BIOLOGY

Chair: Dorothy Lobo, Department of Biology

The Biology curriculum is designed to give students a basic diversified background in the life sciences and prepare them for graduate work, professional school (medicine, dentistry, podiatry, chiropractic, etc.), laboratory work in government and industry, and careers in teaching.

National Biological Honor Society: Beta Beta Beta, Chi Eta Chapter, requires completion of at least ten credits of biology and a 3.2 or better GPA in biology courses.

Department Honors can be earned in Biology based on the following criteria being met:

- Achieving a 3.3 or better overall GPA with a 3.5 or better GPA in biology courses;
- Completing two additional courses (6 credits) at the 300 or 400 level;
- Completing six credits of faculty-directed research and presenting a research thesis, leading to a public presentation of the work upon completion. Up to three credits of research may be substituted by SoS Summer Research program work (or equivalent summer research).

Programs

Majors

- B.S. in Biology (http://catalog.monmouth.edu/undergraduate-catalog/science/biology/biology-bs/)
- B.S. in Biology and Education with Endorsement in Secondary Education in Biology (http://catalog.monmouth.edu/undergraduate-catalog/science/biology/biologyeducation-bs-endorsement-secondary-education-biology/)
- B.S. in Biology with a Concentration in Molecular Cell Physiology (http://catalog.monmouth.edu/undergraduate-catalog/science/biology/biology-bs-concentration-molecular-cell-physiology/)
- B.S. in Marine and Environmental Biology and Policy (http://catalog.monmouth.edu/undergraduate-catalog/science/biology/marine-environmental-biology-policy-bs/)

Minor

- Biology (http://catalog.monmouth.edu/undergraduate-catalog/science/biology/biology-minor/)
- Environmental Biology (http://catalog.monmouth.edu/undergraduate-catalog/science/biology/environmental-biology-minor/)
- Global Sustainability (http://catalog.monmouth.edu/undergraduate-catalog/science/biology/global-sustainability-minor/)

Faculty

Jason E. Adolf, Professor. B.S., Roger Williams University; M.S., University of Hawai'i; Ph.D., University of Maryland. Specializes in phytoplankton ecology and physiology, Harmful Algal Blooms (HABs) and real-time continuous water quality monitoring in the coastal ocean.
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Tsirisoa Andrianarijaona, Lecturer. M.Eng., Institu Superieur de Madagascar; M.Sc., NY Medical College; Ph.D., Ruters University
tandrian@monmouth.edu

Pedram Daneshgar, Professor. B.A., University of Delaware; M.S., Saint Joseph's University; Ph.D., University of Florida. Research interests include community and ecosystem ecology of coastal systems including dunes and mangroves, impacts of invasive plant species, and diversity maintenance mechanisms of grasslands.
pdaneshg@monmouth.edu

Ellen Doss-Pepe, Senior Lecturer. B.S., University of Scranton; Ph.D., Rensselaer Polytechnic Institute. Specializes in biochemistry, protein folding and misfolding, and protein degradation. Current interests include the relationship of protein misfolding and degradation as underlying causes of neurodegenerative diseases and the roles of antioxidant proteins in cells during oxidative stress and neurodegeneration.
edoss@monmouth.edu

Catherine N. Duckett, .
Associate Dean, School of Science. B.A., Brown University; M.A., University of Texas at Austin; Ph.D., Cornell University. Research interests focus on the evolution of tropical flea beetles (Coleoptera: Chrysomelidae: Alticinae) using both molecular and morphological data.
cduckett@monmouth.edu

Bernadette Dunphy, Senior Specialist Professor.
Co-Director of the Pre-Professional Health Advising Committee. P.T., D.P.T., University Medicine and Dentistry, NJ. Specializes in physical therapy, sports medicine, and anatomy and physiology. Current interests are integration of clinical skills and case study work with teaching Physiology and Anatomy as well as preparing students for graduate health programs.
bdunphy@monmouth.edu

Keith Dunton, Associate Professor. B.S., M.S., Ph.D., Stony Brook University. Current research interests are focused on the ecology, management, and conservation of marine fisheries with a specialized focus on species of concern.
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Dennis Gemmell, Lecturer. B.S., Villanova University; M.S., University of North Dakota; Ph.D., Rutgers University
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Kathryn Ann Lionetti, Associate Professor. B.S., Ph.D., State University of New York at Stony Brook. Specializes in microbiology and molecular biology. Current interests include recombinant DNA technology, apoptosis, and applications of molecular biology in clinical diagnostic procedures and emerging viral diseases.
lionetti@monmouth.edu

Dorothy Lobo, Professor and Chair.
Co-Director of the Pre-Professional Health Advising Committee. B.A., Immaculate College; Ph.D., The Catholic University of America. Specializes in cell and molecular biology, and signal transduction pathways. Current research includes the regulation of stress signaling pathways during cell proliferation and programmed cell death, and the use of crafts and models for teaching molecular biology.
dlobo@monmouth.edu

James P. Mack, Professor. B.S., Monmouth University (Monmouth College); M.S., William Paterson College; Ed.D., Teachers College,

Columbia University. Specializes in anatomy and physiology. Current research includes alternative treatment for multidrug-resistant bacterial infections in health care settings including MRSA, MSSA, Pseudomas aeruginosa, E. coli (ESBL), and Enterococcus (VRE). mack@monmouth.edu

