In this course students will learn about variation within populations, the mechanisms of evolution, phylogeny and classification, population and community ecology, animal behavior and ecosystems dynamics. Labs will include investigations in laboratory and field settings. Prerequisite: Grades of "C-" or better in BIO 114, GEOL 110, GEOG 210 or ISAT 112.

BIO 201. Trelawny Learning Community Seminar. 1 credit.
Introduction to the biology major and biological research for first-year students in the Trelawny Learning Community. In addition to lab/field work with faculty or graduate students for 2-3 hours per week, students attend a weekly seminar. Seminar includes research skill and team-building exercises, guest speakers and case studies geared toward a career in science. Faculty and students interact with community members to provide perspectives on the major and research in a scientific network. Prerequisite: Membership in the Trelawny Learning Community. Corequisite: BIO 114.

BIO 202. Trelawny Learning Community Seminar II. 2 credits.
The second part of the research skills seminar for first-year students in the Trelawny Learning Community. Students will have already begun research projects during fall semester, and will continue their projects into spring semester while continuing to build research skills. Students will take part in community, campus, and social events and gain experience helping to run a research-based event. Prerequisite: BIO 201. Corequisite: BIO 124.

BIO 203. Viral Discovery (0, 4). 2 credits.
An exploratory laboratory experience, designed for incoming freshmen. Students will learn about the life cycle and ecology of viruses infecting bacteria. Soil samples will be collected, and techniques for isolation and purification of the viruses will be performed by the students. Isolated viruses will be visualized using electron microscopy. The genomic material will be isolated and prepared for nucleic acid sequencing.

BIO 204. Viral Genome and Bioinformatics (0, 4). 2 credits.
A computer-based laboratory experience, designed for students completing the Viral Discovery course. Students will learn to identify genes in a viral genome, compare the predicted proteins with known proteins in databases, describe the contents of the genome and note all the relevant information for publication. Students will also research the role of bacteriophages in ecology and evolution. Prerequisite: BIO 203 or ISAT 203.

BIO 214. Cell and Molecular Biology (3, 3). 4 credits.
Students will explore the physiology, metabolism and reproductive biology of prokaryotic and eukaryotic cells. Topics will include the structure and function of macromolecules, theoretical and mechanistic aspects of metabolism, bioenergetics and signal transduction. Labs will include investigations that introduce students to various biochemical techniques. Prerequisites: Grades of "C-" or better in BIO 114 and CHEM 131. Students not meeting these prerequisites prior to the start of classes will be administratively dropped.

BIO 220. Cell Biology. 3 credits.
A comparative and theoretical coverage of basic aspects of cell structure and function common to most biological systems, including integration of cell theory, metabolism and gene action. Credit may not be earned in both BIO 220 and CHEM 222. Prerequisite: CHEM 132 or CHEM 120 or equivalent.

BIO 222. Interdisciplinary Biology for Engineering and Physical Sciences (3, 0). 3 credits.
Cases studies and an issues-based approach will provide a framework to understand the biology of science, to stimulate critical thinking, and to appreciate the interdisciplinary nature of biological investigations. This interdisciplinary biology course is intended for students who have at least sophomore status and who are physical science, engineering or mathematics majors. This course is not available for credit toward the major or minor in biology or biotechnology. May be used for general education credit. Prerequisite: MATH 231 or MATH 235.

BIO 224. Genetics and Development (3, 3). 4 credits.
The final course in the introductory series will explore how genetic information is utilized throughout the lifetime of the organism. Labs will make use of common model organisms highlighting the growing base of knowledge on the genetics and molecular biology of developmental processes. Prerequisite: Grade of "C-" or better in BIO 214.

BIO 226. Introductory Topics in Biology (Variable). 1-4 credits.
Introductory studies in specific areas of biology. May be repeated for credit when course content changes.

BIO 270. Human Physiology (3, 2). 4 credits.
An introduction to basic physiological principles using humans as the primary organism. Physiological adaptations will be examined at the molecular through organismal levels. Intended for students in health-related fields and Cluster 3 of the General Education program. Not available for biology or biotechnology major credit. Credit for BIO 270 and 290 may be transferred together to JMU only when transferrable credits for two semesters of anatomy & physiology (I & II) are completed at the same institution. A single semester transfer, or courses from different institutions, transfer as BIO 000. Prerequisites or Corequisites: CHEM 120 or CHEM 131 or equivalent, and MATH 220 or equivalent.

