BIOE 4150* Research Principles and Concepts (1)
Introduction to seniors and graduate students to principles and practices of scientific research. Topics include developing scientific concepts, developing projects, pursuing research, collaborating in multidisciplinary teams, patenting and publishing technical and scientific information, and reviewing professional and ethical standards of performance. Includes Honors sections.

BIOE 4200* Sports Engineering 3 (3)
Study of engineering principles involved in sports: body systems in human motion, analysis of gait, basic performance patterns in athletic movements, performance improvements, design of sports equipment. Prerequisite: BIOE 3020 and BIOE 3200.

BIOE 4230* Cardiovascular Engineering and Pathology (3)
The study of medical and bioengineering aspects of artificial cardiovascular and vascular devices; physiology and pathological aspects of patients with need for such devices; diagnostic techniques and surgical management of diseases and pathology; design aspects of current devices and selection; state of the art in experiments and human clinical trials. Prerequisites: BIOE 3020 and BIOE 3150; and either BIOE 3200 or BIOE 3210.

BIOE 4310* Medical Imaging 3 (2)
Introduction to the history, physics, and basis of medical imaging devices; including X-ray, Computer Tomography, Magnetic Resonance Imaging, and Ultrasound. Students will understand imaging from both an engineering and clinical perspective. Students will have the opportunity to work with real medical images, to understand the tradeoffs between modalities. Prerequisite: Either MATH 2080 and one of ECE 2020 or ECE 2070. Prerequisite or concurrent enrollment: MATH 3700. Corequisite: BIOE 4311.

BIOE 4311* Medical Imaging Laboratory 0 (2)
Non-credit laboratory to accompany BIOE 4310. Corequisite: BIOE 4310.

BIOE 4350* Computer Modeling of Multiphysics Problems 3 (3)
This course will introduce students to a holistic way to deal with complicated engineering problems using a computer modeling approach. For a real-world problem governed by combined mechanical, electrical, thermal, electrochemical and mass transport phenomena will be dealt with in an integrated and multidisciplinary way rather than the conventional piecewise single discipline way. Prerequisite: MATH 2080.

BIOE 4400* Biopharmaceutical Engineering 3 (3)
This course examines the design principles necessary to use bacteria, fungi, and mammalian cells in biopharmaceutical applications, including molecular techniques, fermentation, process scale-up, purification processes, and FDA regulations. The production of biopharmaceuticals derived from recombinant systems, including uses in medical systems, is emphasized. Prerequisite: BCHM 3050.

BIOE 4480 Tissue Engineering 3 (2)
Explores the application of engineering principles toward the development of biologically based substitutes that restore, maintain, or improve tissue function. Topics include biodegradable scaffolds, wound healing and tissue repair, cell-matrix interactions, immunology and biocompatibility, stem cells. Prerequisite: BIOE 3020 and BIOE 3150. Prerequisite or concurrent enrollment: BIOI 4610. Corequisite: BIOE 4481.

BIOE 4481 Tissue Engineering Laboratory 0 (3)
Non-credit laboratory to accompany BIOE 4480. Corequisite: BIOE 4480.

BIOE 4490 Drug Delivery 3 (3)
Fundamental principles of controlled drug delivery including drug release mechanisms, physiological barriers, and various types of delivery routes. Specific emphasis is placed on understanding drug delivery technologies and processes to scale up the fabrication of drug delivery systems. Prerequisite: BIOE 3020.

BIOE 4500 Special Topics in Bioengineering 1-4 (1-4)
Comprehensive study of a topic of current interest in the field of biomedical engineering under the direct supervision and guidance of a faculty member. May be repeated for a maximum of six credits, but only if different topics are covered. Includes Honors sections. Corequisite: Consent of instructor.

BIOE 4510 Creative Inquiry in Bioengineering 1-3 (1-3)
Disciplinary and multidisciplinary team research projects with the goal of developing the students' skills in literature research, engineering design, and data analysis. May be repeated. Corequisite: Consent of instructor.

BIOE 4600 International Bioengineering Research Topics 1-6 (1-6)
Comprehensive study and research exposure relating to bioengineering research topics at an international institution through the Bioengineering study abroad program. Students are exposed to laboratory and research methods while under the direct supervision and guidance of approved international mentors. May be repeated for a maximum of six credits. Includes Honors sections. Corequisite: Consent of instructor.

BIOE 4610 International Study in Bioengineering 3 (3)
Introduction to selected bioengineering topics through participation in international study abroad summer programs. Offers an international study experience to undergraduates through lectures, guest speakers, tours, and/or laboratory exposure on a selected bioengineering topic chosen annually by the department. Prerequisite: Consent of instructor.

BIOE 4690 International Bioengineering Internship 3 (13)
Observation and assignment in an international medical school, dental school, hospital, regulatory agency, or industrial department. Course is affiliated with the bioengineering study abroad program and students are under the direct supervision and guidance of approved international mentors. May be repeated for a maximum of six credits. Corequisite: Consent of instructor.

BIOE 4700 Biophotonics 3 (3)
Biophotonics is an interdisciplinary subject of analyzing photons to study biological samples from individual cells to the entire body. Introduces fundamental and frontier topics in optical imaging aspects of biophotonics for senior-level undergraduates and graduate students to gain the ability to solve bioimaging-related biomedical problems. Prerequisite: MATH 2080 and PHYS 2210; and either ECE 2070 or ECE 3200.

BIOE 4760 Biosurface Engineering 3 (2)
Study of how surface design influences the interactions of biomolecules with biomaterials and how this in turn influences implant biocompatibility. Laboratory addresses both the theory and application of various analytical instruments commonly used in bioengineering to characterize biomaterial surfaces and investigate biomolecule-surface interactions. Prerequisite: Senior standing in Bioengineering and BCHM 3050. Corequisite: BIOE 4761.

