BIOLOGY
(AS) {BIOL}

003. "What every lawyer, businessperson, and citizen needs to know about molecular biology". (C) Living World Sector. All classes. Staff. Prerequisite(s): High school biology required. May not be counted toward the Biology Major. Only offered through the College of Liberal and Professional Studies.

This seminar is intended for students who do not plan to take any additional biology courses, but would like to know what "all the excitement" of modern biology is about. We will cover both the basics of molecular biology and how biotechnology effects our lives. Specific topics will include: DNA fingerprinting, environmental and health applications of genetic engineering and the human genome project.

SM 011. Humans in a Microbial World. (A) Living World Sector. All classes. Brisson.

Microbes are a fundamental part of life on this planet. This course will explore the causes and consequences of the distribution and abundance of microbes (micrbial ecology) as well as microbial evolution on human health and disease risk. We will address the interplay between human society and microbial ecology and evolution in shaping disease risk and directing scientific study. This course will apply concepts from basic biology, ecology, and evolution to study infectious microbes as living creatures.

L/L 042. (BIOL175, NURS042) An Introduction to Microbiology and Human Biochemistry. (B) Pohlschroder/Lafferty-DellaValle. Prerequisite(s): N-40 (Principles of General and Organic Chemistry) or CHEM 101 and 102 or the equivalent courses from an accredited college or university. Lab fee $150. (1.5 c.u.; 7 hours).

This lecture and laboratory course introduces students to cellular biochemistry, molecular genetics, and microbiology to provide an understanding of the fundamental processes of living organisms, particularly as observed in bacteria and humans. Topics will include the organization and characteristics of prokaryotic and eukaryotic cells, the structural and functional relationships of the major biomolecules, interrelationships of the various metabolic pathways, and the basics of molecular biology and immunology.

L/L 101. Introduction to Biology A. (A) Living World Sector. All classes. Staff. Biology Majors and Pre-Medical students should take either BIOL 101 or 121. BIOL 101 is the companion course to BIOL 102, may be taken before or after BIOL 102. Lab fee $150. (3 hrs. lec., 3 hrs. lab, 1.5 c.u.).

General principles of biology that have been established by studies of microbes, animals, and plants and the viruses of these organisms will be covered. Emphasis will be on the basic chemistry of life, cell biology, molecular biology, and genetics. The study of developmental pathways and evolutionary trends in life cycles will be explored using plants as model organisms.

L/L 102. Introduction to Biology B. (B) Living World Sector. All classes. Staff. BIOL 102 is the companion course to BIOL 101, may be taken before or after BIOL 101. Lab fee $150. (3 hrs. lec., 3 hrs. lab, 1.5 c.u.).

General principles of biology focusing on structure and function of animals, with emphasis on the principles of physiology, development, evolution, ecology, and the diversity of adaptations.

L/L 109. (BIBB109, PSYC109) Introduction to Brain and Behavior. (C) Living World Sector. All classes. Medina and Muzzio.

Introduction to the structure and function of the vertebrate nervous system. We begin with the cellular basis of neuronal activities, then discuss the physiological basis of motor control, sensory systems, motivated behaviors, and higher mental processes. This course is intended for students interested in the neurobiology of behavior, ranging from animal behaviors to clinical disorders. Familiarity with elementary physics and chemistry may be helpful.

L/L 121. Introduction to Biology - The Molecular Biology of Life. (C) Living World Sector. All classes. Staff. Prerequisite(s): Solid high school biology and strong high school chemistry or CHEM 001 or 101 taken concurrently. Biology Majors and Pre-Medical students should take either BIOL 101 or 121. BIOL 121 is the companion course to BIOL 124, may be taken before or after BIOL 124. Lab fee $150. (3 hrs. lec., 3 hrs. lab, 1.5 c.u.).

An intensive introductory lecture and laboratory course covering the cell and molecular biology, biochemistry, and genetics of animals, bacteria, and viruses. This course is comparable to Biology 101, but places greater emphasis on molecular mechanisms and experimental approaches. Particular attention is given to the ways in which modern cell biological and molecular genetic methods contribute to our understanding of evolutionary processes, the mechanistic basis of human disease, and recent biotechnological innovations.

