must be Undergraduate Level.

BIOS 310 - Prosection**Credits 1-2**

An introduction to the human body through dissection and demonstration of a selected portion of a human cadaver. **Lecture/Lab Hours:** Thirty hours of laboratory. **Notes:** Special Approval Required. May be taken for a total of 2 credits. **Grade Mode:** A.

Restrictions: Must be Undergraduate Level.

Fee: Dissection \$95.

BIOS 311 - Neurobiology**Credits 3**

Discusses the embryology of the nervous system, the structure and function of the different cells of the nervous system and transmission by neurons. Emphasis on understanding cellular organization and neurophysiology of major subsystems of the vertebrate nervous system.

Grade Mode: A.

Prerequisites: BIOS 111 and BIOS 112; or BIOS 254 or BIOS 236.

Restrictions: Must be Undergraduate Level.

BIOS 312 - Cell and Molecular Biology**Credits 3**

Discusses the molecular organization and function of cells and their organelles, with emphasis on chromosome structure, gene expression, membrane structure and function, energy conversion, and experimental methods used to study subcellular components. **Grade Mode:** A.

Prerequisites: BIOS 111 and BIOS 113. CHEM 301 and CHEM 311; or CHEM 320, or CHEM 321 and CHEM 322 (concurrent registration permitted).

Restrictions: Must be Undergraduate Level.

BIOS 315 - Nutrition and Metabolism**Credits 3**

Study of molecular structure, absorption and cellular use of macro and micronutrients as well as dietary deficiencies and disorders. Analyzes food production, distribution, preparation and digestion. Human health is emphasized. Laboratory includes food analysis, preparation and field trips. **Lecture/Lab Hours:** Three hours lecture.

Notes: Offered in Spring. **Grade Mode:** A, N.

Prerequisites: BIOS 111 and BIOS 113; CHEM 301; or CHEM 320, or CHEM 321 and CHEM 322.

Restrictions: Must be Undergraduate Level.

BIOS 316 - Nutrition and Metabolism Lab**Credit 1**

The Nutrition and Metabolism Laboratory will acquaint students with fundamental techniques used in food preparation and food science. Various foods will be analyzed for total energy content using various forms of calorimetry. Foods will also be analyzed for protein, simple and complex carbohydrate as well as fat content. Students will analyze the physical properties of various foods and experiment with preparation and preservation techniques. Students will tour several food production, processing and distribution centers. Attendance at each scheduled lab session is required and students will document their experimental procedures and results in a lab notebook. **Lecture/Lab Hours:** four hours laboratory.

Notes: Offered in Spring. **Grade Mode:** A, N.

Prerequisites: BIOS 111 and BIOS 113; CHEM 301; or CHEM 320, or CHEM 321 and CHEM 322.

Restrictions: Must be Undergraduate Level.

Fee: \$95.

BIOS 322 - Laboratory in Cell and Molecular Biology**Credits 2**

Practical application of traditional and current laboratory techniques used in research and industry, including microscopy, scanning electron microscopy, histology, chromosomal analysis, tissue cell culture, isolation and purification of DNA, RNA and proteins, PCR, proper documentation and protocols and other laboratory writing skills are emphasized.

Lecture/Lab Hours: Six hours of laboratory, one hour discussion. **Grade Mode:** A.

Prerequisites: BIOS 111 and BIOS 113. CHEM 301 and CHEM 311; or CHEM 320, or CHEM 321 and CHEM 322 (concurrent registration permitted).

Restrictions: Must be Undergraduate Level.

Fee: Lab \$95.

BIOS 325 - Environmental Microbiology**Credits 4**

Microorganisms exist in all areas of nature, ranging from soils and waters to extreme environments, which are too harsh for the existence of humans, animals or plants. Understanding the role played by microorganisms in these environments is critical to our survival and quality of life. Such roles include cycling of elements, breakdown of organic material and pollutants, contribution to geological processes, causing diseases, water quality and waste water treatment, and the biodeterioration of materials. **Lecture/Lab Hours:** Three hours lecture, four hours laboratory. **Grade Mode:** A, N.

Prerequisites: BIOS 103; and CHEM 106 or CHEM 112 or CHEM 120.

Restrictions: Must be Undergraduate Level.

Fee: \$95.