BIOE 4761 Biosurface Engineering Laboratory 0 (3)
Non-credit laboratory to accompany BIOE 4760. Corequisite: BIOE 4760.

BIOE 4820* Biomaterial Implantology 3 (2)
Provides training in the planning and conduct of experimental surgery, including laws and regulations; institutional requirements; selection of animal models; ethical considerations of animal research; preparation of animals for surgery; general and special surgical techniques; aseptic surgical techniques; and basic and applied instrumentation. Prerequisite: Junior standing in Bioengineering. Corequisite: BIOE 4821.

BIOE 4821* Biomaterial Implantology Laboratory 0 (3)
Non-credit laboratory to accompany BIOE 4820. Corequisite: BIOE 4820.

BIOE 4900 Internship 1 (1)
Observation and assignment in a medical school, dental school, hospital, regulatory agency, or industrial department. May be repeated. Prerequisite: Senior standing in Bioengineering and consent of department chair.

BIOE 4910 Internship 1 (1)
Mentored research training for undergraduate students working with a faculty advisor, including literature review, experimental design, research documentation, and presentation of results. May be repeated. Prerequisite: Consent of instructor. Includes Honors sections. Corequisite: Consent of instructor.

BIOLOGY


BIOL 1010 Frontiers in Biology I 1 (1)
Introduces Biological Sciences majors to the Biological Sciences Advising Center, curriculum, preprofessional health advisors, university career services, and the department's faculty. Prerequisite or concurrent enrollment: BIOL 1030 and BIOL 1050, or BIOL 1100.
BIOL 1060 General Biology Laboratory I (13)
Laboratory to accompany BIOL 1040. Emphasizes developing laboratory techniques, becoming familiar with biological instrumentation, and performing investigations and interpreting results in the areas of organismal structure, physiology, and ecology. Prereg or concurrent enrollment: BIOL 1040.

BIOL 1090 Introduction to Life Science 4(3)
Survey of topics in botany, zoology, microbiology, and ecology emphasizing comprehension and practical application of life science concepts to experiments and activities for the elementary school classroom. Enrollment priority will be given to Early Childhood and Elementary Education majors. Coreq: BIOL 1091.

BIOL 1091 Introduction to Life Science Laboratory 0(3)
Non-credit laboratory to accompany BIOL 1090. Coreq: BIOL 1090.

BIOL 1100 Principles of Biology I 5 (4)
Introductory course designed for students majoring in biological disciplines. Integrates lecture and laboratory and emphasizes modern, quantitative, and experimental approach to explanations of structure, composition, dynamics, interactions, and evolution of cells and organisms. High school chemistry is recommended. Credit toward a degree will be given for BIOL 1100 or 1030 only. Includes Honors sections. Coreq: BIOL 1101.

BIOL 1101 Principles of Biology I Laboratory 0(3)
Non-credit laboratory to accompany BIOL 1100. Coreq: BIOL 1100.

BIOL 1110 Principles of Biology II 5 (4)
Continuation of BIOL 1100, emphasizing the study of plants and animals as functional organisms and the principles of ecology. Credit toward a degree will be given for BIOL 1100 or 1040 only. Includes Honors sections. Prereg: BIOL 1100. Coreq: BIOL 1111.

BIOL 1111 Principles of Biology II Laboratory 0(3)
Non-credit laboratory to accompany BIOL 1110. Coreq: BIOL 1110.

BIOL 1200 Biological Inquiry Laboratory 1(3)
Required laboratory experience to accompany BIOL 1220 or 1230. Focuses on the process and outcomes of scientific inquiry. Students employ scientific methodology in a laboratory environment as well as critical analysis of biological problems in a small group context. Prereg or concurrent enrollment: BIOL 1220 or BIOL 1230.

BIOL 1220 Keys to Biodiversity 3(3)
Introduction to scientific inquiry through analysis of biodiversity. Biological foundations for life are studied, including evolution, ecology, genetics, cells, and molecules. Also includes discussion of ethical issues related to biodiversity. Credit toward a degree will be given for only one of BIOL 1220 or 1230.

BIOL 1230 Keys to Human Biology 3(3)
Introduction to scientific inquiry through human biology. Considers biological processes occurring within humans and human impact on global biological processes. Interrelationships ultimately affecting evolution and diversity are explored. Credit toward a degree will be given for only one of BIOL 1220 or BIOL 1230.

BIOL 1900 Directed Research 1-3(9)
Research projects, supervised by faculty in the College of Agriculture, Forestry and Life Sciences introducing research methods. Restricted to outstanding high school students, selected using Governor’s School for Science and Mathematics ranking criteria. May be repeated for a maximum of six credits. Credit: Entering high school junior or senior status and consent of faculty research supervisor and department in which research is conducted.

BIOL 2000 Biology in the News 3(3)
For non-science majors. Students examine current topics of biology appearing in newspapers and other current media. Uses a problem-based learning approach, with students working as teams and individually on areas of interest identified by the class. Students are expected to have completed the General Education Natural Science Requirement prior to enrolling in this course. Prereg: ENGL 1030.

BIOL 2010 Biotechnology and Society 3(3)
Introduction to the theories, fields, and applications of biotechnology, including the structure and function of genes and their manipulation to improve plant and animal productivity and human health. Individual case studies are examined, including social and ethical issues surrounding biotechnology-based research and development. Not open to Genetics majors. Prereg: BIOL 1220; and one of BIOL 1210 or BIOL 1220 or BIOL 1230 or BIOL 1240; and General Education Natural Science requirement.

BIOL 2030 Human Disease and Society 3(3)
Focuses on the basic biology underlying human disease, how disease is understood, and current methods of prevention and treatment of disease. The economics as well as the social and ethical issues surrounding human disease are a common thread throughout the course. Prereg: Both BIOL 1040 and BIOL 1060; or BIOL 1110; or BIOL 1220; or BIOL 1230.