BIO 280. Allied Health Microbiology (2, 4). 4 credits.
An introduction to the biology and significance of microorganisms. Emphasis will be placed on human- and health-related aspects of microbiology. Credit may not be earned in both BIO 280 and BIO 380. Not available for biology or biotechnology major credit. Prerequisite: CHEM 120, ISCI 101, BIO 103 or equivalent.

BIO 290. Human Anatomy (3, 3). 4 credits.
A study of the basic body plan is reinforced by studies of dissected human cadavers and computer simulations. Emphasis is on the major body structures and systems. Credit for BIO 270 and BIO 290 may be transferred together to JMU only when transferrable credits for two semesters of Anatomy & Physiology (I & II) are completed at the same institution. A single semester transfer, or courses from different institutions, transfer as BIO 000.

BIO 301. Introductory Neurosciences. 3 credits.
This course will examine molecular control of neuronal function. Topics include the structure and function of neuronal excitability, chemical and contact-mediated neuronal communication, developing and regenerating nervous systems, sensation and perception, learning and memory formation, repair from neuronal damage and the neuronal pathways of sensation and motor control. In the context of these subjects, we will review the neuronal alterations that cause some common brain diseases. Prerequisites: CHEM 131, and BIO 214 or ISAT 351.

BIO 305. Ornithology (1, 4). 3 credits.
Introduction to avian biology with exercises in field identification. Prerequisite: BIO 124 or permission of the instructor.

BIO 309. Marine and Freshwater Invertebrates (3, 0). 3 credits.
This course is a laboratory course that involves identification, morphology, anatomy and physiology of invertebrates. Invertebrates will be examined in the field and in the lab. The course will provide students with the opportunity to explore the diversity of marine and freshwater invertebrates. Topics include the evolution and diversity of invertebrates, morphology, anatomy and physiology of common invertebrates. The course will also include laboratory exercises designed to reinforce the material covered in lectures. Prerequisites: BIOL 114 or BIOL 115.

BIO 310. General Entomology (2, 4). 3 credits.
A laboratory and field study of insects. Morphology, physiology and behavioral aspects will be emphasized. Collection, identification and preservation of local insects by standard procedures will be part of the course. Prerequisite: BIO 124 or permission of the instructor.
BIO 312. Animal Welfare (3, 0). 3 credits.
An examination of the biological basis of animal welfare. Topics include the evolution of domestic animals, physiological and behavioral measurements of stress, welfare assessment and pain perception. Case studies examine the use of animals for companionship, food, medical research and entertainment. Prerequisite: BIO 124 or permission of the instructor.

BIO 316. Animal Development (3, 0). 3 credits.
This course integrates cell and molecular biology and genetics to understand the processes and mechanisms underlying body plan formation and organ formation in vertebrate animals and insects. The course additionally covers the development of muscle, skeleton and nervous tissues, the postembryonic phenomena of growth, metamorphosis and regeneration, and the developmental basis of evolutionary changes in animal anatomy. Prerequisite: BIO 224.

BIO 316L. Animal Development Lab (0, 3). 1 credit.
This course complements BIO 316 with hands-on laboratory experience. Emphasis will be on microscope study of chick and frog embryos to better understand embryonic processes and anatomy, learning the tools and techniques for manipulating live embryos, and designing and carrying out independent research projects using developmental biology techniques and reagents. Corequisite or prerequisite: BIO 316.

BIO 320. Comparative Anatomy of Vertebrates (2, 4). 4 credits.
A detailed study of the comparative morphology and anatomy of tracheophytes. Prerequisite: BIO 124, BIO 290 or equivalent.

BIO 324. Human Genetics (3, 0). 3 credits.
An intermediate genetics course with an emphasis on human biology. Topics include cytogenetics, pedigree analysis, quantitative traits, mutation, epigenetics, genomics and ethical issues raised by developing technologies. Prerequisite: BIO 224.

A detailed study of the comparative morphology and anatomy of tracheophytes. Prerequisite: BIO 124.