123. Introductory Molecular Biology Laboratory. (C) Bassiri. Prerequisite(s): Advanced Placement credit for BIOL 101 or 121. Students may not take both BIOL 121 and 123 for credit. Lab fee $150. (3.5 hrs. lab., 0.5 c.u.).

An intensive introductory laboratory course emphasizing how molecular biology has revolutionized our understanding of cell and organism functions.

L/L 124. Introductory Organismal Biology Lab. (C) Robinson. Prerequisite(s): Solid high school biology or advanced placement credit for BIOL 102. BIOL 124 is the companion course to BIOL 121, may be taken before or after BIOL 121. Students may not take both BIOL 102 and 124 for credit. Lab fee $150 (1 hr. lec., 3 hrs lab., 0.5 c.u.).

An intensive introductory laboratory course in organismal biology.

140. (BIOL440) Humans and the Environment. (A) Natural Science & Mathematics Sector. Class of 2010 and beyond. Janzen. Prerequisite(s): Sophomore standing or greater. Some biology background suggested.

Intensive exposure to current issues and solutions in contemporary human interactions with the environment. Global in scope, but focused on case histories. Emphasis on providing biological and sociological background for a given major environment-human interaction, and state-of-the-art suggested solutions.

L/L 175. (BIOL042, NURS042) Principles of Microbiology. (B) Lafferty/Pohlschroder. Prerequisite(s): NURS 041 or BIOL 101 or 121 or 091 and one semester of college chemistry. May not be used in the Biology Major. Lab fee $150.

Basic microbiology, including cell physiology and anatomy of micro-organisms and host-pathogen relationships.

L/R 202. Cellular Biology and Biochemistry. (C) Staff. Prerequisite(s): BIOL 101 and 102, or BIOL 121. Strong high school background in chemistry or CHEM 102 recommended.

An introduction to protein structure, enzyme kinetics, mechanism of enzyme action and allosteric regulation of enzyme activity; introduction to cell structure and function including membrane structure, membrane receptors and signal transduction, motility, and the cell cycle.

L/R 215. Vertebrate Physiology. (A) Rome/Ren. Prerequisite(s): BIOL 102 or 121 or 124.

The course will focus on integrative aspects of physiological function of vertebrates. Comparative, environmental and quantitative approaches will be used. Major topics include muscle, the cardiovascular system, respiration, renal function and the nervous system.

221. (BIOL527, GCB 527) Molecular Biology and Genetics. (C) Bonini/Gallagher/Guild. Prerequisite(s): BIOL 101 or 121.

This course will survey the discipline of molecular genetics. Two broad areas will be considered 1) Molecular Biology: DNA replication, transcription, translation, regulation of gene expression in both prokaryotic and eukaryotic systems, and genomics and 2) Genetics: basic Mendelian & molecular genetics.

L/R 230. Evolutionary Biology. (B) Sniegowski/Schmidt, P. Prerequisite(s): BIOL 101 and 102, or BIOL 121.

Theories and mechanisms of evolution, with emphasis on the genetic basis of evolutionary change.

231. (BIBB231, PSYC131) Animal Behavior. (C) Cheney/Seyfarth/White. Prerequisite(s): BIOL 102 or 121 or PSYC 001.

The evolution of social behavior in animals, with special emphasis on group formation, cooperation among kin, mating systems, territoriality and communication.

240. Ecology: from individuals to ecosystems. (A) Helliker/Casper. Prerequisite(s): BIOL 102 or 121.

The study of living organisms in their natural environment, spanning the ecological physiology of individuals, the structure of populations, and interactions among species, including the organization of communities and ecosystem function.

L/L 251. (BIBB251) Molecular and Cellular Neurobiology. (A) Schmidt, M./Abel/Peachey. Prerequisite(s): BIOL 101 and 102, or BIOL 121; PHYS 102 or 151 strongly recommended. Lab fee $150. (3hrs. lec., 3hrs. lab, 1.5 c.u.).

Cellular physiology of neurons and excitable cells, molecular neurobiology and development. Topics include: action potential generation, synaptic transmission, molecular and physiological studies of ion channels, second messengers, simple neural circuits, synaptic plasticity, learning and memory, and neural development.