BIOL 2040 Environment, Energy and Society 3(3)
Examines power and energy production, the resultant environmental effects, and the relationship between this technology and society. Introduces historical and contemporary sources of energy and power; the economic, social, and political forces important for types and patterns of development; and the resultant impacts to ecosystems and the environment.

BIOL 2050 Plant Form and Function 3(3)
Introductory course for students majoring in plant sciences. Integrates lecture and laboratory and emphasizes fundamental structures and functions of higher plants. Prereg: BIOL 1030 and BIOL 1050.

BIOL 2060 Plant Form and Function Laboratory 1(1)
Laboratory for BIOL 2050. Prereg or concurrent enrollment: BIOL 2050.

BIOL 2070 Evolution and Creationism 3(3)
Critical review of the scientific and technological basis for evolutionary theory compared to creationist explanations for the origin and diversity of life. Includes a historical survey of the impact that the evolution/creation debate has had on law, politics, education, and other important aspects of society. Credit toward a degree will be given for only one of BIOL 2100 or PHIL 2100. Prereg: BIOL 1040 or BIOL 1110; and one of BIOL 1220 or BIOL 1230; and General Education Natural Science requirement.

BIOL 2110 Introduction to Toxicology 3(3)
Acquaints students with the field of toxicology, integrates the science of toxicology with regulatory policy, and demonstrates its impact on our daily lives. Prereg: BIOL 1040 and BIOL 1060; or BIOL 1110.

BIOL 2200 Biology: Concepts, Issues, and Values 3(3)
Develops a thorough knowledge of basic biological concepts and issues and explores how these can be incorporated into a system of human values affecting technology, society, and life.

BIOL 2220 Human Anatomy and Physiology I 4(3)
Basic introductory course in integrated human anatomy and physiology covering cells and tissues; integumentary, skeletal, muscular, and nervous systems; sensory organs. Physiology is stressed. Structured primarily for Nursing and other health-related curricula. Prereg: BIOL 1030 and BIOL 1050; or BIOL 1110; and CH 1010 or CH 1050. Coreq: BIOL 2221.

BIOL 2221 Human Anatomy and Physiology I Laboratory 0(2)
Non-credit laboratory to accompany BIOL 2220. Coreq: BIOL 2220.

BIOL 2230 Human Anatomy and Physiology II 4(3)
Continuation of BIOL 2220 covering endocrine, reproductive, cardiovascular, lymphatic, respiratory, urinary, and digestive systems; fluid and electrolyte balance. Physiology is stressed. Prereg: BIOL 2220. Coreq: BIOL 2231.

BIOL 2231 Human Anatomy and Physiology II Laboratory 0(2)
Non-credit laboratory to accompany BIOL 2230. Coreq: BIOL 2230.
BIOL 2300 Emergency Medical Responder 3(3)
Students are prepared to provide emergency prehospital assessment and care for patients with a variety of medical conditions and traumatic injuries. Study areas include introduction to emergency medical services systems, EMR roles and responsibilities, anatomy and physiology, medical emergencies, trauma, and working in the prehospital setting. Preq: BIOL 1030 and BIOL 1040, and BIOL 1050 and BIOL 1060; or BIOL 1100 and BIOL 1110. Consent of instructor.

BIOL (ENT) 3010 Insect Biology and Diversity 4(3)
Introduction to the study of insects, with emphasis on their structure, function, ecology, and behavior. Identification of commonly encountered species is highlighted. Relationships between insect and human populations are discussed. Control technologies are introduced, with emphasis on environmentally responsible tactics. Offered fall semester only. Coreq: BIOL 3011.

BIOL (ENT) 3011 Insect Biology and Diversity Laboratory 0(3) Non-credit laboratory to accompany BIOL 3010. Coreq: BIOL 3010.

BIOL 3020 Invertebrate Biology 3(3)
Introductory study of the taxonomy, ecology, and evolution of plants in their natural environment with an emphasis on identification and characteristics of representative species and plant communities in the Carolinas. Preq: BIOL 1040 and BIOL 1060; or BIOL 1110. Coreq: BIOL 3161.

BIOL 3030 Vertebrate Biology 3(3)
Comprehensive survey of vertebrate animals, including their taxonomy, morphology, evolution, and selected aspects of the natural history and behavior. Includes Honors sections. Preq: BIOL 1040 and BIOL 1060; or BIOL 1110.

BIOL 3040 Biology of Plants 3(3)
Survey of the major groups of plants, their biology, diversity, and evolution. Includes honors sections. Preq: BIOL 1040 and BIOL 1060; or BIOL 1110. Coreq: BIOL 3080.

BIOL 3060 Invertebrate Biology Laboratory 1(3)
Survey and comparison of the biology of living invertebrates, examples of which are drawn primarily from the southeastern coast of the United States. Preq: Introductory two-semester biology sequence with laboratory. Preq or concurrent enrollment: BIOL 3020.

BIOL 3070 Vertebrate Biology Laboratory 1(3)
Comparative and phylogenetic study of the gross morphology of vertebrates. Preq or concurrent enrollment: BIOL 3030.

BIOL 3080 Biology of Plants Practicum 1(3)
Laboratory exercises that explore the major groups of plants, their biology, diversity, and evolution. Coreq: BIOL 3040.

BIOL (WFB) 3130 Conservation Biology 3(3)
Study of the biological bases for the conservation of flora, fauna, and habitats. Biological factors that influence the decision-making process are addressed. May also be offered as WFB 3130. Preq: BIOL 1030 and BIOL 1050 and BIOL 1040 and BIOL 1060; or BIOL 1100 and BIOL 1110.

BIOL 3150 Functional Human Anatomy 4(3)
Introduction to the anatomical structures associated with all organ systems found in the human body at both the gross and microscopic level. Basic physiology is integrated to assist with understanding the function of the anatomical systems. Preq: BIOL 1030 and BIOL 1050; or BIOL 1110; and junior standing. Coreq: BIOL 3151.