BIOS 326 - Sciences CSET Preparation**Credit 1**

Review of the subject matter in the California Subject Examinations for Teachers (CSET) Science subtest exams. Test-taking strategies. **Notes:** May be taken for a total of 3 credits. Only 1 credit may count towards degree. **Grade Mode:** A.

Restrictions: Must be Undergraduate Level.

BIOS 332 - Genetics**Credits 4**

Integrates principles of Mendelian and molecular genetics toward understanding structure and function of the gene. Emphasizes quantitative analysis of genetic data and explores current issues of genetic engineering from technical and ethical viewpoints. **Lecture/Lab Hours:** Three hours lecture, four hours lab. **Grade Mode:** A, N.

Prerequisites: CHEM 301 and CHEM 311; or CHEM 320, or CHEM 321 and CHEM 322 (concurrent registration permitted).

Restrictions: Must be Undergraduate Level.

Fee: Lab \$95.

BIOS 335 - Field Biology**Credits 1-4**

Systematics, distribution, behavior and ecology of the common plants and animals of the selected domestic or international site or region. Emphasis is on the site's biodiversity, ecology, and associated conservation issues. Trips to domestic sites may occur during Interterm or Summer terms, as well as on Saturdays or weekends during the school year. Domestic sites may include the LA region, the Sierra, the Grand Canyon, and the Channel Islands. Trips to international sites may occur in the Interterm or Summer term and may include studies world-wide. Both domestic and international sites will vary from year to year based on faculty interest and student support and enrollment. **Notes:** Students taking this course as an elective will have different assignments than BIOS and BIES majors. Credits vary based on different lengths of time at the study site. **Grade Mode:** A.

Restrictions: Must be Undergraduate Level.**Fee:** Varies by location and duration of trip(s).**BIOS 351 - Invertebrate Biology****Credits 4**

Taxonomy and morphology of invertebrate phyla; laboratory dissection of invertebrates. **Lecture/Lab Hours:** Three hours lecture, four hours laboratory. **Grade Mode:** A, N.

Prerequisites: BIOS 100 and BIOS 110; or BIOS 112 and BIOS 114.**Restrictions:** Must be Undergraduate Level.**Fee:** Lab \$95.**BIOS 352 - Marine Biology****Credits 4**

Introduction to oceanography, marine plant and animal diversity, and ecological relationships. Lab sessions will include field trips. **Lecture/Lab Hours:** Three hours lecture, four hours laboratory. **Grade Mode:** A, N.

Prerequisites: BIOS 100 and 110; or BIOS 112 and BIOS 114.**Restrictions:** Must be Undergraduate Level.**Fee:** Varies based on cost of transportation and activity fees.**BIOS 353 - Environmental Ethics****Credits 3-4**

Investigation of contemporary problems in environmental stewardship including the use of renewable and nonrenewable natural resources, pollution, appropriate land use and development, third world concerns, and preservation of wild nature. In addition to developing a Christian environmental ethic from a stewardship perspective, the course considers such movements and issues as deep ecology and ecofeminism, animal rights, wilderness ethics, wildlife management, biodiversity, and agro-ecology. Emphasis on considering concrete, current ethical debate. **Notes:** Biola or Au Sable offering. **Grade Mode:** A.

Restrictions: Must be Undergraduate Level.**BIOS 354 - Bioethics****Credits 4**

The dilemmas of dangerous knowledge in environmental and medical activities are investigated, including stem cell research and applications, fetal tissue research, human gene manipulation, transgenic bioengineering, genetically modified crops, release of bioengineered organisms into natural ecosystems, and emerging disease, the ethics of environmental activism, and the religious roots of ethical values. This course uses a seminar format in which topics are presented by student teams including presentations, panel discussions, and debate. Current attempts to develop a theological basis for bioethics are considered.

Notes: Au Sable offering. **Grade Mode:** A.**Restrictions:** Must be Undergraduate Level.**BIOS 355 - Environmental Health: An Ecological Perspective****Credits 4**

Introduction to the fundamentals of environmental health, with an introduction to environmental epidemiology and environmental medicine. Environmental pollutants and their sources, effects of environmental pollution on the environment and public health, environmental control agencies, methods of pollution control, environmental law and policy, environmental and public health research agencies, environmental epidemiology, environmental medicine, and environmental stewardship are included. Field trips and lab assignments complement the materials covered in lectures. **Notes:** Au Sable offering. **Grade Mode:** A.