275. (BIOL575) Introduction to Microbiology. (I) Pohlschroder/Daldal/Goulian. Prerequisite(s): BIOL 101 or 121.

Microbiology plays a central role in diverse areas of human life such as infectious disease, ecology, and biotechnology. This course will cover aspects of modern microbiology with an emphasis on prokaryotic organisms. The topics will include basic aspects of microbial diversity, genetics, and pathogenesis as well as examples of applied microbiology.

L/L 306. Histology. (C) Prerequisite(s): BIOL 101 and 102, or BIOL 121 and 202 preferred. Lab fee $150. Only offered through the College of Liberal and Professional Studies.

This course is designed to introduce the undergraduate student to the structure of tissues at the cellular level and to the way in which those tissues are assembled into organs. This knowledge of structure will be the basis for discussion of tissue and organ function.

325. Marine Biology. (J) Petraitis. Prerequisite(s): BIOL 102 or 121 or permission of instructor.

An introduction to marine biology and oceanography. Topics will include chemical and physical oceanography, a survey of form, function and phylogeny of algae, invertebrates and vertebrates, and an examination of ecological and evolutionary principles as applied to marine organisms and ecosystems.

L/R 354. Developmental Biology. (B) Wagner J. Prerequisite(s): BIOL 202 and 221.

A view of how an animal embryo is specified to develop and differentiate into a wide spectrum of cell types, and how the spatial patterns and axes of embyros are determined. The course will focus on genetic and molecular approaches, but will also cover the comparative anatomy of developing embryos to the extent necessary to understand the conserved aspects of embryonic patterning. Special emphasis will be placed on organisms with particular advantages for the study of embryonic development: e.g., mouse, frog, zebrafish, and Drosophila. The first half of the course will cover cell fate restrictions, cloning animals using nuclear transfer, stem cell biology, formation of the embryonic axes in vertebrates and Drosophila, and patterning of the neural tube and mesodermal tissues. The second half of the course will focus on emerging ideas and findings in the field, with emphasis on analysis of original literature.

399. Independent Study. (C)

Laboratory or library research with a faculty member in the Department of Biology. Research may also be conducted elsewhere on campus but sponsored by a faculty member in Biology. A final paper is required. Apply at the Biology Academic Office, 102 Leidy Labs.

400. Field Botany. (I) Rhoads/Block. Prerequisite(s): BIOL 101 or 124 or permission of instructor.

Students will learn to identify plants in the field using keys and manuals; lab exercises will also include the use of quantitative techniques for measuring plant populations and characterizing plant communities. Students will also learn how to collect and prepare herbarium specimens. Most of the class time will be spent outdoors.

402. Biochemistry. (B) Rea/Staff. Prerequisite(s): BIOL 202, CHEM 241, the latter of which may be taken concurrently. CHEM 242 is recommended and may also be taken concurrently.

Basic principles of protein characterization, enzyme kinetics and mechanism, membrane structure and function, metabolism, and biochemistry of energy and signal transduction. A problem-solving approach will be employed and emphasis will be placed on the application of quantitative methods to biochemical problems. Each of the five major sections of the course will be concluded with group discussions specifically directed at the solution of numerical problems and the interpretation of experimental results. In order to maximize the opportunities for students to think critically, analytically and creatively, most of the material covered in the course will be tested using take-home examinations. Students will have the option of attending sessions in which the recent original literature will be discussed.

404. Immunobiology. (C) Staff. Prerequisite(s): BIOL 202 and BIOL 221. Only offered through the College of Liberal and Professional Studies.

Early development of microbiology, pathology, and immunobiology; molecular and cellular bases of immune phenomena including: immunity to pathogens, immune diseases, autoimmunity, and hypersensitivity.

SM 406. Molecular Mechanisms of Infectious Disease Biology. (A) Roos. Prerequisite(s): BIOL 101 and 102, or BIOL 121; BIOL 202 and 221 are strongly recommended.

This course is designed for advanced undergraduates and beginning graduate students with a particular interest in infectious disease biology. Note that this course is not a comprehensive survey of the field and is not appropriate for students seeking a lecture course on disease. The primary objective of this course is to teach students considering a career in the biomedical sciences how to read, discuss, and question research papers effectively. Intensive classroom discussions focus on the experimental methods used, results obtained, interpretation of these results in the context of pathogen interactions with host cells and organisms, and implications for basic research and therapeutic development.