BIO/MATH 342. Mathematical Models in Biology. 3 credits.
Introduction to dynamical models (discrete and continuous time) applied to biology. Tools of mathematical analysis from linear and nonlinear dynamics will be taught, including stability analysis of equilibria, as well as appropriate use of software packages. Emphasis will be on model development and interpretation in the context of applications, including effective written and oral presentation. Prerequisite: MATH 232 or MATH 235 or equivalent.

BIO 343. Immunology (3, 0). 3 credits.
A study of the molecular and cellular basis of the immune system. Topics include the properties of antigens and immunoglobulins, the development and regulation of humoral and cell-mediated immunity, resistance and immunization to infectious diseases, allergies and autoimmune and immunodeficiency disorders. Prerequisite: BIO 214 or permission of the instructor.

BIO 343L. Immunology Laboratory (0, 4). 1 credit.
This course will introduce students to the theory and application of many of the methods currently used in clinical and research immunology. Laboratory exercises will focus on methods for identifying, quantifying and assessing functional activities of immune cells and molecules. Students will gain experience using experimental animals and in animal cell culture techniques. Corequisite: BIO 343.

BIO 345. Animal Field Biology. 3 credits.
The course is designed to use the nutritional and energetic relationships between plants and animals to lead to the evolutionary relationship of members of the different animal phyla. Field study and lab specimens will be used to develop understanding of the ecological relationships of humans and local animals, insects and plants. Prerequisite: BIO 114 or equivalent.

BIO/GEOL 350. Invertebrate Paleontology (3, 2). 4 credits.
The evolution and ecological structure of the biosphere from the origin of life to the present, emphasizing the evolution and paleobiology of animal life as shown by the fossil record. Lectures discuss methods used to interpret the fossil record and cover topics such as phylogeny and systematics, functional morphology, biostratigraphy, paleoecology, evolution and extinction. Laboratories focus on the major groups of invertebrates that are common in the geologic record. Prerequisite: GEOL 230, BIO 114 or permission of the instructor.

BIO 353. Basic Ecology (3, 3). 4 credits.
Ecological principles are presented in a context which will aid pre-college teachers to understand the background science of the subject and apply it to instruction. Prerequisites: Course is open only to IDLS majors and biology or biotechnology majors enrolled in the secondary education licensure pre-professional program. ISCI 173 or equivalent.

BIO 354. Global Climate Change and Life: Ecological and Biological Impacts of Climate Variability (2, 3). 3 credits.
Global climate change is important to the distribution, diversity, health and survival of organisms. The biota have changed through evolution in part as a response to selection pressures from these variations. Living things can also adjust to changes through phenotypic flexibility. This course examines, in a seminar/discussion format, the potential ecological impacts of past and current patterns of climate alteration on organisms. Prerequisite: BIO 124 or equivalent.

BIO 360. Plant Biology (3, 0). 3 credits.
An introduction to the biology of plants including evolution, diversity, form and function, ecology and biotechnology. Prerequisites: BIO 124 and BIO 214.

BIO/CHEM 361. Biochemistry I (3, 0). 3 credits.
An introduction to the molecules and chemical reactions of living systems. Structure and function of important classes of biomolecules are explored and the relationship of structure to function is stressed. Basic metabolic sequences are discussed. Prerequisites: CHEM 241 and permission of the instructor.

BIO 364. Human Uses of Plants (3, 0). 3 credits.
A survey of past, present and future uses of plants with emphasis on economically important plant families. Issues of cultivated plant origins, biodiversity and germplasm preservation are considered. Prerequisite: BIO 124 or permission of the instructor.

BIO 364L. Laboratory in Human Uses of Plants (0, 3). 1 credit.
An investigative examination of plants and their constituents with an emphasis on their physiological ecology, adaptations and economic utilization by humans. Prerequisite or corequisite: BIO 364.

BIO 366. Plants and Environment (3, 3). 4 credits.
An exploration of contemporary environmental issues as they relate to ecological principles. Ecological changes and organismal adaptations will be viewed from an evolutionary context. Past and present resource management by humans will be examined along with implications for the future. Prerequisites: Course is open only to IDLS majors and biology or biotechnology majors enrolled in the secondary education licensure pre-professional program. ISCI 173 or equivalent.

