BIOLOGY (BIO)

BIO 100 Selected Topics in Biology (1-6 Credits)
Arts & Sciences
Repeatable

BIO 105 Technology Inspired by Nature-Learning from the Natural World (3 Credits)
Arts & Sciences
Investigations into how human technology has been and can be inspired by nature. Research process; production of novel adhesives, building materials, fabrics; solar power, biofuels, aerodynamics, computer design, artificial intelligence, and robotics.

BIO 106 Ocean Life (3 Credits)
Arts & Sciences
An introduction to the biology of the diverse organisms that live in the ocean, applications of cutting edge technology to their study, recent scientific discoveries, and the science behind current global conservation issues.

BIO 121 General Biology I (3 Credits)
Arts & Sciences
First course in a survey of biological concepts ranging from the molecular level to global ecology. Units include the nature of science, life chemistry, cell structure and function, photosynthesis and respiration, genetics, and evolution.
Coreq: BIO 122

BIO 122 General Biology I Laboratory (1 Credit)
Arts & Sciences
Laboratory associated with BIO 121. Includes inquiry-based exploration and practical application of concepts discussed in BIO 121.
Coreq: BIO 121

BIO 123 General Biology II (3 Credits)
Arts & Sciences
Second course in a survey of major biological concepts ranging from the molecular level to global ecology. Units include biodiversity, plant structure and function, human and comparative animal anatomy and function, ecology, and evolution.

BIO 124 General Biology II Laboratory (1 Credit)
Arts & Sciences
Laboratory course associated with BIO 123. Includes inquiry-based exploration and practical application of concepts discussed in BIO 123. One laboratory session per week. Includes inquiry-based exploration and practical application of concepts discussed in BIO 123.
Coreq: BIO 123

BIO 180 International Course (1-12 Credits)
Arts & Sciences
Offered through SUAbroad by educational institution outside the United States. Student registers for the course at the foreign institution and is graded according to that institution's practice. SUAbroad works with the SU academic department to assign the appropriate course level, title, and grade for the student's transcript.
Repeatable

BIO 200 Selected Topics (1-6 Credits)
Arts & Sciences
Exploration of a topic (to be determined) not covered by the standard curriculum but of interest to faculty and students in a particular semester.
Repeatable

BIO 202 Strategies for Success in Biology (1 Credit)
Arts & Sciences
Do you want to do better academically? This course will help you to develop evidence-based strategies for success and achieve your potential. We will cover effective study techniques and learning strategies and discuss different resources that are available to help you succeed.

BIO 211 Introduction to Neuroscience (3 Credits)
Arts & Sciences
Cross-listed with NEU 211
Foundations of neurobiology beginning with cellular neurobiology, moving on to integrative systems and ending with higher brain functions. Emphasizes understanding of nervous system operation. Lectures, discussion and demonstrations.
Shared Competencies: Scientific Inquiry and Research Skills (https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/)

BIO 216 Anatomy & Physiology I (4 Credits)
Arts & Sciences
Lecture and laboratory course relating form and function. Structure and function of tissues, bones, joints, muscle, nervous system, and special senses. Biology majors may not receive credit toward the major. Credit cannot be given for BIO 216 after successfully completing BIO 316.
Prereq: BIO 121 and 123 and 124
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/)

BIO 217 Anatomy and Physiology II (4 Credits)
Arts & Sciences
Lecture and laboratory course, continuation of BIO 216, relating form and function. Structure and function of urinary, digestive, endocrine, reproductive, and cardiovascular systems. Biology majors may not receive credit toward the major. Credit cannot be given for BIO 217 after successfully completing BIO 317.
Prereq: BIO 121 and 123 and 124
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/)

BIO 220 Biology Abroad (1-6 Credits)
Arts & Sciences
Examination of specific biological problems offered in, or with a specific focus on, a particular international setting. Combination of lectures and appropriate laboratory and field exercises.
Repeatable

BIO 221 Peer Led Team Learninq Leadership Training I (1-2 Credits)
Arts & Sciences
Training and experience in peer leadership for the first semester of an undergraduate course sequence in which the student has previously earned a grade of B or higher. Applies concepts aligned with the associated course to problem solving activities.
Repeatable 2 times for 4 credits maximum