SM 407. Cancer Cell Biology. (B) Keith. Prerequisite(s): BIOL 121 (or BIOL 101/102); BIOL 202, 221, and permission of instructor.

This course will focus on the molecular mechanisms by which fundamental cellular processes are disrupted in the development of cancer.

410. Evolution of Populations. (I) Sniegowski. Prerequisite(s): BIOL 230 or permission of instructor.

Mechanisms of evolution at the genetic and populational levels. Empirical and theoretical approaches to natural selection, population structure, gene flow, and quantitative genetics will be emphasized.

414. Advanced Ecology. (K) Petraitis/Casper/Dunham. Prerequisite(s): BIOL 240 and one semester of calculus or permission of instructor.

Theoretical and conceptual background of core issues and questions in population, community, and ecosystem ecology. Topics include physiological ecology, demography, the growth and regulation of natural populations, species interactions, and biogeochemical cycling.

415. Freshwater Ecology. (B) Bott. Prerequisite(s): BIOL 101 or 121 and one semester of college chemistry.

Survey of the physical, chemical and biological properties of freshwater ecosystems, both riverine and lentic, natural and polluted.

L/R 421. (CAMB421) Molecular Genetics. (A) Weinberg. Prerequisite(s): BIOL 221 or equivalent course.

A detailed analysis of gene structure and expression in both prokaryotic and eukaryotic organisms. Rapid advances in DNA technology and genomics will be emphasized. The application of these advances to the molecular genetic analysis of development, cell function and disease will be discussed.

422. Human Genetics and Genomics. (B) Tishkoff. Prerequisite(s): BIOL 221.

In this course we will discuss the identification and characterization of genetic diversity in the human genome, the genetic basis of normal variable traits, and the genetic basis of human disease. The study of human genetics impacts almost every aspect of our society, from medicine to law enforcement to how we view ourselves. An ability to understand the basics of genetic analyses will serve you well since in your lifetime you are almost certain to be faced with a major decision involving your heredity; and society will be forced to make major reforms in medicine and law because of our increasing genetic knowledge. Human genetics is a topic that gets frequent attention in the press. Reports about genes for traits ranging from breast cancer to criminal behavior are constantly in the news. Our society is engaged in a debate about the implications of genetic typing, particularly with the advent of personalized genomics. By the end of this class you should be able to sort fact from fiction and to have a better understanding of the science behind the study of the human genome.

423. (CAMB482) Plant Ecology. (M) Casper. Prerequisite(s): A year of introductory biology or equivalent.

The course consists of both lecture material and hands on research involving questions in plant population or community ecology. Quantitative information from published studies will be discussed, and students, working in teams, will summarize and analyze data from class experiments.

425. Biochemistry and Molecular Genetics Superlab. (C) Wagner J. Prerequisite(s): BIOL 202 or 221 or an equivalent course are recommended. Lab fee $150.

Intensive laboratory class where open-ended, interesting biological problems are explored using modern lab techniques. Topics may include protein structure/function studies; genetic screens, genomics and gene expression studies; proteomics and protein purification techniques; and molecular cloning and DNA manipulation. The course emphasizes developing scientific communication and independent research skills. Course topics reflect the interests of individual Biology faculty members. This course is recommended for students considering independent research.

SM 432. (PSYC431) Animal Cognition. (B) Cheney. Prerequisite(s): BIOL 231/BIBB 231/PSYC 131.

This course considers the sorts of knowledge that animals have of their environment, their location in space, and their conspecifics. How do different animal species remember where food is located or find their way home? What is the adaptive significance of recognizing other individuals' social relationships or dominance ranks? The behavior of animals from a variety of different taxa is considered, ranging from invertebrates to apes. Emphasis is placed on animals living under natural conditions, though some research on learning and memory in captive animals is also discussed.

SM 436. Molecular Physiology. (A) Ren. Prerequisite(s): A year of introductory biology or equivalent.