Karen Pesce, Senior Lecturer. B.A., B.S., M.S., Seton Hall University; Ph.D., Rutgers University. Specializes in environmental microbiology. Current research interests include microbial community analysis and characterization of noval biodegradative genes from polluted environments.
kpesce@monmouth.edu

Dennis Rhoads, Professor. B.A., University of Delaware; Ph.D., University of Cincinnati. Specializes in biochemistry and neuroscience. Current research on neurobiology of alcohol and drug abuse.
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Sean Sterrett, Assistant Professor. B.Sc., Butler University; M.S., Ph.D., Warnell School of Forestry and Natural Resources, University of Georgia. Specializes in wildlife biology, ecology, management and conservation with a concentration on reptiles and amphibians. Current interests include diamondback terrpin ecology and management on the Jersey Coast and influence of "Big Night" volunteer efforst to mitigate road mortality of migrating amphibians.
ssterret@monmouth.edu

Jeffrey Weisburg, Specialist Professor. B.A., Ph.D., Cornell-Weill Graduate School of Biomedical Sciences. Specializes in anatomy and physiology and immunology. Current research involves the use of nutraceuticals and food derivatives that have pharmacological properties for treat cancers of the oral cavity and leukemia.
jweiss@monmouth.edu

Courses

BY-101 Issues and Methods of Biology **Credits: 3**
Prerequisite(s): SC-100
Term Offered: Spring Term
Course Type(s): None
Major concepts in biological science and their importance in current society. Methods and approaches to questions in biology. Cannot be used in satisfaction of a major requirement in the Biology program.

BY-102 Applications in Biotechnology **Credits: 3**
Term Offered: Spring Term
Course Type(s): NS
Introduction for non-science majors. The focus is on basic principles of biotechnology along with an exploration of associated bioethical issues. The laboratory component serves to familiarize students with scientific practice.

BY-103 Environmental Science **Credits: 3**
Term Offered: All Terms
Course Type(s): NS
Examines society's effects on the natural environment and current efforts to address environmental issues in a sustainable manner. Stresses the interdisciplinary nature of environmental issues, and that resolution of environmental problems sustainably involves the application of sound scientific information, but at the same time involves social, political, cultural, and economic values as well.

BY-104 Human Biology **Credits: 3**
Term Offered: All Terms
Course Type(s): NS
Introductory course for non-science majors. Focus is on basic structure and function of human body systems and diseases of these systems. The laboratory component serves to familiarize students with scientific practice.

BY-105 Introductory Biology and Human Development **Credits: 3**
Term Offered: All Terms
Course Type(s): NS
An introductory-level survey of biology with an emphasis on human biology that includes human development, aging, genetics and other topics selected to support the social work program. An introduction to neurobiology will be provided with applications in mental health. Not for credit toward a major in biology. For Social Work majors only.

BY-106 The Brain - Highs and Lows **Credits: 3**
Term Offered: Spring Term
Course Type(s): NS
An introductory neurobiology course designed for non-science majors. The focus is the study of the human brain from the highs of intelligence and creativity to the lows of depression. The brain will also be examined for its roles in drug use, from the highs of euphoria to the lows of dependence. Topics will include the interplay between genetic and environmental influences that shape the brain and its responses. Not for credit towards a major in Biology.

BY-107 Microbiology in Health and Disease **Credits: 4**
Term Offered: All Terms
Course Type(s): None
Microorganisms pathogenic for man; emphasizing etiology, modes of transmission and control. Laboratory includes proper collection of specimens, aseptic technique, cultivation, identification, and disposal of microbes. Three hours of class, two hours of laboratory per week.

BY-108 Evolution and the History of Life on Earth **Credits: 3**
Term Offered: Spring Term
Course Type(s): NS
Examines evolution both as a process and as a phenomenon. Students will examine how evolutionary processes occur in time, both very short and geological time scales, and how both are studied. Students will review the history of life on earth with emphasis on major lineages such as vertebrates, mollusks, insects and plants, as well as basic geological processes and continental drift during these time periods. Bacterial evolution will be examined in the context of the importance of understanding natural selection and evolution and their impacts on society and medicine. Emphasis will be placed on understanding evolution of groups and processes often cited in creationist arguments, to help students be prepared to enter civil discourse as informed citizens. Evidence of evolutionary change from the fossil record and DNA sequences of organisms will be compared and reviewed.

BY-109 Introduction to Biodiversity and Evolution **Credits: 4**
Term Offered: All Terms
Course Type(s): NS
An introductory course for biology majors. Focus is on evolution, phylogeny, taxonomy, origin and diversity of life, physiology of plant and animal systems, and ecological principles. Three hours of lecture and two hours of laboratory per week. Limited to students who are majors in Biology, Chemistry, Mathematics, Computer Science and Software Engineering.

BY-110 Introduction to Cell and Molecular Biology **Credits: 4**
Term Offered: All Terms
Course Type(s): NS
For biology majors and other students needing an introduction to the cellular and molecular levels of biology. Includes an introduction to cell structure and function, biochemistry and metabolism, bioenergetics, genetics and cell division, and molecular biology. Three hours of lecture and three hours of laboratory per week. Limited to majors in Biology, Chemistry, Clinical Science, Medical Laboratory Science, Mathematics, Computer Science, Software Engineering, Criminal Justice, Health Studies, and Health and Physical Education.