BIO 223 Peer Led Team Learninq Leadership Training II (1-2 Credits)
Arts & Sciences
Training and experience in peer leadership for the second semester of an undergraduate course sequence in which the student has previously earned a grade of B or higher. Applies concepts aligned with the associated course to problem solving activities.
Repeatable 2 times for 4 credits maximum

BIO 224 Integrative Biology Laboratory (2 Credits)
Arts & Sciences
This laboratory course covers key research skills for students including experimental design, statistical analysis, basic lab skills, reading and analyzing research papers, and ethical research practices.
Prereq: BIO 121

BIO 270 Experience Credit (1-4 Credits)
Arts & Sciences
Participation in a discipline or subject related experience. Student must be evaluated by written or oral reports or an examination. Permission in advance with the consent of the department chairperson, instructor, and dean. Limited to those in good academic standing.
Repeatable

BIO 280 International Course (1-12 Credits)
Arts & Sciences
Offered through SUAbroad by educational institution outside the United States. Student registers for the course at the foreign institution and is graded according to that institution's practice. SUAbroad works with the S.U. academic department to assign the appropriate course level, title, and grade for the student's transcript.
Repeatable

BIO 290 Independent Study (1-6 Credits)
Arts & Sciences
Exploration of a problem, or problems, in depth. Individual independent study upon a plan submitted by the student. Admission by consent of supervising instructor(s) and the department.
Repeatable

BIO 300 Selected Topics (1-6 Credits)
Arts & Sciences
Exploration of a topic (to be determined) not covered by the standard curriculum but of interest to faculty and students in a particular semester.
Repeatable

BIO 306 Drug Discovery (3 Credits)
Arts & Sciences
Offered regularly through Syracuse Abroad. This course provides an overview of the process involved from drug discovery to final market approval. We will explore historical perspectives and new biotechnology tools for the discovery and design of new drugs.

BIO 307 South African Ecosystems and Diversity OTS (4 Credits)
Arts & Sciences
Taught in South Africa through OTS program. Field and classroom instruction, integrated analysis of diversity of South Africa's ecosystems based on sources in geology, climatology, ecosystem ecology, co-evolution of plants and animals; roles of humans.

BIO 310 Evolutionary Biology, Religion & Society (3 Credits)
Arts & Sciences
This seminar format course will examine evolutionary biology and its intersection with society. Topics of discussion will include evolution and philosophy, history, medicine, environmental issues, politics, education and religion.

BIO 311 Fundamentals of Tropical Biology-Costa Rica OTS (4 Credits)
Arts & Sciences
Taught in Costa Rica through OTS program. Integrates classroom and field instruction; fundamental principle of tropical biology; the natural history of important plants, animals; major conceptual problems guiding basic ecological research in tropical habitats.

BIO 312 Marine Ecology of the Mediterranean Sea and North Africa (3 Credits)
Arts & Sciences
Offered only in Madrid. Marine ecosystems and their components and how they behave alone and in interaction. Observe and analyze conservation issues such as problems resulting from excessive use of resources, including renewable and non-renewable natural resources and the deterioration and loss of both.
Shared Competencies: Civic and Global Responsibility (https://coursecatalog.syracuse.edu/shared-competencies/civic-and-global-responsibility/)

BIO 313 Marine Ecology Laboratory (1 Credit)
Arts & Sciences
Hands-on study of the Neritic Biome in the Canary Islands.
Coreq: BIO 312

BIO 316 Anatomy and Physiology I for Biology Majors (4 Credits)
Arts & Sciences
Lecture and laboratory course relating form and function. Structure and function of tissues, bones, joints, muscle, nervous system, and special senses. Credit cannot be given for BIO 316 after successful completion of BIO 216.
Prereq: BIO 121
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/)

BIO 317 Anatomy and Physiology II for Biology Majors (4 Credits)
Arts & Sciences
Lecture and laboratory course, relating form and function. Structure and function of urinary, digestive, endocrine, reproductive, and cardiovascular systems. Credit cannot be given for BIO 317 after successful completion of BIO 217.
Prereq: BIO 121
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/)