BIOL 3151 Functional Human Anatomy Laboratory 0(3) Non-credit laboratory to accompany BIOL 3150. Coreq: BIOL 3150.

BIOL 3160 Human Physiology 4(3) Study of the functional processes associated with the various organ systems in the human body. Students develop a basic understanding of the important and fundamental concepts in human physiology and how organ systems maintain homeostasis. Preq: BIOL 1040 and BIOL 1060; or BIOL 1110; and CH 1020; and junior standing. Coreq: BIOL 3161.

BIOL 3161 Human Physiology Laboratory 0(3) Non-credit laboratory to accompany BIOL 3160. Coreq: BIOL 3160.

BIOL 3200 Field Botany 4(2)
Introductory study of the taxonomy, ecology, and evolution of plants in their natural environment with an emphasis on identification and characteristics of representative species and plant communities in the Carolinas. Preq: BIOL 1040 and BIOL 1060; or BIOL 1110. Coreq: BIOL 3201.

BIOL 3201 Field Botany Laboratory 0(4) Non-credit laboratory to accompany BIOL 3200. Coreq: BIOL 3200.

BIOL 3350 Evolutionary Biology 3(3)
Introduction to basic concepts and underlying principles of modern evolutionary biology. Topics include a historical overview of evolutionary theories, elementary population genetics, principles of adaptation, speciation, systematic and phylogenetic inference, fossil record, biogeography, molecular evolution, and human evolution. Includes honors sections. Preq: GEN 3000 or GEN 3020.

BIOL (PES) 3400 Medical Botany 3(3) Study of the effects of flora and fauna, and their ecological and evolutionary role. Study of plants, including absorption of matter and energy, water relations of the plant, utilization of reserve products, and liberation of energy. Includes honors sections. Preq: BIOL 1040 and BIOL 1060; or BIOL 1110; and CH 1020. Coreq: BIOL 3150. Coreq: BIOL 3150.

BIOL (ANTH) 3510 Biological Anthropology 3(3)
Introduction to forensic anthropology, the science that utilizes methods from skeletal biology and archaeology as tools in human identification in a medicolegal context. May also be offered as ANTH 3530. Preq: Junior standing.

BIOL 3940 Selected Topics in Creative Inquiry I 3(1) Disciplinary and multidisciplinary group research projects develop the student's ability to discover, analyze, and evaluate data. May be repeated for a maximum of six credits. Honors students must take at least six credits over a two-semester period with the same research advisor and write an honors thesis. These credits may include BIOL 3940, BIOL 4940 or both. Includes honors sections. Preq: Consent of instructor. Coreq: BIOL 3941.

BIOL 3941 Selected Topics in Creative Inquiry I Laboratory 0(6) Non-credit laboratory to accompany BIOL 3940. Coreq: BIOL 3940.

BIOL (ENT) 4000 Insect Morphology 4(3) Study of insect structure in relation to function and of the variation of form in insects. Includes honors sections. May also be offered as ENT 4000. Preq: ENT 3010. Coreq: BIOL 4001.

BIOL (ENT) 4001 Insect Morphology Laboratory 0(3) Non-credit laboratory to accompany BIOL 4000. May also be offered as ENT 4000. Coreq: BIOL 4000.

BIOL 4010 Plant Physiology 3(3) Relations and processes pertaining to maintenance, growth, and reproduction of plants, including absorption of matter and energy, water relations of the plant, utilization of reserve products, and liberation of energy. Preq or concurrent enrollment: BIOL 4010.

BIOL 4020 Plant Physiology Laboratory 1(3) Laboratory exercises and experiments designed to indicate the relations and processes which pertain to maintenance, growth, and reproduction of plants, including absorption of matter and energy, water relations of the plant, utilization of reserve products, and liberation of energy. Preq or concurrent enrollment: BIOL 4010.

BIOL 4030 Introduction to Applied Genomics 3(3) Emphasizes the practical application of bioinformatic/genomic skills to solve biological problems. The course includes an introduction to the Linux operating system, the bash command line environment, principles of next-generation sequencing, genome assembly, gene prediction, annotation, databases, gene/gene clustering, recombination detection, phylogenomics, transcriptomics, and metagenomics. Preq: GEN 3000 or GEN 3020 or MICR 4150.

BIOL (GEN) 4050 Molecular Genetics of Eukaryotes 3(3) Molecular genetic analyses of eukaryotes in relation to mutations and repair, complex phenotypes, biochemical pathways, short- and long-term regulation of gene expression, and evolution. May also be offered as GEN 4050. Preq: one of the following combinations: BCHM 3010 or BCHM 3050; or GEN 3000 and GEN 3020.

BIOL 4060 Introductory Plant Taxonomy 3(3) Introduction to the basic principles and concepts of plant systematics with emphasis on the plants of South Carolina. Includes honors sections. Preq: BIOL 1040 and BIOL 1060; or BIOL 1110. Coreq: BIOL 4070.

BIOL 4070 Plant Taxonomy Laboratory 1(3) Introduction to basic techniques of plant taxonomy with laboratory and field emphasis on the flora of South Carolina. Coreq: BIOL 4060.
Biol 4080* Comparative Vertebrate Morphology 3(3) Phylogeny and diversity of vertebrates and study of their comparative morphology, leading to an understanding of the relationships and functioning of living organisms. Includes Honors sections. Preq: Biol 1040 and Biol 1060; or Biol 1110. Coreq: Biol 4090.

Biol 4090* Comparative Vertebrate Morphology Laboratory 2 (5) Comparative anatomy of representative vertebrates; methods used in preparing specimens for study and display. Includes Honors sections. Coreq: Biol 4080.

Biol 4100* Limnology 3(3) Detailed introduction to the physical, chemical, and biological interrelationships that characterize inland water environments. A fundamental approach to the interactions of components of the environment is developed at a theoretical level. Preq: Biol 1040 and Biol 1060; or Biol 1110.