BY-111 Anatomy and Physiology I **Credits: 4**
Term Offered: All Terms
Course Type(s): NS
Study of human systems: structure, function and integration, including chemical and cellular base, integumentary, skeletal, muscular and nervous systems. Laboratory covers human anatomy, microscopy of tissues and organs, and physiological study of living organisms. Three hours of lecture, two hours of laboratory per week. Open to Health Studies, Health Promotion, Health and Physical Education and Education, and Nursing majors only. This course is a non-major level Biology course and cannot be used to fulfill the Biology minor. Students pursuing professional graduate health programs should register for BY-211. Students who take BY-111 are not eligible to take BY-211.

BY-112 Anatomy and Physiology II **Credits: 4**
Prerequisite(s): BY-111 passed with a grade of C- or higher
Course Type(s): NS
Study of human systems: structure, function and integration, including special senses, digestive, endocrine, cardiovascular, lymphatic and immunity, respiratory, urinary and reproductive. Laboratory covers human anatomy, microscopy of tissues and organs, and physiological study of living organisms. Three hours of lecture, two hours of laboratory per week. Open to Health Studies, Health Promotion, Health and Physical Education and Education, and Nursing majors only. This course is a non-major level Biology course and cannot be used to fulfill the Biology minor. Students pursuing professional graduate health program should register for BY-212. Students who have taken BY-112 are not eligible to take BY-212.

BY-113 Introduction to Structure and Function of Living Systems **Credits: 3**
Term Offered: All Terms
Course Type(s): NS
Examines the characteristics of living organisms. Intended primarily for future elementary teachers to provide them with a better understanding of the life sciences they will teach. Content will focus on the structure and function of cells, tissues and organs and life processes. There is an emphasis on understanding heredity, including patterns of inheritance of traits and the molecular basis of heredity, and growth and development. This is an activity-centered/lab course to demonstrate scientific inquiry (questioning, developing hypotheses, gathering data, and drawing reasonable conclusions) and how to use resources and research material in science. BY-113 does not count towards the Biology major or minor requirements.

BY-114 Unity and Diversity of Life **Credits: 3**
Term Offered: Fall Term
Course Type(s): NS
Intended primarily for future elementary school teachers to provide them with a better understanding of the life sciences they will teach. Examining the interdependence and individuality of organisms in ecosystems, populations and communities and how these organisms change over time due to life cycles, mutations, adaptions and natural selection. Classification of organism will also be covered. This is an activity-centered/lab course to demonstrate scientific inquiry (questioning, developing hypotheses, gathering data, and drawing reasonable conclusions) and how to use resources and research material in science. BY-114 does not count towards the Biology major or minor requirements.

BY-116 The Biology of Nutrition, Aging, and Anti-Aging Nutrition **Credits: 3**
Course Type(s): None
Discussions of the theories of aging and the role of nutrition in delaying aging and preventing degenerative disease. Analysis of the scientifically sound, medically reliable evaluation of widely promoted nutritional supplements, including the anti-aging nutrients: vitamins, minerals, amino acids, nucleic acid derivatives, lipids and derivatives, pharmaceuticals and chemicals (BHA, BHT, DMSO, etc.) and other supplements (L-Carnitine, ginseng, etc.)

BY-118 The Mighty Microbes **Credits: 3**
Term Offered: Spring Term
Course Type(s): NS
An introductory microbiology course designed for non-science majors. Students will investigate microbiology in everyday living. Topics will include the role microbes have in health, disease, the environment, and food and beverage production. Attention will be devoted to microbiology related current issues. Students will learn the impact microbes have in society so that they develop awareness, knowledge of and appreciation of microbiology.

BY-119 Introductory Biology Major Seminar **Credits: 1**
Term Offered: All Terms
Course Type(s): None
Designed for first-year students in any of the majors offered by the Biology Department, this course will introduce students to the academic requirements required for the major, and the related skills to be successful in college and beyond, including University resources, curricular and co-curricular requirements, and opportunities related to the Biology major. Preparation for research and advanced coursework will be emphasized, and students will be introduced to career resources. Transition to studying and integrating into the Monmouth University Department of Biology will be complemented by the assistance of a peer learning assistant for the course. Attendance at a limited number of campus events will be required. This course will be offered as "pass/fail". Limited to students with 30 or fewer credits.

BY-201 Introduction to Biotechnology **Credits: 3**
Prerequisite(s): BY-110 passed with a grade of C- or higher
Term Offered: All Terms
Course Type(s): MC
Introduction to recent advances in biotechnology: the use of living organisms to create products, applications or processes that improve the quality of life for humans and other species. Presents historical and modern applications of biotechnology that impact our everyday lives. An overview of current developments and applications of microbial, agricultural, animal, marine and forensic biotechnology, bioremediation, and medical biotechnology will be presented. Regulatory agencies and policies that govern the biotechnology industry will be discussed, and students will also learn to formulate opinions about ethical, legal and social issues associated with biotechnology.

BY-205 Zoology **Credits: 3**
Prerequisite(s): BY-109 passed with a grade of C- or higher
Term Offered: All Terms
Course Type(s): None
This course provides an introductory survey of vertebrate and invertebrate zoology. Topics covered include taxonomy and classification, anatomy and physiology, behavior and ecology, and evolutionary relationships of the major phyla of the animal kingdom with a specific focus on local marine species. The laboratory component of the course focuses on the diversity of the animal kingdom from a structural, functional and ecological perspective. Labs will include exercises that will include examination of live organisms, dissections and examinations of preserved specimens, and field trips.