BIO 322 Cell and Molecular Biology (4 Credits)
Arts & Sciences
Structural and functional relationships of cells are discussed with emphasis to similarities among all living organisms. Introduction to cellular biochemistry, metabolism and energy flow, cellular and Mendelian genetics, and the chemical basis of heredity.
Prereq: BIO 121 and BIO 123 and BIO 224 and (CHE 106 or CHE 109)

BIO 323 Integrative Physiology and Ecology (4 Credits)
Arts & Sciences
At the scale of the organism, students will understand: the physiological systems (structure and function) including energy transformation, homeostasis and adaptation; integration across organisms within communities and ecosystems; fitness of organisms to their environment over evolutionary time and the impact of human societies on habitat.
Prereq: BIO 121 and BIO 123 and BIO 224
Shared Competencies: Scientific Inquiry and Research Skills (https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/)

BIO 324 Evolution (4 Credits)
Arts & Sciences
This course explores evolution, the central and unifying concept of biology and related fields.
Prereq: BIO 121 and BIO 123 and BIO 224

BIO 326 Genetics (3 Credits)
Arts & Sciences
Principles of inheritance, structure and synthesis of nucleic acids and proteins, basic enzymology, microbial genetics, recombinant DNA technology and introduction to genomics.
Prereq: BIO 121 AND CHE 106 or CHE 109 or CHE 150
Shared Competencies: Scientific Inquiry and Research Skills (https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/)

BIO 327 Cell Biology (3 Credits)
Arts & Sciences
Cell structure, molecular biology of eukaryotic cells, cytoskeletal organization and function, cell division cycle, membrane structure and function, cell-cell interactions, cell differentiation and regulation.
Prereq: (BIO 121 or BEN 201) and (CHE 106 or CHE 109)

BIO 336 Life in the Invisible World (3 Credits)
Arts & Sciences
This course examines the diversity of microorganisms within the context of the tree of life. A series of themes relating microbial life with human society and biology are explored using historical and modern case-studies.

BIO 345 Ecology and Evolution (3 Credits)
Arts & Sciences
Survey of modern topics in ecology and evolutionary biology. Evolution, phylogenetics, animal behavior, population ecology, community ecology and ecosystems
Prereq: BIO 121
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/); Communication Skills (https://coursecatalog.syracuse.edu/shared-competencies/communication-skills/); Scientific Inquiry and Research Skills (https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/)

BIO 351 Ecology (3 Credits)
Arts & Sciences
Ecology is the study of interactions between organisms and their environment. This course will introduce you to the fundamental concepts of the field such as the distribution of organisms, interactions among organisms, population dynamics, community ecology and ecosystem processes.
Prereq: BIO 121, 122, 123, 224, 323, 324

BIO 355 General Physiology (3 Credits)
Arts & Sciences
Physiology of systems of higher animals and plants, including circulation, regulation of body fluids, nervous system, muscle, sensory systems, and photosynthesis.
Prereq: BIO 121 and (CHE 106 or CHE 109 or CHE 150)

BIO 360 Biology Laboratory Assistant (1 Credit)
Arts & Sciences
Biology majors (and Biology related majors) who have successfully completed the core requirements for their major (B or better Bio GPA) may receive 1 credit hour for assisting in the teaching of Bio 122 or Bio 124. This credit hour does not count as a lab credit.
Repeatable 2 times for 2 credits maximum

BIO 361 Autonomic Physiology (3 Credits)
Arts & Sciences
This course is an exploration of the autonomic nervous system, its regulation of various organ systems as well as diseases and disorders that manifest as a result of autonomic dysregulation.
Prereq: BIO 121 and (BIO 123 or NEU 211)

BIO 380 International Course (1-12 Credits)
Arts & Sciences
Offered through SUAbroad by educational institution outside the United States. Student registers for the course at the foreign institution and is graded according to that institution's practice. SUAbroad works with the SU academic department to assign the appropriate course level, title, and grade for the student's transcript.
Repeatable

BIO 396 Stem Cells and Society (3 Credits)
Arts & Sciences
Cross-listed with PHI 396
The science of stem cells and the philosophical, religious and legal complexities surrounding the research and use of stem cell technologies.
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/); Ethics and Integrity (https://coursecatalog.syracuse.edu/shared-competencies/ethics-and-integrity/); Scientific Inquiry and Research Skills (https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/)