This course is designed for advanced undergraduate and graduate students who are interested in molecular physiology of sensory signal transduction. The major topics to cover will be signal transduction mechanisms used by membrane

ion channels and receptors that detect the sensory stimuli (light, sound, temperature and tastes, for example) and transmit the signals to the nervous system. Modern molecular/structural techniques (patch clamp, protein crystallization, molecular genetics, expression cloning and protein purification) will be introduced along with each topic. References will be primary research articles. Students will critically evaluate research discoveries by reading and presenting one to two original research papers. Each student is required to write a 10-page research proposal and to critique proposals written by fellow students.

438. Systems Biology: Integrative physiology and biomechanics of the muscular system. (B) Rome. Prerequisite(s): 1 year physics, 1 year chemistry, and BIOL 215 or 251.

The course will focus on muscle function from the level of molecules to whole animal locomotion. At each level of organization, muscle function will be explored from mechanical and energetic viewpoints. The course will include lectures, demonstrations, and several guest expert lectures. Students will also be introduced to realistic musculo-skeletal modelling and forward dynamic simulations to explore integrated function.

440. (BIOL140) Advanced Analysis of Humans and the Environment. (A) Natural Science & Mathematics Sector. Class of 2010 and beyond. Janzen. Prerequisite(s): Permission of instructor.

Advanced version of BIOL 140: Humans and the Environment. Additional readings and course work as directed.

442. (INSC575, PSYC421) Neurobiology of Learning and Memory. (M) Abel/Muzzio. Prerequisite(s): BIOL 251/BIBB 251 and PSYC 1, or permission of instructor.

This course focuses on the current state of our knowledge about the neurobiological basis of learning and memory. A combination of lectures and student seminars will explore the molecular and cellular basis of learning in invertebrates and vertebrates from a behavioral and neural perspective.

446. Statistics for Biologists. (A) Plotkin. Prerequisite(s): MATH 104 or equivalent; or permission of instructor.

Introductory probability theory. Principles of statistical methods. Problems of estimation and hypothesis testing in biology and related areas.

448. Principles of Drug Action. Manning. Prerequisite(s): Biol 202.

Principles of Drug Action covers the concepts of pharmacological sciences as they relate to biochemistry, cell biology, and drug therapy. The intent of the course is to provide a solid grounding in targets of drug action, dose-response relationships, pharmacodynamics, and pharmacokinetics. The grounding is achieved by a discussion of these concepts explicitly and, through selected examples, implicitly. The first part of the course covers each of the concepts. Emphasis is placed on the integration with principles of cell biology and biochemistry. The second part of the course covers selected therapeutic applications. The applications chosen fall within four areas: cardiovascular, brain and behavior, antipyretic and antiinflammatory, and antimicrobial. They are used to recapitulate important concepts and provide insight into the interplay between pharmacology and human physiology. The applications and the areas they represent are by no means comprehensive, but students will be able to pursue additional interests through papers.

L/L 450. Plant Systematics. (K) Rhoads/Block. Prerequisite(s): BIOL 101 or 124 or permission of instructor. Lab fee $150.

Plant Systematics is a study of diversity in the flowering plants emphasizing evolutionary relationships. Learn how DNA sequence data have revolutionized the interpretation of plant evolution by providing direct evidence of phylogenetic relationships. Each class will combine lecture and lab sessions where plant samples will be examined. The course includes a field trip to Bartram's Garden.

451. (PSYC479) Systems Neuroscience. (B) Schmidt, M./Medina. Prerequisite(s): BIOL 251/BIBB 251 and permission of instructor.

This course will investigate neural processing at the systems level. Principles of how brains encode information will be explored in both sensory (e.g. visual, auditory, olfactory, etc.) and motor systems. Neural encoding strategies will be discussed in relation to the specific behavioral needs of the animal. Examples will be drawn from a variety of different model systems.

465. Ecological Techniques in Conservation. (B) McShea. Prerequisite(s): Previous field experience and introductory statistics recommended. Course will be taught at the Smithsonian Institution's Conservation & Research Center adjacent to Shenandoah National Park just outside Front Royal, Virginia in January (preparatory lectures at Penn) and March (field work at CRC). Students must pre-register. Prepayment of transportation and living expenses required. Students should be prepared for strenuous, extended field work under varied weather conditions.