BY-206 Introduction to Oceanography **Credits: 3**
Term Offered: All Terms
Course Type(s): MEBP
Our lives are linked to the oceans, and through this class you will gain a better understanding of our natural world by learning the key aspects and natural processes of our planet's oceans. Topics covered include ocean origins, chemistry, physics, atmospheric interactions, biological oceanography and environmental issues including climate change impacts. Course will include field trips.

BY-209 Environment and Human Health **Credits: 3**
Prerequisite(s): BY-109 and BY-110, both passed with a grade of C- or higher
Term Offered: Fall Term
Course Type(s): MC, MEBP
Human activities are adversely affecting ecosystems throughout the world. Some of these changes may be deleterious to human health. The purpose of this course is to provide students with an understanding of the relationship between the environment and human health. Specific topics that will be covered are the importance of biodiversity to human health, the relationships between global warming and vector-borne diseases, microbial evolution and resistance of pathogenic organisms, persistent pollutants and toxicity, and the effect of environmental disasters on human health. A focus of this course will be to integrate several areas of biology including microbiology, toxicology, and environmental science.

BY-210 Forensic Genetics and DNA Analysis **Credits: 3**
Prerequisite(s): BY-110 and CJ-211
Term Offered: Spring Term
Course Type(s): None
Focus on fundamental principles of DNA and genetic analysis and their applications in forensics. Designed for criminal justice majors who have had an introduction to Mendelian and molecular genetics and to DNA structure, but who need more background in the underlying biology of forensic DNA analysis and interpretation. Sources of DNA will be presented along with methods for DNA extraction, amplification of DNA by polymerase chain reaction, analysis of restriction fragment length polymorphisms and short tandem repeats. Open only to Criminal Justice majors.

BY-211 Physiology with Anatomy I **Credits: 4**
Prerequisite(s): BY-110, CE-111, and CE-112 all passed with a grade of C- or higher
Term Offered: All Terms
Course Type(s): None
Lecture and laboratory course Study of Human Systems: Their structure, function and integration. Laboratory covers gross human anatomy and physiology. Three hours of lecture and two hours of laboratory per week. Open only to Biology, Chemistry, Medical Lab Science, Clinical Lab Science, Health, and Psychology majors. Students who have taken BY-211 are not eligible to take BY-111.

BY-212 Physiology with Anatomy II **Credits: 4**
Prerequisite(s): BY-110, BY-211, CE-111, and CE-112 all passed with a grade of C- or higher
Course Type(s): None
Lecture and laboratory course Study of Human Systems: Their structure, function and integration. Laboratory covers gross human anatomy and physiology. Three hours of lecture and two hours of laboratory per week. Open only to Biology, Chemistry, Medical Lab Science, Clinical Lab Science, Health, and Psychology majors. Students who have taken BY-212 are not eligible to take BY-112.

BY-214 Botany **Credits: 3**
Prerequisite(s): BY-109 passed with a grade of C- or higher
Course Type(s): None
Characteristics of the major plant groups, principles of plant taxonomy, considerations of evolutionary and ecological relationships. Two hours of class, two hours of laboratory per week.

BY-216 Introduction to Genetics **Credits: 4**
Prerequisite(s): BY-110 passed with a grade of C- or higher
Term Offered: All Terms
Course Type(s): TL
Focuses on one of the core concepts of biology; the flow, exchange, and storage of hereditary information. Topics will include principles of classical and molecular genetics, including transmission, arrangement, and alteration of genetic information; structure, function, and regulation of the genetic material; biological variation resulting from recombination, mutation, and population genetics; applications to human heredity. Two 80-minute lectures and one 3-hour lab per week.

BY-220 Environmental Biology and Policy **Credits: 3**
Prerequisite(s): BY-109
Term Offered: Fall Term
Course Type(s): ME, SUS
Focuses on human use of natural resources and the environment and the problems and impacts that result from those uses. By taking an interdisciplinary perspective, students will gain an understanding of the scientific, political and socioeconomic factors that underlie resolution of these problems.

BY-221 Introduction to Global Sustainability **Credits: 3**
Term Offered: Fall Term
Course Type(s): MEBP, SUS
Introduces students to the global, environmental, economic and social foundations of sustainability and the policy and scientific challenges involved with accommodating population growth, development, and resources used while assuring that future generations will have the natural and economic resources to support an enhanced quality of life. An emphasis will be placed on understanding of sustainability principles from multiple perspectives and cross-disciplinary application of sustainable practices. Also listed as PS-223.

BY-223 General Microbiology **Credits: 4**
Prerequisite(s): BY-110 passed with a grade of C- or higher
Term Offered: All Terms
Course Type(s): MEBP
Morphology, taxonomy, physiology, genetics, and control of microorganisms; history of microbiology. Three hours of class, three hours of laboratory per week.

BY-250 Research in Molecular Cell Physiology **Credits: 1-3**
Prerequisite(s): BY-110 passed with a grade of C- or higher
Term Offered: All Terms
Course Type(s): EX5, MC
Faculty-student collaborative research lab course designed to introduce students to the research process. Students will work in small groups under faculty supervision to conduct research on a project in molecular cell physiology determined by the directing faculty member. Students will be involved in the research process by developing hypotheses, planning and carrying out experiments using modern lab techniques, analyzing data, and evaluating resource information. Research may be extended in detail in BY-450. Limited to sophomore Biology majors.