Biol 4110* Limnological Analyses 2(1) Examine a broad range of topics covered with both standing and running fresh waters. About one-third of the laboratory exercises address the major physical components of lakes and streams. The remainder provides rationale and methods for quantitative analyses of biota, as well as some integrated analyses of whole ecosystems. Includes Honors sections. Preq or concurrent enrollment: Biol 4100 or Biol 4430. Coreq: Biol 4111.

Biol 4111* Limnological Analyses Laboratory 0(2) Non-credit laboratory to accompany Biol 4110. Coreq: Biol 4110.

Biol (Enr) 4130* Restoration Ecology 3(3) Applies ecological principles to the restoration of disturbed terrestrial, wetland, and aquatic ecosystems. Includes the restoration of soils and waterways, of flora and fauna, and of natural ecological processes such as plant succession and nutrient cycling. May also be offered as Enr 4130. Preq: Biol 3130 or Biol 4410 or Wfb 3130.

Biol (Avs, Micr) 4140* Basic Immunology 3(3) Introduction to the immune system of vertebrate animals, with an emphasis on structure, function, regulation, and cellular and molecular mechanisms of immune responses. Includes Honors sections. May also be offered as Avs 4140 or Micr 4140. Preq: Biol 4610 and Micr 3050.

Biol (Ent) 4150* Insect Taxonomy 3(1) Identification of the principal families of the major orders of adult insects. Laboratory work consists of intensive practice of such identification. Lecture material deals with theoretical discussion of taxonomic features observed in the laboratory. May also be offered as Ent 4150. Preq: Biol 4000 or Ent 4000. Coreq: Biol 4151.

Biol (Ent) 4151* Insect Taxonomy Laboratory 0(6) None-credit laboratory to accompany Biol 4150. May also be offered as Ent 4151. Coreq: Biol 4150.


Biol 4200* Neurobiology 3(3) Broad background in neurobiology. Topics include neuroanatomical structure and function; conduction in the neuron; neurite growth and development; neuromuscular junction; chemistry, physiology, and pharmacology of specific neurotransmitters and receptors; visual process; axoplasmic transport; hypothalamic-pituitary regulation; theories of behavior; theories of learning and memory. Includes Honors sections. Preq: Biol 1040 and Biol 1060; or Biol 1110.

Biol (Avs, Micr) 4240 Immunology Laboratory 1(3) This course is designed to apply the knowledge gained in Micr 4140, Immunology lecture, in an applied setting. The experiments in this beginning immunology laboratory are designed to study both the innate and acquired immune systems. Experimentation into the formation, function and detection of antibodies provides students with skills in basic immunologic techniques. May also be offered as Avs 4240 or Micr 4240. Preq or concurrent enrollment: Micr 4140.

Biol (Plpa) 4250* Introductory Mycology 3(3) Introduction to the biology of all the groups of fungi and some related organisms, with considerations of the taxonomy, morphology, development, physiology, and ecology of representative forms. May also be offered as Plpa 4250. Preq: Biol 1040 and Biol 1060; or Biol 1110. Preq or concurrent enrollment: Biol 4260 or Plpa 4260.

Biol (Plpa) 4260* Mycology Practicum 2(1) Application of the principles of mycological techniques, microscopic study of fungi. Examples from all major groups of fungi are included. May also be offered as Plpa 4260. Preq or concurrent enrollment: Biol 4260 or Plpa 4260. Coreq: Biol 4261.

Biol (Plpa) 4261* Mycology Practicum Laboratory 0(2) Non-credit laboratory to accompany Biol 4261. May also be offered as Plpa 4261. Coreq: Biol 4260.

Biol 4280* Quantitative Biology 4(3) Applies quantitative methods to a wide range of biological problems. Main focus is on building modeling skills using population, physiological, genetic, and evolutionary problems. Also includes a review of statistical principles and introduces basic bioinformatics techniques. Preq: Biol 1040 and Biol 1060; or Biol 1110; and Math 1080 or Math 1110. Coreq: Biol 4281.

Biol 4281* Quantitative Biology Laboratory 0(3) Non-credit laboratory to accompany Biol 4280. Coreq: Biol 4280.

Biol 4320* Animal Histology 3(3) Structural and functional study of the basic tissues of animals and tissue makeup of organs. Emphasizes light microscopic level with selected tissue studied at the electron microscope level. Includes Honors sections. Preq: Biol 1040 and Biol 1060; or Biol 1110. Coreq: Biol 4330.

Biol 4330* Animal Histology Laboratory 2(1) Microscopic examination of basic animal tissue types and the tissue makeup of organs which comprise systems. Includes Honors sections. Coreq: Biol 4320 and Biol 4331.

Biol 4331* Animal Histology Laboratory 0(2) Non-credit laboratory to accompany Biol 4330. Coreq: Biol 4330.

Biol 4340 Biological Chemistry Laboratory Techniques 2(1) Theory and application of some of the routine tools and techniques used in biological chemistry. Lectures introduce laboratory theory and provide additional laboratory instructions; discuss results; and conduct student evaluations. Laboratory periods are used to conduct each activity. Preq or concurrent enrollment: Bchm 3010 or Bchm 3050. Coreq: Biol 4341.

Biol 4341 Biological Chemistry Laboratory Techniques Laboratory 0(3) Non-credit laboratory to accompany Biol 4340. Coreq: Biol 4340.

Biol (Ent) 4360* Insect Behavior 3(2) Fundamentals of insect behavior in an evolutionary and ecological perspective. Laboratory emphasizes generation and testing of hypotheses and observation, description, and quantification of insect behavior. May also be offered as Ent 4360. Preq: Ent 3010. Coreq: Biol 4361.

Biol (Ent) 4361* Insect Behavior Laboratory 0(3) Non-credit laboratory to accompany Biol 4360. May also be offered as Ent 4361. Coreq: Biol 4360.