Restrictions: Must be Undergraduate Level.**BIOS 360 - Principles of Geographic Information Systems****Credits 4**

This course will provide an understanding of the importance of geographic information systems software (GIS) that is used worldwide to create maps and analyze digital data and photos for use in many disciplines. Within the biological and environmental sciences it is used in environmental impact reports, city or regional planning, and species and ecosystem management plans. Students will create maps and analyze data gained from the web or created by themselves. **Lecture/Lab Hours:** Three hours lecture, four hours laboratory, weekly. **Notes:** Must have good computer skills and be familiar with Microsoft Excel. **Grade Mode:** A, N.

Restrictions: Must not be Freshman Class; and must be Undergraduate Level.**Fee:** \$95.**BIOS 362 - Natural History of Southern California****Credits 3**

A field-oriented course to study and identify the common plants and animals found within the major plant and animal communities of Southern California. **Lecture/Lab Hours:** Two hours lecture, four hours laboratory/field, including one or two extended field trips. **Grade Mode:** A.

Prerequisites: BIOS 100 and BIOS 110; or BIOS 112 and BIOS 114.**Restrictions:** Must be Undergraduate Level.**Fee:** Transportation fee varies.**BIOS 371 - Conservation Biology****Credits 4**

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. **Fee:** \$95 **Notes:** Biola and Au Sable offering. **Grade Mode:** A.

Prerequisites: BIOS 100 and BIOS 110, or BIOS 112 and BIOS 114.**Restrictions:** Must be Undergraduate Level.**BIOS 372 - Restoration Ecology****Credits 4**

Ecological and theoretical foundations for ecosystem and biotic community restoration. This course develops ecological principles for ecosystem restoration and applies them to redeeming and restoring degraded and damaged ecosystems and endangered species. Field studies include analysis of restoration and rehabilitation work with Kirtland Warbler, an officially designated wild river, coastal dunes, kettle-hole bogs, deforested lands, degraded residential and farming sites, and abandoned oil wells. A practical field laboratory is included in which techniques are applied to a specific site. **Notes:** Au Sable offering. **Grade Mode:** A.

Restrictions: Must be Undergraduate Level.