BY-262 Primate Behavior, Evolution, and Ecology **Credits: 3**
Term Offered: Spring Term
Course Type(s): NS
The study of primatology, which examines the lifeways, biology, and behavior of our closest living relatives. Various topics will be explored including taxonomy and classification, diet, behavior, grouping patterns, locomotion, and land usage patterns of monkeys, apes and prosimians. These topics will be explored within the frameworks of natural selection, sexual selection, and evolution. Also listed as AN-262.

BY-264 Environmental Field Methods **Credits: 3**
Prerequisite(s): BY-109, CE-111, CE-111L, CE-112 and CE-112L
Term Offered: Fall Term
Course Type(s): MEBP
Environmental Field Methods provides students with hands on experience in environmental and marine research by learning a suite of techniques and working under real field conditions. Students become familiar with the use and application of standard environmental and marine science instruments and sampling techniques and devices, as well as data handling, management and analysis techniques. One course meeting per week for three hours. This course will be taught as a fully integrated team-taught course, with two faculty who have environmental and marine research expertise.

BY-290 Open Water Scuba Certification Course **Credits: 2**
Term Offered: All Terms
Course Type(s): MEBP, OUTDR
The Open Water Scuba Certification course entails completion of the Professional Association of Diving Instructors (PADI) Open Water Diver course, the world's most popular scuba course. Completion of this course leads to PADI scuba certification as an open water diver. Limited to 8 students. Skills course: Outdoor Pursuits (Individual). This is a pass/fail course. Also listed as PE-290.

BY-298 Special Topics in Biology (200 Level) **Credits: 1-3**
Term Offered: All Terms
Course Type(s): None
An intensive study of a particular subject or problem in biology to be announced prior to registration. May be conducted in a lecture, seminar, or laboratory format. Please note: when Scuba is offered as BY-298 it does not carry a course type of MC. If a prerequisite is required it will be announced in the course schedule.

BY-299 Independent Study in Biology **Credits: 1-3**
Term Offered: All Terms
Course Type(s): None
Principles of independent study and research; critical review of published work on a designated topic in the biological sciences or original research; preparation of a research paper or review article in publishable format or oral presentation of research results. Laboratory or field work arranged as needed. Requires submission and approval of an "Application for Independent Study" (an e-form is available on WEBadvisor) with a faculty mentor. To take this course, students need prior permission of the directing professor and department chair and Sophomore or higher standing in Biology (Total of all independent study credits to be counted towards the degree may not exceed six, unless approved by the Dean).

BY-301 Vertebrate Histology **Credits: 3**
Prerequisite(s): BY-205 passed with a grade of C- or higher
Course Type(s): MC
Microscopic structure of vertebrate cells, tissues, and organs, emphasizing microscopic anatomy of the human body. Laboratory identification of vertebrate tissues. Two hours of class, three hours of laboratory per week.

BY-308 Unifying Concepts in Biology **Credits: 3**
Prerequisite(s): BY-113 and BY-114 or permission of the instructor
Course Type(s): None
Unifying Concepts in Biology is a capstone course for elementary education majors in the Interdisciplinary Studies for Elementary Educators (ISEE) program. This course integrates scientific methodology, life science, earth science, and environmental science concepts and is designed to prepare future educators for the K-8 science classroom. A strong emphasis is placed on exploring relationships between living organisms and the environment through the use of hands on lab activities, problem-based approaches, and inquiry learning. BY-308 does not count toward the biology major or minor requirements.

BY-310 Biochemistry and Lab **Credits: 4**
Prerequisite(s): BY-216 and CE-242 passed with a grade of C- or higher; and EN-101 and EN-102 or permission of the instructor
Course Type(s): MEBP, WT
A survey of the major principles of biochemistry with attention to the structures and functions of proteins, carbohydrates and fats; the major pathways for metabolism of proteins, carbohydrates and fats; and the biochemical basis of DNA replication and gene expression. Laboratory provides hands-on experience in selected biochemical techniques with an emphasis on protein characterization. Designed to provide practice and critique in effective writing and appropriate writing style and format.

BY-314 Topics in Horticulture **Credits: 3**
Term Offered: Spring Term
Course Type(s): MC, ME, MEBP
Principles and practices of plant culture; practical experience through greenhouse projects; the horticulture industry and career possibilities; field trips to places of horticultural interest. Two hours of class, three hours of laboratory per week. Field trips arranged.

BY-317 Tropical Island Ecology **Credits: 3**
Term Offered: Spring Term
Course Type(s): EX5, FLT, ME, MEBP, NS
A field course focusing on investigations of plants, animals, and natural ecosystems of the Bahamas with emphasis on marine ecosystems, island ecology, resource management, and sustainable development.

BY-322 Ichthyology **Credits: 4**
Prerequisite(s): BY-109 and BY-205, passed with a C- or better
Term Offered: Fall Term
Course Type(s): MEBP
A survey of all-extant groups of fishes (e.g., bony fishes, cartilaginous fishes, and jawless fishes), including sections on evolution, taxonomy, form and function, biogeography, behavior, and ecology. Laboratory component will include required dissections. There will be several scheduled off campus field trips. Three hours of lecture and three hours of laboratory per week.

BY-324 Applied Microbiology **Credits: 4**
Prerequisite(s): BY-223 passed with a grade of C - or higher
Term Offered: Spring Term
Course Type(s): MC, ME, MEBP
Microorganisms of food, water, soil, dairy products, industrial processes, disease, and genetic engineering. Three hours of class, three hours of laboratory per week.