BIO 400 Selected Topics (1-6 Credits)
Arts & Sciences
Exploration of a topic (to be determined) not covered by the standard curriculum but of interest to faculty and students in a particular semester. *
Repeatable

BIO 405 Introduction to Field Biology Laboratory (4 Credits)
Arts & Sciences
Scientific methods and design. Intensive field research conducted during spring break at the Archbold Biological Station in Florida. Design, implement, analyze own research projects. Travel to ecosystems discussed in lecture.
Prereq: BIO 121

BIO 406 Biology of Marine Mammals (3 Credits)
Arts & Sciences
This course explores the evolution, ecology and conservation of marine mammals through background readings and lectures on fundamental concepts followed by discussion of primary scientific literature and synthesis of concepts through applied program solving and research projects.

BIO 407 Advanced Neuroscience (3 Credits)
Arts & Sciences
Cross-listed with NEU 407
Double-numbered with BIO 607, NEU 607
Detailed analysis of the anatomy, physiology, and chemistry of the nervous system and behaviors that it mediates. Topics include: neurons and electrochemical properties of neurons, sensory and motor systems, homeostasis, sleep, consciousness, learning, and memory. Additional work required of graduate students.
Prereq: BIO 211 or NEU 211
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/)

BIO 409 General Microbiology (3 Credits)
Arts & Sciences
Micro-organisms and life processes, human disease, and the environment. Topics cover microbial physiology, morphology, biochemistry, genetics, genomics, and evolution.
Prereq: (BIO 326 and 327) or (BIO 322 and BIO 324) Coreq: BIO 410

BIO 410 General Microbiology Laboratory (1 Credit)
Arts & Sciences
Laboratory course associated with BIO 409. Topics cover microbial growth, identification, isolation, staining, and relevant molecular technologies including genome sequencing and analysis.
Prereq: BIO 326 and BIO 327 or BIO 322 and BIO 324 Coreq: BIO 409

BIO 411 Evolutionary Mechanisms (3 Credits)
Arts & Sciences
Double-numbered with BIO 611
Core processes & mechanisms involved in evolution, extending to molecular evolution, evolutionary genetics, & genomics. Topics include: genetic variation, mutation & neutral evolution, selection, drift & inbreeding, quantitative genetics, molecular evolution, selection in the wild, adaptation, & speciation. Additional work required of graduate students.
Prereq: BIO 326 and 345

BIO 412 Research Methods in Tropical Biology-OTS (4 Credits)
Arts & Sciences
Taught in Costa Rica through OTS program. Research design, field methods, basic data analysis in a tropic context. Hypothesis testing and statistical analysis. Design, implement, and analyze own field projects.

BIO 413 Neurobiology of Pain and Analgesia (3 Credits)
Arts & Sciences
This course explores the etiology of chronic pain, and the mechanisms of its treatment.
Prereq: BIO 121 or BIO 123 or NEU 211

BIO 414 Brain & Behavioral Plasticity (3 Credits)
Arts & Sciences
Double-numbered with BIO 614
Behavioral adaptations give animals the ability to use their pasts to solve new problems, an ability important to their survival. This course will examine behavioral plasticity and the brain mechanisms responsible for adaptive changes inn behavior. Additional work required of graduate students.
Prereq: NEU 211 or NEU 223 or BIO 217 or BIO 317 or BIO 326 or BIO 327

BIO 415 Conservation Biology (3 Credits)
Arts & Sciences
Double-numbered with BIO 615
Considered from the standpoint of modern molecular, genetic, and population biology. Biodiversity, minimum viable populations, reserve design, genetic variation, applications of recombinant DNA technology, ex situ, care and ecosystem reconstruction. Additional work required of graduate students.
Prereq: BIO 345

BIO 416 Biology of Aging (3 Credits)
Arts & Sciences
Double-numbered with BIO 616
Reviews and discusses current topics on biology of aging emphasizing distinctions between healthy and pathological aging. Primary focus will be on molecular, cellular, systems-level and whole organism changes accompanying aging. Additional work required of graduate students. Additional work required of graduate students.
Prereq: BIO 327 or 355