The main focus of this course is to provide an overview of techniques used by conservation biologists and wildlife managers. The emphasis is on field work and most of each day will be spent outside attempting to collect real data on real organisms. The general topics covered will be survey techniques for forest birds, small mammals, white-tailed

deer, and vegetation. A brief introduction to Geographic Information Systems and Global Positioning Systems is also included. Each topic will start with an introductory lecture the night before and then field work during the day.

475. Advanced Microbiology. (H) Pohlschroder/Daldal. Prerequisite(s): BIOL 221, BIOL 275, or permission of instructor.

Microbiology plays a central role in diverse areas of human life such as infectious disease, ecology, and biotechnology. Following an overview of basic microbiological principles, the course will focus on in-depth discussions of selective cutting edge topics, including emerging technologies in microbiology. In addition to lectures given by experts in the field, students will present scientific papers on selected topics.

476. Microbiology Lab. (A) Pohlschroder/Daldal/Bassiri. Prerequisite(s): BIOL 275 or 475 recommended previously or concurrently. Lab fee $150. (3 hours lab, 0.5 cu).

This course will provide practical, indepth laboratory experience with isolation, characterization, genetic and molecular biology of microorganisms.

480. (CAMB480) Advanced Cell Biology. (A) Guo. Prerequisite(s): BIOL 202.

This course is designed for beginning graduate students and advanced undergraduates with a particular enthusiasm for Cell Biology. Biology 480 does not attempt to cover all aspects of cell biology, and is therefore not appropriate for students seeking a lecture course which provides a comprehensive survey of the field. Rather, the primary objective of this course is to teach those students considering a career in the biomedical sciences how to read, discuss, and question original research papers effectively. Intensive classroom discussions focus on the experimental methods used, results obtained, interpretation of these results in the context of cell structure and function, and implications for further studies.

SM 482. (CAMB482) Communication at the Cellular Level. (M) Gallagher. Prerequisite(s): BIOL 202 or permission of instructor.

The evolution of multicellularity required that cells be able to both send and receive signals from their neighbors. The development of organs and differentiation of cells and tissues requires reliable and continuous communication between cells. Consequences of inappropriate or anomalous signaling include development abnormalities and cancer. This class will examine mechanisms of cell-to-cell signaling between bacterial, plant, and animal cells with an emphasis on the cell biology of development. Particular attention will be given to the mechanims by which biomolecules are able to traffic from cell to cell and cross membranes and the role of the cytoskeleton in signaling.

483. (CAMB483) Epigenetics. (B) Wagner D. Prerequisite(s): BIOL 221.

This course investigates epigenetic phenomena: heritable alternate states of gene activity that do not result from an alteration in nucleotide composition (mutations). Epigenetic mechanisms regulate genome accessibility and cell differentiation. They play a key role in normal development and in oncogenesis. For example both mammalian X-chromosome inactivation and nuclear transfer (cloning) are subject to epigenetic regulation. Amongst the epigenetic mechanisms we will discuss in this course are chromatin organization, histone modification, DNA methylation and non-coding RNAs. The course is geared toward advanced undergraduate and beginning graduate students and is a combination of lectures, student presentations and research presentations by guest speakers. Students will work with the current scientific literature.

SM 484. (CAMB484) Cell Motility and the Cytoskeleton. (A) Svitkina. Prerequisite(s): BIOL 202.

Cytoskeleton and cell motility plays a crucial role in many aspects of normal and pathological physiology of individual cells, tissues, and whole organisms, including morphogenesis, immune response, wound healing, oncogenesis, and infection. This course will cover current topics in cell biology with emphasis on cytoskeleton and cell motility and their roles in these processes. Lectures, student presentations, and discussions in the class will be based on primary scientific literature.

SM 486. (CAMB486) Chromosomes and the Cell Cycle. (B) Lampson. Prerequisite(s): BIOL 202 or permission of instructor.

Life depends on the propagation of genetic material from one generation to the next through cycles of genome replication and cell division. The genome is copied by the parent, and one exact copy is inherited by each daughter cell. We will treat chromosomes as discrete entities, rather than collections of genes, that are replicated and divided with high fidelity to ensure that the genome remains stable over many generations. By reading selected primary literature covering several decades, we will build an understanding of the cell cycle by focusing on chromosomes and the associated molecular machinery. We will explore mechanisms that underlie replication and division, particularly control mechanisms that maintain genome integrity and are critical to prevent disease. The goal of the course is to develop a picture of the cell cycle by examining some of the key experiments and insights that have led to our current understanding.