BIO 367. Journey Through the Cell (4, 2). 4 credits.
A study of molecular biology, how these molecules interact to carry out life-sustaining processes, where these processes take place in the cell and how these foundations can be applied to solve biological problems. Students will develop the knowledge and skills necessary to deeply understand and effectively teach these concepts, as well as an understanding of the mental models that K-8 students have surrounding these concepts as a basis for developing meaningful pedagogies. Prerequisites: Course is open only to IDLS majors and not available for biology or biotechnology major or minor credit. ISCI 173.

Design and function of cellular and organ physiology will be explored in both non-human and human animals. Class activities will emphasize problem-solving and collaborative and independent learning. The laboratories will utilize computer simulations and animal/human experiments to examine principles of both physiology and scientific investigation. Prerequisites: BIO 214 and CHEM 132 or permission of the instructor. One semester each of calculus and statistics are recommended.

BIO 380. General Microbiology (2, 4). 4 credits.
A study of the structure and function of microorganisms and their relationship to humans and to the environment. Credit may not be earned in both BIO 280 and BIO 380. Prerequisite: BIO 214 or permission of the instructor.

BIO 386. Field Botany (3, 3). 4 credits.
An in-depth survey of vascular plants in the field with emphasis on identification, diversity of form and function, and ecology. Laboratory topics will include techniques for sampling plant communities, identifying local flora and preserving botanical materials. Prerequisite: BIO 124.

BIO/PSYC 395. Comparative Animal Behavior (3, 0). 3 credits.
This course covers aspects of the development, function and evolution of the behavior of nonhuman animals. Topics include interspecies communication, feeding, aggression, territoriality, reproductive behavior and social behavior. Prerequisites: Psychology majors: PSYC 211 or PSYC 213; biology or biotechnology majors: BIO 114 and BIO 124 and one of the following (“C” or better): MATH 205, 220, 231, 235, 285, 318.

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BIO/GEOL 400. Geology and Ecology of the Bahamas. 3 credits.
This course explores the geology and ecology of the shallower-water marine environment by examining the preeminent modern example, the Bahamas platform. The Bahamas provide an excellent model for understanding modern and ancient carbonate and reef deposits and a variety of terrestrial/aquatic habitats. Biological processes are responsible for many of the geological features of the Bahamas, so the course considers the biology/ecology of marine organisms in addition to geological topics. Prerequisites: GEOL 110, GEOL 211 or a 200-level GEOL or BIO course; at least four hours of additional lab science, at least sophomore status, and permission of the instructor.

BIO 402. Forest Ecology. 4 credits.
A study of the function, structure and composition of forested ecosystems. The effect of physical geography on the distribution of forest communities will be explored. Issues of forest management and restoration will also be considered. Field laboratory topics will include dendrology and sampling techniques within different forest successional stages. Prerequisite: BIO 124 or equivalent.

BIO 403. Animal Communication. 3 credits.
In this integrated lecture and lab course, students will develop an understanding of how and why animals communicate. This course will explore animal communication from diverse perspectives, including the physical nature of signals, evolution of signals, and will do so through in-depth examination of examples of communication systems. Prerequisites: BIO 124 and MATH 220, MATH 285 or MATH 318 or permission of the instructor.

BIO 404. Evolutionary Analysis (3, 0). 3 credits.
An examination of the place of theoretical thought in biology. The concepts of phylogenetic relationships and the mechanisms of organic change as expressed through the principles of organic evolution will be stressed. Prerequisite: BIO 224 or permission of the instructor.

BIO/GEOL 405. Vertebrate Paleontology (3, 1). 3 credits.
A study of the origin and evolution of the vertebrates. Emphasis will be on understanding how the processes of Earth evolution and biological evolution have interacted through time to produce a coherent picture of vertebrate history. Prerequisite: GEOL 230, BIO 124 or permission of the instructor.

BIO 410. Advanced Human Anatomy (1, 6). 3 credits.
An advanced study of topics in human anatomy using dissection techniques. Prerequisites: BIO 290 and/or BIO 320 and permission of the instructor.

BIO 412. Mammalogy. 4 credits.
An introduction to the study of mammals, incorporating evolutionary history, general physiology, reproductive biology, systematics, ecology, wildlife management and behavior, followed by review of mammalian taxonomic orders. Lecture is reinforced with laboratory and field experience. Completion of BIO 320 recommended. Prerequisite: BIO 124 or equivalent.