- BIOS 380 - Advanced Microbiology** Credits 4
Same as BIOS 282, with the additional requirement of microbial isolation and identification of field and clinical samples. An 8–10 page research paper and presentation on one of these isolations is also required. **Lecture/Lab Hours:** Three hours lecture, four hours laboratory. **Grade Mode:** A, N.
Prerequisites: CHEM 106 or CHEM 112 or CHEM 120.
Restrictions: Must be Undergraduate Level.
Fee: \$95.
- BIOS 381 - Advanced Physiology** Credits 4
An advanced study of human physiology that emphasizes the mechanisms of homeostasis at the cellular, organ, and system levels. Neural, vascular, respiratory, excretory, digestive, and endocrine systems are studied. Advanced Physiology includes a major laboratory research project. **Lecture/Lab Hours:** Three hours lecture, four hours laboratory. **Grade Mode:** A, N.
Prerequisites: CHEM 106 or CHEM 120; BIOS 112 and BIOS 114, or BIOS 254.
Restrictions: Must be Undergraduate Level.
- BIOS 382 - Vertebrate Physiology** Credits 4
Discusses the mechanisms of integration and homeostasis at the cellular, organ and system levels. Muscular, neural, vascular, excretory, and endocrine interactions are studied. Variations between vertebrate groups are presented. Includes a major research project. **Lecture/Lab Hours:** Three hours lecture, four hours laboratory. **Grade Mode:** A, N.
Prerequisites: BIOS 112 and BIOS 114, or BIOS 254; CHEM 106 or CHEM 112 or CHEM 120.
Restrictions: Must be Undergraduate Level.
Fee: Lab \$95.
- BIOS 390 - Au Sable Institute of Environmental Studies** Credits 4
Au Sable is a Christian institute focusing on field studies from a stewardship perspective. Biola is a participating member of the institute. Courses are taught at field stations in Michigan, Washington, Florida and India. Coursework taken through the institute can be counted as elective credit in the Biological Sciences, or may be substituted for specific major requirements. **Notes:** May be taken for a total of 16 credits with different content. **Grade Mode:** A.
Restrictions: Must be Undergraduate Level.
- BIOS 401 - General Ecology** Credits 4
An introduction to the general concepts of the ecology of populations, communities and ecosystems, including physiological ecology, speciation and evolutionary theory. Laboratory includes field trips and a research project. **Grade Mode:** A, N.
Prerequisites: BIOS 100 and BIOS 110; or BIOS 112 and BIOS 114.
Restrictions: Must be Junior Class, or Senior Class; and Undergraduate Level.
Fee: Lab \$95.
- BIOS 402 - Parasitology** Credits 4
Taxonomy, life history, physiology, molecular basis, ecology, and morphology of animal parasites with emphasis on those affecting humans. **Lecture/Lab Hours:** Three hours lecture, four hours laboratory. **Grade Mode:** A, N.
Prerequisites: BIOS 111 and BIOS 113; and BIOS 112 and BIOS 114.
Restrictions: Must be Junior Class, or Senior Class; and Undergraduate Level.
Fee: Lab \$95.
- BIOS 410 - Topics in Environmental Science** Credits 1-4
Selected topics in environmental science. **Notes:** May be taken for a total of 8 credits with different content. Biola or Au Sable offering. **Grade Mode:** A.
Restrictions: Must be Undergraduate Level.
- BIOS 411 - General Biochemistry I** Credits 3
Structures and properties of biomolecular components of cells, including proteins, carbohydrates, lipids, nucleotides, nucleic acids, vitamins and coenzymes, kinetics and mechanism and regulation of enzyme action in biological systems. **Notes:** BIOS 111 and BIOS 113 (Fundamentals of Cellular and Molecular Biology) recommended. **Grade Mode:** A.
Prerequisites: CHEM 302.
Restrictions: Must be Undergraduate Level.
- BIOS 412 - General Biochemistry II** Credits 3
Principles of metabolic processes; mathematical treatment of bioenergetics emphasizing major concepts and problem solving. **Notes:** BIOS 111 and BIOS 113 (Fundamentals of Cellular and Molecular Biology) recommended. **Grade Mode:** A.
Prerequisites: CHEM 302.
Restrictions: Must be Undergraduate Level.
- BIOS 413 - Laboratory in General Biochemistry** Credits 2
A laboratory course to accompany BIOS 411, BIOS 412 (CHEM 411, CHEM 412). The isolation, characterization and analysis of biomolecules including the use of biochemical instrumentation and methodology for work in protein structure, enzymology, metabolism and genetics. BIOS 111 and BIOS 113 (Fundamentals of Cellular and Molecular Biology) recommended. **Grade Mode:** A.
Prerequisites: CHEM 302.
Restrictions: Must be Undergraduate Level.
Fee: Lab \$175.
- BIOS 424 - Advanced Molecular Techniques** Credits 2
Continuation of the molecular techniques introduced in BIOS 332 laboratory. Includes various techniques of advanced molecular analysis such as RNA isolation, reverse transcription, expression constructs, northern blotting, in situ hybridization, and genotyping. **Lecture/Lab Hours:** Six hours lab. **Grade Mode:** A.
Prerequisites: BIOS 322.
Restrictions: Must be Undergraduate Level.
Fee: \$95.
- BIOS 430 - Topics in Natural Resource Management** Credits 1-4
Selected topics in natural resource management. **Notes:** May be taken for a total of 8 credits with different content. Au Sable offering. **Grade Mode:** A.
Restrictions: Must be Undergraduate Level.
- BIOS 431 - Developmental Biology** Credits 4
Analyzes the molecular, genetic and cellular mechanisms that control fertilization, the development of body form, cell specialization and differentiation as well as metamorphosis, maturation and aging. Laboratory emphasizes gametogenesis, fertilization, comparative embryology of vertebrates and invertebrates and directed experimental manipulation of embryos. **Lecture/Lab Hours:** Three hours lecture, four hours laboratory. **Grade Mode:** A, N.
Prerequisites: BIOS 312.
Restrictions: Must be Undergraduate Level.
Fee: Lab \$95.

BIOS 440 - Topics in Advanced Biology**Credits 1-4**

Selected topics of current interest and concern are studied. **Notes:** Course may be taken multiple times for credit with different content (section title). **Grade Mode:** A.