488. (CAMB578, INSC578) Advanced Topics in Behavioral Genetics. (J) Abel/Bucan. Prerequisite(s): Permission of Instructor.

This course focuses on the use of genetic techniques to study the molecular and cellular bases of behavior. Particular emphasis will be given to the role of genetic approaches in understanding the biological processes underlying memory storage, circadian rhythms, and neurological and psychiatric disorders. Reverse genetic approaches utilizing gene knockout and transgenic technologies, as well as forward genetic approaches using mutagenesis and quantitative genetic techniques will be discussed.

499. Advanced Independent Study. (C) Staff. Prerequisite(s): BIOL 399 in the same laboratory as the proposed BIOL 499.

A second semester of independent study, in most cases extending the research undertaken for the Biol 399. Apply at the Biology Academic Office, 102 Leidy Labs.

L/R 501. Principles of Biological Science. (L) Waldron/Bergey.

This course will provide a strong background in biology for middle school teachers in the MISEP program. The major topics will be animal and plant biology, cell biology and genetics, and evolution and diversity.

SM 526. (CAMB526, MOLB526) Experimental Principles in Cell and Molecular Biology. (A) Staff.

The course aims to introduce principles of current experimental techniques used in modern biology.

527. (BIOL221, GCB 527) Genetics for Computational Biology. (C) Bonini/Gallagher/Guild. Prerequisite(s): BIOL 101 or 121. Permission of instructor needed.

This course will survey the discipline of molecular genetics. Two broad areas will be considered: 1) Molecular biology: DNA replication, transcription, translation, and the regulation of gene expression in both prokaryotic and eukaryotic systems and genomics and 2) Genetics: basic Mendelian & molecular genetics.

535. Ecological Modeling. (K) Dunham.

Survey and development of mathematical theories in ecology, particularly theories of population growth, predation, and competition, as well as other topics of current interest.

536. (CIS 536, GCB 536) Computational Biology. (B) Kim. Prerequisite(s): College level introductory biology required; undergraduate or graduate level statistics taken previously or concurrently required; molecular biology and/or genetics encouraged; programming experience encouraged.

Introductory computational biology course designed for both biology students and computer science, engineering students. The course will cover fundamentals of algorithms, statistics, and mathematics as applied to biological problems. In particular, emphasis will be given to biological problem modeling and understanding the algorithms and mathematical procedures at the "pencil and paper" level. That is, practical implementation of the algorithms is not taught but principles of the algorithms are covered using small sized examples. Topics to be covered are: genome annotation and string algorithms, pattern search and statistical learning, molecular evolution and phylogenetics, functional genomics and systems level analysis.

SM 537. (CIS 635, GCB 537) Advanced Computational Biology. (A) S. Hannenhalli, L. Wong. Prerequisite(s): BIOL 536 or permission of instructor.

Discussion of special research topics.

540. (CAMB541, MOLB541) Genetic Analysis. (B) Poethig. Prerequisite(s): BIOL 221 or permission of instructor.

The logic and methodology of genetic analysis in plants and animals. This lecture course will focus on the use of mutations to study gene function and higher order biological processes, methods for reporting and manipulating gene expression, and analysis of the genetic basis of natural variation.

544. Mathematics for Biologists. (J) Dunham.

Review of basic mathematics designed to equip students to handle applications to model problems in biological science. Topics to be considered will depend on the interests and needs of the student.

556. Advanced Statistics. (K) Petraitis. Prerequisite(s): BIOL 446 or equivalent, and permission of instructor.

Advanced statistical methods, including multivariate techniques (in particular discriminant functions, principal components, multiple correlation, and regression) and the design and analysis of experiments.

SM 615. Seminar on Environmental and Evolutionary Biology. (C) Staff.

Selection and presentation of current papers of interest in the areas of environmental and evolutionary biology.

SM 700. Topics in Molecular, Cellular, and Developmental Biology. (A) Staff. Course open to Biology graduate students only.

Faculty research presentations in Cell and Molecular Biology.

999. Independent Study and Research. (C) May be taken for multiple course unit credit.