BIO 414. Clinical Anatomy for Occupational Therapists. 4 credits.
This course offers an in-depth study of the structure of the musculoskeletal and peripheral nervous systems of the human body. Specific structural and neural pathologies will be examined in regards to impact on occupational performance. Laboratory experiences involving cadaver dissection, skeletal material, models and audiovisual technology will be utilized. Prerequisite: Admission to the Occupational Therapy program.

BIO 416. Human Embryology (3, 3). 4 credits.
An introduction to human development. Topics include the molecular and cellular process of gametogenesis, fertilization, gastrulation and organogenesis, as well as the macroscopic changes that occur from conception to birth. This course will provide a basis for understanding congenital malformations, cloning and stem cell research. Prerequisite: BIO 224 or BIO 290.

BIO 420. Medical Parasitology (3, 0). 3 credits.
The study and medical implications of parasites that infect humans. Class activities will emphasize parasite morphology, modes of transmission, mechanisms of host entry and infection, niche selection, life cycles, pathogenesis, diagnosis, and treatment control. Prerequisite: BIO 214 or permission of the instructor.

BIO 420L. Medical Parasitology Lab (0, 3). 1 credit.
This course will introduce students to the techniques and procedures currently used in clinical and research parasitology. Laboratory exercises will focus on diagnostic methods and the use of animal models that illustrate parasite life cycles, including their infectious stages and modes of transmission. Corequisite or prerequisite: BIO 420.

BIO 426. Topics in Biology. 1-4 credits.
Specified areas of biology. May be repeated for credit when course content changes. Prerequisite: See MyMadison for prerequisites for specific topics.

BIO 427. Topics in Biology with Laboratory. 1-4 credits.
Laboratory studies in special areas of biology to accompany BIO 426 or stand alone. May be repeated for credit when course content changes. Prerequisite: See MyMadison for prerequisites for specific topics.

BIO 432. Light Microscopy (2, 4). 4 credits.
This course covers the principles behind light microscopy, from the properties of light to the latest technologies in microscopy. Students will get hands-on experience with the different kinds of microscopes, including the confocal microscope. The course also covers fluorescent probes, advanced fluorescence techniques, digital imaging, methods of quantification and figure preparation for publication, with an emphasis on biological applications. Prerequisite: BIO 222 or BIO 224.

BIO 440. Functional Neuroscience for Occupational Therapists. 3 credits.
This course will examine functional performance of all aspects of the human nervous system. Specific nervous system conditions will be introduced and their impact on occupational performance, performance components and environmental contexts discussed. Prerequisite: Admission to the Occupational Therapy program.

BIO 444. Virology (3, 0). 3 credits.
A study of the fundamental aspects of both basic and medical virology. Credit may not be earned in both BIO 444 and BIO 544. Prerequisites: BIO 214 and BIO 224 or permission of the instructor.

Molecular, cellular and network mechanisms underlying behavior will be studied using problem-solving, discussion, lecture and critical reading of the primary literature. Similarities and differences between nervous systems and computers will be explored. Laboratories will utilize contemporary electrophysiology and computer simulation to examine the neurobiology of simple animal model systems. Prerequisite: BIO 214.

BIO 447. Evolution and Ecology of Infectious Disease (3, 0). 3 credits.
An introduction to the evolution and ecology of pathogenic microorganisms, with an emphasis on the bacteria. Emphasis will be placed on the study, discussion, and critique of scientific literature, as well as formal presentation of scientific information and data. Prerequisite: BIO 280 or BIO 380.

BIO 448. Medical Microbiology (3, 3). 4 credits. Offered fall.
This class focuses on microorganisms of medical importance, mainly bacteria and viruses. Lecture follows an organism-by-organism approach. Key topics for each organism include general cell structure, unique structures/functions, epidemiology of the disease that the organism causes, mechanisms of pathogenesis, isolation and identification of the organism, and treatment options. Prerequisite: BIO 380.

BIO 449/BIO 549. Insect Ecology (2, 4). 4 credits. Offered fall.
An overview of insect ecology from an evolutionary perspective, focusing on the processes that affect the diversity, distribution, and abundance of insects in natural and managed ecosystems. The role of insects as model systems in understanding ecological and evolutionary principles is included, and current literature in the field is highlighted. Field surveys and experiments are emphasized, including general insect collection and identification. Prerequisite: BIO 124.