Biol 4400 Developmental Animal Biology 3(3) Events and mechanisms responsible for the development of multicellular animals. Gametogenesis, fertilization, embryonic development, cellular differentiation, morphogenesis, larval forms and metamorphosis, sexual regeneraton, regeneration, malignancy, and aging are analyzed in terms of fundamental concepts and control processes. Includes Honors sections. Preq: Bchm 3010 or 3050.

Biol 4410* Ecology 3(3) Study of basic ecological principles underlying the relationships between organisms and their biotic and abiotic environments. Includes physiological, population, and community ecology, with applications of each to human ecological concern. Includes Honors sections. Preq: Biol 1040 and Biol 1060; or Biol 1110.

Biol 4420* Biogography 3(3) Study of patterns of distribution of plants and animals in space and time. Includes Honors sections. Preq: Biol 3020 or Biol 3030 or Biol 3040.

Biol 4430* Freshwater Ecology 3(3) Study of basic ecological principles and concepts as they apply to freshwater environments: rivers and streams, wetlands, lakes and ponds, and reservoirs. Preq: Biol 1040 and Biol 1060; or Biol 1110.

Biol 4440* Freshwater Ecology Laboratory (lecture portion) 2(1) Laboratory-based course providing a synthesis of major components of freshwater ecosystems. Activities are hypothesis driven and relate to each other to form an overall synthesis of the field. Hands-on experience allows engagement in creative inquiry. Preq or concurrent enrollment: Biol 4430. Coreq: Biol 4441.

Biol 4441* Freshwater Ecology Laboratory 0(2) Non-credit laboratory to accompany Biol 4440. Coreq: Biol 4440.

Biol 4450* Ecology Laboratory (lecture portion) 2(1) Modern and classical approaches to the study of ecological problems discussed in Biol 4410. Students are introduced to field, laboratory and computer-based analyses of plant and animal populations and communities. Includes Honors sections. Preq or concurrent enrollment: Biol 4410. Coreq: Biol 4451.
BIOL 4451* Ecology Laboratory 0(2) Non-credit laboratory to accompany BIOL 4450. Coreq: BIOL 4450.

BIOL 4460* Plant Ecology 3(3) Ecology of plants in relation to their biotic and abiotic environments. Individual organisms, populations, and communities are considered with an emphasis on seed plants in terrestrial environments. Includes Honors sections. Preq: BIOL 1040 and BIOL 1060; or BIOL 1110.

BIOL 4470* Plant Ecology Laboratory (Lecture Portion) 2(1) Experimental and observational approach to addressing principles discussed in BIOL 4460. Students are introduced to field and laboratory methods involving individual organisms, populations, and communities. Includes Honors sections. Preq or concurrent enrollment: BIOL 4460. Coreq: BIOL 4471.

BIOL 4471* Plant Ecology Laboratory 0(2) Non-credit laboratory to accompany BIOL 4470. Coreq: BIOL 4470.

BIOL 4500* Developmental Biology Laboratory (Lecture Portion) 2(1) Examines a broad range of topics concerned with the development of multicellular animals such as gametogenesis, fertilization, embryonic development, cell differentiation, morphogenesis, larval metamorphosis, and regeneration. Laboratory exercises provide the rationale and methods for the descriptive and experimental analysis of development in representative invertebrates and vertebrates. Includes Honors sections. Preq or concurrent enrollment: BIOL 4400. Coreq: BIOL 4501.

BIOL 4501* Developmental Biology Laboratory 0(2) Non-credit laboratory to accompany BIOL 4500. Coreq: BIOL 4500.

BIOL (ANTH) 4510 Biological Variation in Human Populations 3(3) Provides an in-depth discussion of the most influential topics in human skeletal biology. Course explores the history and ethical dilemmas of the field, and examines how biological anthropologists use skeletons to reconstruct patterns of diet, disease, demography and physical activity in human populations. May be offered as ANTH 4510. Preq: ANTH 4510. Preq or concurrent enrollment: BIOL 4510. Coreq: BIOL 4501.

BIOL (PLPA) 4540* Plant Virology 4(3) Study of plant viruses: their morphology, biochemistry, purification, and transmission; symptoms resulting from virus infection; virus vector relationships. Serological and nucleic acid hybridization procedures. Diagnosis of viral diseases and the identification of causal agents. Replication of plant viruses, the interaction between viral host and plant genome. Control of plant viral diseases. May also be offered as PLPA 4540. Preq: BCHM 3010 or BCHM 3050 or MIRC 3050. Coreq: BIOL 4541.

BIOL (PLPA) 4541* Plant Virology Laboratory 0(3) Non-credit laboratory to accompany BIOL 4540. Coreq: BIOL 4540. May also be offered as PLPA 4541.

BIOL (MICR) 4560* Medical and Veterinary Parasitology 3(3) Introduction to parasitism in the animal kingdom. Emphasizes basic and applied principles related to economically and medically important diseases. Classical and experimental approaches to the study of parasitism are examined in reference to protozoa, helminths, and arthropods. Includes Honors sections. May also be offered as MICR 4560. Preq: BIOL 1040 and BIOL 1060; or BIOL 1110. Coreq: BIOL 4560.

BIOL (MICR) 4570* Medical and Veterinary Parasitology Laboratory (Lecture Portion) 2(1) Laboratory to reinforce material presented in BIOL 4560. Introduces students to both live and preserved human/animal parasites. Also introduces techniques used in collection, preservation, and examination of animal parasites. Includes Honors sections. May also be offered as MICR 4570. Coreq: BIOL 4560 and BIOL 4571.

BIOL (MICR) 4571* Medical and Veterinary Parasitology Laboratory 0(2) Non-credit laboratory to accompany BIOL 4570. May also be offered as MICR 4571. Coreq: BIOL 4560 and MICR 4571.