BIO 417 Animal Behavior and Evolutionary Biology Laboratory (3 Credits)
Arts & Sciences
Focuses on understanding the process of natural selection, with an emphasis on the evolution of adaptive animal behavior. Planned lab and field exercises, independent research projects. Suitable for junior and senior biology majors.
Coreq: BIO 345

BIO 418 Ecosystem Ecology Lab (3 Credits)
Arts & Sciences
This lab course addresses the fluxes of energy and materials through plants and ecosystems and how they are related to global warming.
Prereq: BIO 345

BIO 419 Junior and Senior Thesis Seminar (1 Credit)
Arts & Sciences
Discussion of research activities of major interest to the participants. Open only to students admitted to the upper-division biology honors program. May be taken for credit up to four times.
Repeatable 4 times for 4 credits maximum
Shared Competencies: Communication Skills (https://coursecatalog.syracuse.edu/shared-competencies/communication-skills/); Scientific Inquiry and Research Skills (https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/)

BIO 421 Capstone Seminar in Biotechnology (3 Credits)
Arts & Sciences
A seminar course for upper-level students, particularly (but not limited to) students completing a major in Biotechnology. Evaluation of scientific papers, current news stories, and biotechnology related issues.
Prereq: BIO 463
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/); Communication Skills (https://coursecatalog.syracuse.edu/shared-competencies/communication-skills/)

BIO 422 Bioinformatics for Life Scientists (3 Credits)
Arts & Sciences
Bioinformatics and how to apply it to biological research. As a lab course emphasis will be on the hands-on use of bioinformatics tools to solve relevant biological problems.
Prereq: BIO 326

BIO 424 Comparative Vertebrate Biology (4 Credits)
Arts & Sciences
Phylogenetic relationships and adaptations of vertebrates based upon comparative embryology, anatomy, histology, and physiology. Laboratory includes microscopic work, dissections, and interactive computer-video exercises.
Prereq: BIO 327 and 345

BIO 428 Seminar in Environmental Science (3 Credits)
Arts & Sciences
Cross-listed with EAR 428
Seminar for students following the environmental science curriculum. Students will work together to critically evaluate, and propose solutions to, current environmental problems using a combination of reading, class discussion, written analyses, and oral presentations.

BIO 430 Genetics Laboratory (3 Credits)
Arts & Sciences
Double-numbered with BIO 630
Experience in genetic methods and analyses using various model organisms, such as budding yeast, fruit flies, nematodes, and mustard plants. Experiments will include gene mapping, phenotypic analysis, transformation, complementation, and an introduction to molecular biology. Additional work required for graduate students.
Prereq: BIO 326 and BIO 327

BIO 431 Population Genetics (3 Credits)
Arts & Sciences
Double-numbered with BIO 631
Models of population growth, Hardy-Weinburg equilibrium, X-linkage and two loci, subdivision, inbreeding and finite populations, quantitative characters, selection, migration, mutation, the fundamental theorem, stochastic processes, and requisite mathematics. Computer programming is part of the laboratory requirement. Additional work required of graduate students.
Prereq: BIO 345 and (MAT 285 or 295)

BIO 432 Droplets and Gels in Healthy and Diseased Cells (3 Credits)
Arts & Sciences
Double-numbered with BIO 632
Examines how macromolecules spatially reorganize inside cells to form biomolecular condensates (sometimes called membraneless organelles). Dysregulation of condensates is linked to neurodegenerative disorders and cancer. We will read recent primary literature and interface with active researchers. Additional work required of graduate students.
Prereq: BIO 121, BIO 122, BIO 123, BIO 322
Shared Competencies: Communication Skills (https://coursecatalog.syracuse.edu/shared-competencies/communication-skills/); Scientific Inquiry and Research Skills (https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/)

BIO 434 Advanced Microscopy Techniques in Cell and Developmental Biology Lab (3 Credits)
Arts & Sciences
Double-numbered with BIO 634
Both a literature-based course in light microscopy and a hands-on lab experience using high-end microscopic systems. Students cover studies contributing to their knowledge on cell and development biology while implementing those techniques in the lab. Additional work required for grad students.
Pre-reqs: BIO 326 and BIO 327