BIO 450. Evolutionary and Societal Impacts of Developmental Biology (3, 0). 3 credits.
Discussion-based course on topical issues in developmental biology and how they impact animal evolution, bioethics, human identity and environmental science. Prerequisite: BIO 224.

Theoretical and applied aspects of distributions and abundance, population regulation, interactions between populations and conservation will be studied in selected organisms, including humans. Credit may not be earned in both BIO 452 and 552. Prerequisite: BIO 124.

BIO 453. Microbial Ecology and Evolution (2, 4). 3 credits.
The ecology of microorganisms will be covered, including those important in human health and in natural environments. Emphasis will be placed on the study and critique of scientific literature. Credit may not be earned in both BIO 453 and 553. Prerequisites: BIO 124, and BIO 280 or BIO 380.

BIO 454/MATH 354. Introduction to Biometrics (3, 1). 4 credits.
This course discusses the role of statistics in biological research and interpretation of biological phenomena. The course will cover topics of sampling, correlation, regression analysis, tests of hypotheses, commonly observed distributions in natural populations, nonparametric tests, goodness-of-fit tests and ANOVA. In order to fully comprehend the statistical analysis of those publications, students will review approximately half a dozen publications from different fields of biology. Prerequisite: MATH 220 or equivalent.

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BIO 455/BIO 555. Plant Physiology (3, 3). 4 credits.
An in-depth study of plant function including metabolism, water relations, transport phenomena, growth and development, physiological ecology, and responses to pathogens and abiotic stress. Credit may not be earned in both BIO 455 and BIO 555. Prerequisite: BIO 214.

BIO 456. Landscape Ecology (3, 3). 4 credits.
The functional and descriptive study of the interaction of the mosaic of ecosystems that comprise the landscape prevalent in a region. Prerequisite: BIO 124.

This course will explore the various ways that geographic information systems (GIS) can be used to answer biological questions. Students will use GIS software to study applications in ecology, conservation biology and environmental biology. No prior GIS experience is required. Prerequisites: BIO 124 or permission of the instructor.

Functional relationships and productivity of freshwater communities are examined as they are affected by their physical, chemical and biotic environment. Organisms inhabiting lakes, ponds, rivers, streams and estuaries are studied at the population, community and ecosystem levels. Credit may not be earned in both BIO 459 and BIO 559. Prerequisites: BIO 124, CHEM 131 and CHEM 132.

BIO 460. Plant Cell and Tissue Culture (2, 4). 4 credits.
Theory and practice of growing isolated plant cells, tissues and organs. Credit may not be earned in both BIO 460 and BIO 560. Prerequisites: BIO 114 and CHEM 132.

BIO 465. Environmental Toxicology (2, 4). 4 credits.
The study of types, sources and biological effects of environmental pollutants. Class activities will include discussions of foundational material covering the biological effects of a broad range of pollutants. Labs will focus on the use of simulation models, geographic information systems and other software currently used in environmental toxicology for the analysis of environmental data. Credit may not be earned in both BIO 465 and BIO 565. Prerequisite: BIO 224 or equivalent.

BIO 466. Toxicology Seminar (3, 0). 3 credits.
Readings and discussions of the primary scientific literature with a focus on the biological effects of toxins at the genetic, cellular, physiological and ecological level. Prerequisite: BIO 224 or equivalent.

Comparative morphology, ecology and taxonomy of representative algae, fungi and bryophytes. Credit may not be earned in both BIO 470 and BIO 570. Prerequisite: BIO 124.

BIO 472. Human Metabolism (3, 0). 3 credits.
This course will focus on the cellular physiological mechanisms responsible for regulation of normal human metabolism and place them in the context of the development of chronic disease processes. Prerequisites: CHEM 241 and BIO 214 or permission of the instructor.

BIO 475. Advanced Cell Biology (3, 0). 3 credits.
This seminar-style course covers topics in advanced cell and molecular biology. Class format will be discussions from assigned review articles, followed by student-led presentations of assigned primary literature. Students write a research grant proposal and give an oral presentation of their proposal in class. Prerequisite: BIO 224.

BIO 477. The Genetics of Cancer (3, 0). 3 credits.
Exploration of the genetic and epigenetic factors that drive the evolution of cancer cells, taking into account both inherited and environmental contributions to this process. The cellular mechanisms debilitated or subverted during cancer development will be studied, and student teams will demonstrate their understanding of the material through the diagnosis, genetic characterization and treatment of a hypothetical cancer patient. Prerequisite: BIO 224.