BIOL 4600* Systems Physiology Laboratory (Lecture Portion) 2(1) Modern and classical experimental methods are used to demonstrate fundamental physiological principles discussed in BIOL 4590. Students are introduced to computer-aided data acquisition and computer simulations of physiological function. Preq or concurrent enrollment: BIOL 4590. Coreq: BIOL 4601.

BIOL 4601* Systems Physiology Laboratory 0(2) Non-credit laboratory to accompany BIOL 4600. Coreq: BIOL 4600.

BIOL 4610* Cell Biology 3(3) In-depth analysis of how and where intracellular and extracellular molecules control general and specific cellular functions such as gene expression, secretion, motility, signaling, cell-cycle control and differentiation. Taught and graded at a level where students are expected to infer from and integrate cellular events. Includes Honors sections. Preq: BCHM 3010 or BCHM 3050.

BIOL 4620* Cell Biology Laboratory (Lecture Portion) 2(1) Laboratory to accompany BIOL 4620. Focuses on molecular and microscopic analysis of eukaryotic cells. Preq or concurrent enrollment: BIOL 4620. Coreq: BIOL 4621.

BIOL 4621* Cell Biology Laboratory 0(2) Non-credit laboratory to accompany BIOL 4620. Coreq: BIOL 4620.


BIOL 4641* Mammalogy Laboratory 0(3) Non-credit laboratory to accompany BIOL 4640. Coreq: BIOL 4640.

BIOL (ANTH) 4660* Evolution of Human Behavior 3(3) Familiarizes students with the evolutionary basis of human behavior. Examines topics such as altruism, cooperation, mating systems, parental investment, and social systems using diverse examples, from hunter-gatherer to technological societies. May also be offered as ANTH 4660. Preq: ANTH 3510 or BIOL 3350 or BIOL 3510 or BIOL 4700 or BIOL 6700 or PSYC 2010.

BIOL 4670 Principles of Hematology 3(3) Basic hematological principles as they relate to normal blood cell production, as well as in abnormal conditions that result in diseases of the hematological system. Clinical practice, ethics and controversies in hematology are discussed. Preq: BIOL 1040 and BIOL 1060; or BIOL 1110.

BIOL (WFB) 4680* Herpetology 4(3) Physiological, functional morphology, ecology, evolution, biomechanics and current literature of amphibians and reptiles. Laboratory study examines morphology and identification of world families and United States genera, as well as southeastern species. Field trips are required. May also be offered as WFB 4680. Preq: BIOL 1040 and BIOL 1060; or BIOL 1110. Coreq: BIOL 4681.

BIOL (WFB) 4681* Herpetology Laboratory 0(3) Non-credit laboratory to accompany BIOL 4680. May also be offered as WFB 4681. Coreq: BIOL 4680.

BIOL (ENT, WFB) 4690* Aquatic Insects 3(1) Identification, life history, habitats, and interrelationships of aquatic insects; techniques of qualitative field collecting and modern developments in aquatic insects. Includes Honors sections. May also be offered as ENT 4690 or WFB 4690. Preq: ENT 3010. Coreq: BIOL 4691.

BIOL (ENT, WFB) 4691* Aquatic Insects Laboratory 0(6) Non-credit laboratory to accompany BIOL 4690. May also be offered as ENT 4691 or WFB 4691. Coreq: BIOL 4690.

BIOL 4700* Behavioral Ecology 3(3) Historical and modern developments in animal behavior emphasizing the evolutionary and ecological determinants of behavior. A synthesis of ethology and comparative psychology. Includes Honors sections. Preq: BIOL 1040 and BIOL 1060; or BIOL 1110.

BIOL 4710* Behavioral Ecology Laboratory (Lecture Portion) 2(1) Laboratory exercises that explore the behavior of animals. Emphasizes behavioral observation and analysis and presentation of findings in a report format. Includes a semester-long independent research project. Preq or concurrent enrollment: BIOL 4700. Coreq: BIOL 4711.

BIOL 4711* Behavioral Ecology Laboratory 0(2) Non-credit laboratory to accompany BIOL 4710. Coreq: BIOL 4710.
BIOL 4720* Ornithology 4(3) Biology of birds: their origin and diversification, adaptations, phylogeny, classification, structure and function, behavior, ecology, and biogeography. Field identification is emphasized, and field trips are required. Preq: BIOL 1040 and BIOL 1060; or BIOL 1110. Coreq: BIOL 4721.

BIOL 4721* Ornithology Laboratory 0(3) Non-credit laboratory to accompany BIOL 4720. Coreq: BIOL 4720.

BIOL 4730* History of Modern Biology 3(3) Examines the intellectual and social factors defining the study of life from the scientific revolution of the 1600s to the modern biological sciences. Investigates the historical origins of biological disciplines and explores the differing cultures, methodologies, and philosophical commitments of these communities. Preq: BIOL 1040 and BIOL 1060; or BIOL 1110.

BIOL (ANTH) 4740* Primatology 4(3) Biology of nonhuman primates, including their evolution, taxonomy, physiology, life history, behavioral ecology, and conservation. Three field trips are required, during which students conduct behavioral observations and later analyze their data and present it in report format. May also be offered as ANTH 4740. Preq: ANTH 3510 or BIOL 3510; and either BIOL 1110 or both BIOL 1040 and BIOL 1060. Coreq: BIOL 4741.

BIOL (ANTH) 4741* Primatology Laboratory 0(3) Non-credit laboratory to accompany BIOL 4740. May also be offered as ANTH 4741. Coreq: BIOL 4740.

BIOL 4750* Comparative Physiology 3(3) Physiological systems of invertebrates and vertebrates emphasizing environmental adaptation. Physiological principles as they relate to metabolism, thermoregulation, osmoregulation, respiration, and neural and integrative physiology. Includes honors sections. Preq: CH 1020; and either BIOL 1110 or both BIOL 1040 and BIOL 1060.