BY-327 Design and Analysis of Biological Experiments **Credits: 3**
Prerequisite(s): MA-151 or MA-220 or BE-251 passed with a grade of C or higher or permission of the instructors.
Term Offered: Spring Term
Course Type(s): MEBP
The purpose of this course is to learn about the statistical design & analysis of biological experiments. After learning mathematical techniques of designing experiments, and statistical analyses customized to them, students will be presented with a broad research question by the instructors. Literature surveys will be a critical part of the course to allow students to find pertinent, relevant, potentially publishable biological questions that address a specific aspect of the larger question posed by the instructors. Students will design their own experiment addressing their question, generate their own data collection plan, collect their data, and then analyze their data using statistical techniques taught in class. This course will involve field/lab work for data collection and computer work in the statistical analysis of the final data. Students will defend their question, design and analysis from both a statistical and biological perspective. At the end of the semester students will complete a formal manuscript in journal format. This course can be used to fulfill the Mathematics or Statistics minor and the Bio/MEBP elective. This course is a research based course and students must have demonstrated a strong interest in and potential for research. Also listed as MA-327.

BY-341 Marine Biology **Credits: 4**
Prerequisite(s): BY-205 and BY-214, both passed with a grade of C- or higher
Term Offered: Fall Term
Course Type(s): None
Biota of the oceans and inshore waters with an emphasis on ecology, functional morphology, and marine and estuarine habitats. Basic oceanography is also included. Marine biology is a laboratory course supported by lectures and field projects. Field trips outside of class time may be required.

BY-342 Coastal Zone Management **Credits: 3**
Prerequisite(s): BY-220 passed with a grade of C- or higher, and EN-101 and EN-102
Term Offered: Spring Term
Course Type(s): ME, WT
Focus on the impact of increased demand on the coastal environment based on the theme that management of an environment for multiple purposes requires an understanding of the effects of use and exploitation throughout that environmental system and how decisions can be made in an effective, equitable manner.

BY-360 The Business of Biotechnology: From the Bench to the Market **Credits: 3**
Prerequisite(s): Limited to junior or senior biology majors or other students with approval by the course faculty. BY-110 or BY-201 completed with a grade of C- or higher. For Business majors: BY-102, BY-110, or BY-201, completed with a grade of C- or higher
Term Offered: Fall Term
Course Type(s): MC
Tomorrow's biotechnology leaders require a breadth of cross-functional knowledge to face the scientific, regulatory, and financial challenges for developing biotech companies in the 21st century. This course will provide students with a strategic overview of the business of biotechnology, exploring the integration of science, technology, the regulatory framework, financial requirements, and market forces that drive the industry. The course will introduce students to basic aspects of molecular biology related to product development in the biopharmaceutical industry, and the regulatory and financial requirements for drug development, placing emphasis on real-world application and the challenges of bringing new biotechnology drugs to market for the treatment of human disease. Limited to junior or senior biology majors or other students with approval by the course faculty. BY-110 or BY-201 completed with a minimum grade of C- or higher is required. For Business majors BY-102, BY-110, or BY-201, completed with a minimum grade of C- or higher are required.

BY-370 Cell Biology **Credits: 3**
Prerequisite(s): BY-310
Course Type(s): None
In-depth study of biology at the cellular and subcellular levels. Integrates principles of biochemistry into an understanding of cell structure and physiology. Prerequisite: BY-310

BY-375L Laboratory in Molecular and Cellular Biology **Credits: 3**
Prerequisite(s): BY-310, and EN-101 and EN-102 or permission of the instructor
Term Offered: All Terms
Course Type(s): MEBP, RD, WT
Designed to introduce biology majors to basic laboratory techniques used in molecular and cellular biology. Students will develop proficiency in modern techniques in molecular and cellular biology including micro pipetting, bacterial culturing and sterile technique, solution preparation, DNA extraction, restriction digestion of DNA, DNA sub cloning, gel electrophoresis of nucleic acids and proteins, nucleic acid blotting and analysis with molecular probes, DNA sequencing, polymerase chain reaction (PCR), immunological techniques for analysis of proteins, mammalian cell culture and transfection, and DNA sequence analysis on the Internet. The use of traditional and Internet information resources for molecular and cellular biology will also be emphasized. The presentation of data in both oral and written form will be emphasized. Partially fulfills the reasoned oral discourse requirement for biology and biology/molecular cell physiology.

BY-388 Cooperative Education: Biological Sciences **Credits: 1-4**
Prerequisite(s): 6 credits in Biology, overall G.P.A. of 2.00 and Junior standing or higher
Term Offered: All Terms
Course Type(s): EX2
Provides an opportunity for students to fulfill the Experiential Education requirement by pursuing a short-term cooperative work experience in biology or for students who, are currently employed in a biological or medical field, to integrate the work with a related academic component. May be repeated for credit. This is a pass/fail course. Departmental approval is required to take this course.

BY-389 Internship in Biological Science **Credits: 1-3**
Prerequisite(s): Overall GPA of 2.00; Junior status, at least six credits of biology courses and departmental approval
Term Offered: All Terms
Course Type(s): EX1
Complements the practical experience gained by students at internship sites, such as hospitals, clinics, private practices, research laboratories, environmental agencies, museums, botanical gardens, and zoos with a significant set of academic goals. May be repeated once for credit. This is a pass/fail course.