BIO 480. Advanced Molecular Biology (3, 4). 4 credits.
Cellular constituents and genetics are emphasized at the molecular level. Credit may not be earned in both BIO 480 and BIO 580. Prerequisites: BIO 224, and CHEM 241 or CHEM 342.

BIO 481. Genomics (3, 3). 4 credits.
An advanced biology course designed for students to learn about the structure and function of genomes, to develop facility in web-based tools and resources, and to appreciate the power and limitations of current resources and knowledge. Focus is on the biological questions that genomics can help to answer. Laboratory exercises will be sequencing and analyzing genomic DNA. Prerequisite: BIO 224.

BIO 482. Human Histology (3, 3). 4 credits.
Microscopic structure of cells, tissues and major organ systems of the body. Basic anatomical and physiological function is presented to emphasize the histological significance of the examined organ systems. Prerequisite: BIO 270, BIO 290 or equivalent.

BIO 483. Bioinformatics (3, 3). 4 credits.
Focuses on building databases and computer programs to manage and analyze biological sequence data, and secondarily on theoretical aspects. The overall objective is to learn current information about the intersection of information science and biology, to develop facility in the many web-based tools and resources for further studies and research in genomics/bioinformatics, and to appreciate the power and limitations of current resources and knowledge. Prerequisite: BIO 224.

BIO 486. Systematics of Vascular Plants (2, 4). 4 credits.
Study of systematic theory and an overview of the classification and evolution of higher plants with particular attention to flowering plant families. Techniques for plant identification and collection and for construction of phylogenies will be taught in lab. Prerequisite: BIO 124 or permission of the instructor.

The interactions of organisms with their physical environment. Concepts from fluid and solid mechanics are applied to biological form and function. Prerequisite: BIO 114 or permission of the instructor.

BIO 492. Mentored Biology Course Assistant (0, 4). 1 credit.
Students are trained in research theory and techniques. Students must contact and make arrangements with the supervising instructor in the term prior to registration. May be repeated for a maximum of two credits when course content changes. Prerequisites: GPA of 2.5 or higher and permission of the instructor.

BIO 493. Pre-Veterinary Student Internship (0, 7). 2 credits.
Students are supervised by veterinarians and lab technicians in diagnostic lab activities at a regional animal health laboratory. A proposal and final presentation are required. Enrollment is limited to 1-2 individuals per term and students are advised to contact the Pre-Veterinary Coordinator to be waitlisted. Offered as credit/no credit only. Prerequisites: Completion of BIO 224, GPA of 2.5 or higher and permission of the instructor.

BIO 494. Internship in Biology (0, 4-8). 1-2 credits.
Students participate in research or applied biology outside of this university. Students must contact and obtain approval of a supervising instructor at the off campus location and with the department internship coordinator in the term prior to registration. A proposal must be approved prior to registration and a final paper or presentation will be completed. Offered as credit/no credit only. Prerequisites: Biology or biotechnology major with a minimum of eight biology credit hours and a GPA of 2.5 or greater.

BIO 495. Biotechniques (0, 4). 1 credit.
Students are trained in research theory and techniques. Students must contact and make arrangements with a supervising instructor in the term prior to registration. May be repeated for a maximum of two credits when course content changes. Prerequisite: GPA of 2.5 or greater.

BIO 496. Research Literature (0, 4). 1 credit.
Students pursue literature research in a selected area of biology. Students must contact and make arrangements with a supervising instructor in the term prior to registration. May be repeated for a maximum of 2 credits when course content changes. Prerequisite: GPA of 2.5 or greater.

BIO 497. Biological Research (0, 4-8). 1-2 credits.
Students pursue a lab or field research project in a selected area of biology. Students must contact and make arrangements with a supervising instructor in the term prior to registration and complete a 2-3 page proposal no later than five weeks after the start of the course. Course may be repeated. Prerequisite: GPA of 2.5 or greater.

BIO 498. Senior Project (0, 8). 2 credits.
Three semester courses taken as Parts A, B and C; 2 credits each. Expectations, requirements and prerequisites are defined in the department senior project policy. Students must contact and make arrangements with a supervising instructor in the term prior to registration.

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