BIOL 4760* Comparative Physiology Laboratory (Lecture Portion) 2(1) Modern classical experimental methods are used to demonstrate fundamental physiological principles discussed in BIOL 4750. Introduces students to computer-aided data acquisition and manipulation as well as computer simulations of physiological function. Includes honors sections. Preq or concurrent enrollment: BIOL 4750. Coreq: BIOL 4760.

BIOL 4761* Comparative Physiology Laboratory 0(2) Non-credit laboratory to accompany BIOL 4760. Coreq: BIOL 4760.

BIOL 4770* Ichthyology 3(2) Systematics, life history, distribution, ecology, and current literature of fish. Laboratory study of morphology and identification of U.S. genera, as well as all southeastern species. Field trips are required. Preq: BIOL 1040 and BIOL 1060; or BIOL 1110. Coreq: BIOL 4771.

BIOL 4771* Ichthyology Laboratory 0(3) Non-credit laboratory to accompany BIOL 4770. Coreq: BIOL 4770.
BMOL 4270* Membranes for Biotechnology and Biomedicine 3(3) Students learn principles of membrane science and technology and study membrane applications in the biotechnology and biomedical industries. Advanced topics include surface modification of membranes, synthesis of porous membranes for biomedical applications such as tissue engineering, environmentally responsive membranes, and membrane-based biomedical devices. Preq: CHE 3300.

BMOL 4290 Bioprocess Engineering 3(3) Chemical engineering principles are applied to bioprocess design. Emphasis is placed on design of bioreactors and bioprocessing unit operations used in industrial biotechnology and the chemical process industry. Application of bioreaction and bioprocessing operations to other chemical processes are discussed. Preq: CHE 3300 and CHE 4500.

BIOSYSTEMS TECHNOLOGY
Professor: T.R. Dobbins; Associate Professor: C.M. Dragcho

BT 2200 Biosystems Technology I 3(3) Introduces fundamental and applied concepts used in bioprocessing for biofuels and other high value compounds. Topics include operation of batch and continuous flow bioreactors, microbial growth in anaerobic and aerobic environments, fermentation for biofuel production, and use of renewable energy in bioprocessing. Laboratory includes hands-on exercises, problem-solving, computer simulations and oral presentations. Preq: BIOL 1030 and BIOL 1050 and CH 1101. Coreq: BT 2201.

BT 2201 Biosystems Technology I Laboratory 0(3) Non-credit laboratory to accompany BT 2200. Coreq: BT 2200.

BT 2400 Biosystems Technology II 3(2) Introduces basic unit operations used in bioprocessing for biofuels and other bioproducts. Covers operation and selection of pumps, heat exchangers, separation systems and sensors used in bioprocessing. Laboratory includes hands-on exercises, problem-solving, computer simulations, and oral presentations. Preq: BT 2200. Coreq: BT 2401.

BT 2401 Biosystems Technology II Laboratory 0(3) Non-credit laboratory to accompany BT 2400. Coreq: BT 2400.

BUSINESS
Professor: M.A. McKnew; Senior Lecturers: E.B. De Julio, S. Edge, J.G. Gaubert; Lecturers: R.A. Lucas, D.L. McCubbin, W.E. Tumblin II

BUS 1010 Business Foundations 1(1) Introduction to a variety of topics critical to student success, including an overview of Clemson business degrees, on-campus resources available to ensure success, academic advising, business ethics, internships, co-ops, study abroad programs, student organizations, ePortfolios, and Clemson history.

BUS 2910 Business Honors Seminar in International Business 1(1) Introduction to the International Business Honors Program presented through a discussion of thesis expectations, study abroad experiences, and seminars given by returning senior International Business Honors students. To be taken Pass/No Pass only. Preq: Membership in Calhoun Honors College.

BUS 2990 Creative Inquiry-Business 1-4(1-4) In consultation with and under the direction of a faculty member, students pursue scholarly activities individually or in teams. These creative inquiry projects may be interdisciplinary. Arrangements with mentors must be established prior to registration. May be repeated for a maximum of four credits.

BUS 3910 International Business Honors Thesis Research 1(1) Students work with a Clemson advisor and an international advisor to develop a research topic for the senior thesis. Students work and conduct research while participating in an approved study abroad. To be taken Pass/No Pass only. Preq: BUS 2910.

BUS 3920 International Business Honors Thesis Proposal 1(1) Students work with a Clemson advisor and an international advisor to complete a proposal for the senior thesis. Students work and conduct research while participating in an approved study abroad. To be taken Pass/No Pass only. Preq: BUS 3910.

BUS 3990 Creative Inquiry-Business 1-4(1-4) In consultation with and under the direction of a faculty member, students pursue scholarly activities individually or in teams. These creative inquiry projects may be interdisciplinary. Arrangements with mentors must be established prior to registration. May be repeated for a maximum of four credits.

BUS 4910 International Business Honors Thesis 3(3) Students work with an advisor to conduct literature review and research on a senior thesis topic and prepare presentations and thesis drafts based on this work. Preq: BUS 3920.

BUS 4920 International Business Honors Thesis II 3(3) Students work with an advisor to complete a senior thesis. They prepare and present a seminar on the topic for presentation to faculty and other International Business Honors students. Preq: BUS 4910.

BUS 4990 Creative Inquiry-Business 1-4(1-4) In consultation with and under the direction of a faculty member, students pursue scholarly activities individually or in teams. These creative inquiry projects may be interdisciplinary. Arrangements with mentors must be established prior to registration. May be repeated for a maximum of four credits.

COLLEGE OF ARCHITECTURE, ARTS AND HUMANITIES

CAAH 2010 Cultural Literacies Across Media 3(3) Hands-on practicum course in which students reflect critically on the cultural, aural, visual, professional and technological literacies learned as a result of a semester-long study abroad experience. May be repeated for a maximum of six credits. Preq: Enrollment in a study abroad program and ENGL 1030.