BY-395 Seminar in Marine and Environmental Biology **Credits: 3**
Term Offered: Spring Term
Course Type(s): RD
A seminar-style course for juniors in the Marine and Environmental Biology and Policy (MEBP) major.

BY-398 Special Topics in Biology (300 Level) **Credits: 1-3**
Prerequisite(s): BY-110
Term Offered: All Terms
Course Type(s): None
An intensive study of a particular subject or problem in biology to be announced prior to registration. May be conducted in a lecture, seminar, or laboratory format. If a prerequisite is required it will be announced in the course schedule.

BY-399 Independent Study in Biology **Credits: 1-3**
Term Offered: All Terms
Course Type(s): None
Principles of independent study and research; critical review of published work on a designated topic in the biological sciences or original research; preparation of a research paper or review article in publishable format or oral presentation of research results. Laboratory or field work arranged as needed. Requires submission and approval of an "Application for Independent Study" an e-form is available on WEBadvisor) with a faculty member. Students must have prior permission of the directing professor and department chair; and Junior standing in Biology to take this class. (Total of all independent study credits to be counted towards the degree may not exceed six, unless approved by the Dean.)

BY-404 Animal Behavior **Credits: 3**
Prerequisite(s): PY-103 or BY-103 or above, passed with a grade of C- or higher
Course Type(s): None
Why and how animals (vertebrates and invertebrates) do the things they do. Emphasizes rules governing the evolution of behavior rather than mere description of how animals behave. Focus includes behavioral ecology, habitat selection, feeding strategies, predator-prey tactics, mating systems and strategies, social behavior (conflict and cooperation) and population dynamics. The course begins with an historical overview and ends with the evolution of human behavior. Also listed as PY-404.

BY-404L Animal Behavior Laboratory **Credits: 1**
Prerequisite(s): PY-311 and PY-320 passed with a grade of C or higher
Co-requisite(s): BY-404 or PY-404
Term Offered: Spring Term
Course Type(s): None
Methods in the study of animal behavior. Projects on instinctive behavior, early experience, learning, dominance relationships, territoriality, behavioral ecology, and sociobiology. One all-day field trip and an independent project will be required.

BY-406 Introduction to Neurosciences **Credits: 3**
Prerequisite(s): BY-216 passed with a grade of C- or higher
Term Offered: Spring Term
Course Type(s): MC, ME
The organization of the nervous system in terms of its anatomy, physiology, neurochemical correlates, and evolution; behavioral processes such as attention, sleep, motivation, instinct, learning, and languages.

BY-406L Neurosciences Laboratory **Credits: 1**
Co-requisite(s): BY-406
Course Type(s): MC
Human and animal neuroanatomy; surgical techniques, including lesion, stimulation, and perfusion; histology; drug and hormone administration; physiological recording techniques. Three hours per week.

BY-410 Molecular Biology **Credits: 3**
Prerequisite(s): BY-216 or BY-310 or CE-331 passed with a grade of C- or higher
Term Offered: All Terms
Course Type(s): None
Provides a detailed examination of the central dogma of molecular biology - DNA replication, transcription, reverse transcription, and translation - in viruses, prokaryotes, and eukaryotes. Standard techniques of biotechnology used to study molecular biology will be emphasized. Additional topics, including eukaryotic chromosome structure and regulation of gene expression, will also be discussed.

BY-412 Vertebrate Physiology and Laboratory **Credits: 3**
Term Offered: Spring Term
Course Type(s): MC
Comparative vertebrate physiology, with emphasis on osmotic regulation, nutrition, circulation, respiration, and muscle physiology. One hour of class, four hours of laboratory per week.

BY-420 Applied Field Biology **Credits: 1-3**
Prerequisite(s): BY-205, BY-214, and BY-220 or permission of the instructor
Term Offered: Spring Term
Course Type(s): EX1, MEBP
Applied Field Biology is a research-based applied ecology course that combines lectures, hands-on field and laboratory activities, and focused data collection and analysis to allow participating students to understand techniques used by scientists and environmental managers in order to provide information necessary to perform key functions associated with natural resource and ecosystem conservation and management. The course is designed to allow students in the Marine and Environmental Biology and Policy Program (MEBP) to fulfill their Experiential Education requirement. This course is repeatable twice for credit.

BY-424 Evolution **Credits: 3**
Prerequisite(s): BY-109 and BY-216, both passed with a grade of C- or higher
Term Offered: All Terms
Course Type(s): MC, ME, MEBP
Synthetic theory of evolution, including sources of genetic variability, Hardy-Weinberg, natural selection, genetic drift, balanced polymorphism, molecular evolution, speciation and the origin of life. Three hours of class per week.

BY-425 Principles of Developmental Biology **Credits: 4**
Prerequisite(s): BY-216 passed with a grade of C- or higher
Term Offered: All Terms
Course Type(s): None
The study of major morphological changes during development and the analysis of causative factors. Model organisms used in the study of development include: sea urchin, nematode worm, Drosophila, frog, and mouse. Topics include: fertilization, growth, differentiation, morphogenesis, regeneration, and tissue interactions. The genetic control of development will be emphasized.

BY-427 Cancer Biology **Credits: 3**
Co-requisite(s): BY-370 or BY-410
Term Offered: Spring Term
Course Type(s): MC
Course will provide students with a foundation in the molecular biology of cancer. Topics include the genetic and molecular changes that lead to transformation, oncogenes, tumor suppressors, viruses, angiogenesis, metastasis, tumor immunology, and clinical trials and treatments. Primary literature and review articles, as well as field work, will be used to understand advances in cancer biology and treatment.