Restrictions: Bio Sci:Secondary Instruction (BISI), Pre-Chiropractic (BIHC), Environmental Science (BIES), Pre-Medical Studies (BCPM), Biochemistry (BCHM), Pre-Med/Pre-Health Care Profes (BPRE), General Science (BSBG) or Human Biology (BIHB); and Undergraduate Level.

BIOS 445 - Immunology**Credits 3**

A study of the structures and functions of the immune system, humoral and cell mediated immunity, and analysis of medically significant disorders of the immune system. **Grade Mode:** A.

Prerequisites: BIOS 312 (may be taken concurrently).

Restrictions: Must be Undergraduate Level.

BIOS 446 - Ornithology**Credits 4**

Systematics, distribution, physiology, behavior and ecology of birds. Field identification emphasized. **Lecture/Lab Hours:** Two hours lecture, four hours laboratory/field trip. Saturday field trips are required. **Grade Mode:** A.

Prerequisites: BIOS 100 and BIOS 110; or BIOS 112 and BIOS 114.

Restrictions: Must be Undergraduate Level.

Fee: \$95.

BIOS 450 - Directed Research**Credits 1-4**

Literature and laboratory or field research of a specific subject or technique in biology; advanced students gain experience in experimental design, laboratory investigation and technical writing. **Notes:** Special approval required. Requires a written report. May be taken in subsequent semesters for a total of 4 credits. **Grade Mode:** A.

Restrictions: Must be Junior Class, or Senior Class; a Major in Biological Science (BIOS), a Major in Biochemistry (BCHM), a Major in Bio Sci:Secondary Instruction (BISI) or a Major in Human Biology (BIHB); and Undergraduate Level.

Fee: Lab \$95.

BIOS 452 - Directed Studies in Environmental Sciences**Credits 1-2**

This course is taken as an arranged course in consultation with an academic advisor. Course is taken when it is determined that a student is deficient in content and/or credits in a given subject matter. The specific content of the course will be recorded on the student's transcript to indicate a student's completion of the major specific requirement(s) for graduation in that major. **Notes:** May be taken for credit multiple times for a maximum of 6 credits. **Grade Mode:** A.

Restrictions: Must be Undergraduate Level.

BIOS 455 - General Virology**Credits 4**

Virology is a course that examines the diversity of plant, animal and bacterial viruses. Emphasis on topics such as: molecular interactions between the host and virus, the genetics and chemical nature of viruses and the replication strategies of viruses. How viruses caused disease, how they are used in biotechnology and their overall impact on society will also be discussed. Bacteriophage and tissues culture techniques will be stressed in laboratory. **Lecture/Lab Hours:** Three hours lecture, four hour laboratory. **Grade Mode:** A, N.

Prerequisites: BIOS 111 and BIOS 113; BIOS 282 or BIOS 380.

Restrictions: Must be Undergraduate Level.

Fee: \$95.

BIOS 460 - Clinical Observation Practicum**Credits 1-2**

- Pre-Medical Practicum
- Pre-Dental Practicum
- Pre-Medical Technology
- Pre-Veterinary Practicum

Practicum: A professionally supervised observation, demonstration and study in a local medical, dental or laboratory facility. Introduction to health care philosophies, hospital and patient routines, personnel, instrumentation and specific treatment practices. **Notes:** Special Approval required. Case study and research paper required. Thirty hours of observation. May be taken for 2 credits total. **Grade Mode:** A.

Restrictions: Must be Junior Class, or Senior Class; and Undergraduate Level.

Fee: Insurance \$75.

BIOS 470 - Seminar in Advanced Biology**Credit 1**

Literature research followed by oral presentation, group discussion and evaluation; independent thought and study stressed. **Notes:** May be taken twice for a maximum of 2 credits. **Grade Mode:** A.

Restrictions: Must be Junior Class, or Senior Class; and must be Undergraduate Level.

BIOS 480 - Internship**Credits 1-2**

Professionally supervised participation in pre-approved research or a project at an off-campus site. Documentation of the time spent and the activities performed as well as a written paper explaining the project are required. **Notes:** Special Approval required. A minimum of thirty hours of involvement. May be taken twice for a maximum of 2 credits. **Grade Mode:** A.

Restrictions: Must be Undergraduate Level.