BY-430 Neuroscience Beyond Neurons **Credits: 3**
Prerequisite(s): BY-216
Term Offered: Spring Term
Course Type(s): MC
A seminar-style class with focus on the different cell types that make up the brain and how they interact and signal with one another. Topics include how glial-neuronal interactions impact brain development, brain metabolism, and numerous pathological conditions. Objectives will be met through lectures and class discussions, readings from primary literature, journals clubs and class debate.

BY-431 Immunology **Credits: 3**
Prerequisite(s): BY-110 passed with a grade of C- or higher
Term Offered: All Terms
Course Type(s): MC
Components of the immune system; biological individuality and the recognition of "foreignness"; structure of antibodies; cellular immunity and graft rejection; blood group antigens; the immune system and cancer development; immunogenetics; clinical and experimental applications. Two hours of class, two hours of laboratory per week.

BY-440 Ecology **Credits: 4**
Prerequisite(s): BY-205 or BY-214, and BY-220 all passed with a grade of C- or higher, and EN-101 and EN-102 and Senior standing.
Term Offered: Fall Term
Course Type(s): WT
Lecture and laboratory course examining the concepts of ecology and evolutionary biology, the interaction of organisms and their environment, population ecology, community ecology, and ecosystems dynamics. 3 hours of lecture and 3 hours of lab/field work per week. Prerequisites: BY-205 or BY-214, and BY-220 all passed with a grade of C- or higher, and EN-101 and EN-102 and Senior standing

BY-442 Natural Resource Conservation and Management **Credits: 3**
Prerequisite(s): BY-220 and BY-440, both passed with a grade of C- or higher, and EN-101 and EN-102
Term Offered: Spring Term
Course Type(s): SUS, WT
The principles of ecology and resource management are used to analyze contemporary environmental problems and highlight legislative, technological, and methodological solutions to environmental problems that move us toward a sustainable society.

BY-450 Research in Molecular Cell Physiology **Credits: 1-3**
Prerequisite(s): BY-310 passed with a grade of C- or higher
Term Offered: All Terms
Course Type(s): EX5, MC
A faculty-student collaborative research lab course. Students will work in small groups under faculty supervision to conduct comprehensive research on a project in molecular cell physiology determined by the directing faculty member. Students will experience all aspects of the research process, from developing hypotheses, planning and carrying out experiments using modern lab techniques, and analyzing data, to preparing research results for publication. May be taken to extend research initiated in BY-250. May be repeated for a maximum of six credits. Limited to Junior or Senior biology majors.

BY-475 Endocrinology **Credits: 3**
Prerequisite(s): BY-310 or twelve credits in Biology
Term Offered: Spring Term
Course Type(s): MC, ME
Introduction to biochemical, molecular, and physiological aspects of the vertebrate endocrine system and mechanisms by which hormones maintain homeostasis in animals, including humans. Topics to be studied include: molecular structures: biochemical properties and interactions of different categories of hormones and their receptors; major endocrine systems that regulate reproduction, growth, development, and metabolism; neuroendocrinology; and pathophysiology of the endocrine system. Hormones and organs that influence processes such as calcium homeostasis, digestion, salt balance, carbohydrate metabolism, and sex differentiation and development will be examined. Endocrine regulation of male and female reproductive organs and reproduction will also be discussed, including the hormonal control of fertilization, implantation, placental function, pregnancy, parturition, lactation, and contraception.

BY-489 Internship in Biological Science **Credits: 3**
Prerequisite(s): 6 credits in Biology, Junior standing and a minimum G.P.A. of 2.00
Term Offered: All Terms
Course Type(s): EX1
Complements the practical experience gained by students at internship sites, such as hospitals, clinics, private practices, research laboratories, environmental agencies, museums, botanical gardens, and zoos with a significant set of academic goals. May be repeated once for credit. Departmental approval is required to take this course. This is a pass/fail course.

BY-495 Senior Seminar **Credits: 1**
Prerequisite(s): completion of 90 credits; for Biology majors only
Term Offered: All Terms
Course Type(s): RD
A seminar course with presentations by guest scientists as well as students. Gauges students' abilities to draw upon a broad background of coursework and experience to organize, present, discuss, and evaluate topics of current interest in biology.

BY-499 Independent Study in Biology **Credits: 1-3**
Term Offered: All Terms
Course Type(s): None
Principles of independent study and research; critical review of published work on a designated topic in the biological sciences or original research; preparation of a research paper or review article in publishable format or oral presentation of research results. Laboratory or field work arranged as needed. Requires submission and approval of an "Application for Independent Study" (an e-form is available on WEBadvisor) with a faculty member. Students are required to have prior permission of the directing professor and department chair and Senior standing in Biology to take this course. (Total of all independent study credits to be counted towards the degree may not exceed six, unless approved by the Dean.)

BY-499T Independent Study in Biology with Thesis **Credits: 1**
Term Offered: All Terms
Course Type(s): None
Preparation and submission of a thesis in science journal format. The thesis will contain results from the completion of independent study and research and will include appropriate description of the background and methods for the project and discussion of the results and its significance. It is designed specifically for students desiring Biology departmental honors. Students are required to have permission of the course advisor and Senior standing in Biology, Biology with a concentration in Cell and Molecular Physiology, or Marine and Environmental Biology and Policy in order to take this course.