BIO 436 Pharmacology of Substance Abuse (3 Credits)
Arts & Sciences
Double-numbered with BIO 636
This course covers major substances of abuse, including alcohol, marijuana, cocaine, hallucinogens, methamphetamine, and opiates, and will include relevant neuroanatomy and cellular and biochemical mechanisms of their mode of action. Additional work required of graduate students.
Prereq: BIO/NEU 211 and CHE 275 and BIO 322

BIO 437 Seminar in Developmental Neuroscience (3 Credits)
Arts & Sciences
Double-numbered with BIO 637
Seminar course designed to enable students to develop & practice skills in critical analysis as applied to reading primary scientific literature, covering some of the general principles of how a functioning nervous system is made in developing animals. Additional work required of graduate students.
Prereq: (BIO 326 and 327) or BIO 322

BIO 439 Seminar in Ecosystem Ecology (3 Credits)
Arts & Sciences
Double-numbered with BIO 639
Examines the main drivers of climate, biodiversity, trophic structure - of energy and nutrient flows through terrestrial and aquatic ecosystems by exploring reviews and the primary research literature. Additional work required of graduate students.
Prereq: BIO 345

BIO 440 Applied Genomics (3 Credits)
Arts & Sciences
Double-numbered with BIO 640
Introduction to Next Generation Sequencing (NGS) technologies and their application to a variety of biological problems, such as genome assembly and annotation, gene expression analysis, microbial genomics, and comparative evolutionary analyses. Additional work required for graduate students.
Prereq: BIO 326 and 327

BIO 441 Seminar in Infectious Diseases (3 Credits)
Arts & Sciences
Double-numbered with BIO 641
Seminar focusing on human diseases caused by infectious agents such as viruses and bacteria. Cause (agent), contagion, symptoms, treatment & potential outcomes will be discussed. Lectures & review of patient case studies. Additional work required of graduate students.

BIO 442 Seminar in Model Organism Genetics (3 Credits)
Arts & Sciences
Double-numbered with BIO 642
Literature review of research papers using model genetic systems to investigate topics including animal and plant development, cancer, neurological disease, behavior, and aging. Additional work is required of graduate students.
Prereq: BIO 326 and 327

BIO 443 Seminar in Epigenetics (3 Credits)
Arts & Sciences
Double-numbered with BIO 643
Seminar covering how epigenetic (gene expression inherited without change in DNA sequence) mechanisms regulate gene expression for proper development of organisms, including how they regulate health & behavior of animals due to environmental stimuli. Additional work is required of graduate students.
Prereq: (BIO 326 and 327) or BIO 322

BIO 444 Seminar in Neurotoxicology (3 Credits)
Arts & Sciences
Double-numbered with BIO 644
Examination of the mechanisms and consequences of toxicity of poisons in the central and peripheral nervous systems with a focus on the primary research literature. Additional work is required of graduate students.
Prereq: BIO 211 or NEU 211

BIO 445 Environmental Biology Laboratory (3 Credits)
Arts & Sciences
Double-numbered with BIO 645
Students learn spatial and Geographic Information System software, statistical analysis and evaluation of satellite data to explore, through discovery-based learning, major global environmental changes and their relevance to biodiversity and ecosystem function. Additional work required of graduate students.
Prereq: BIO 323

BIO 446 Epigenetics of Health & Disease (3 Credits)
Arts & Sciences
Double-numbered with BIO 646
Exploration of how epigenetic modifications influence our health and modify our risk of disease, including neurodevelopmental and neurodegenerative disorders, heart disease, and obesity. Additional work required of graduate students.
Prereq: BIO 326 and 327

BIO 447 Basic Immunology (3 Credits)
Arts & Sciences
Natural and adaptive humoral and cellular immunity. Immunoglobulin structure, generation of diversity, isotopes. Antigen recognition and processing. Complement pathways. Immune quantitation. Leucocyte differentiation. Interleukins. T-cell receptor structures and generation of diversity. Major histocompatibility complex proteins.
Prereq: (BIO 326 and 327) or BIO 322

BIO 448 Evolutionary Medicine (3 Credits)
Arts & Sciences
Application of evolutionary principles to prevention and treatment of human disease. Evolution of antibiotic resistance, epidemiology, virulence, population genetics, germ theory of disease, aging, human evolution. Lectures and discussion.
Prereq: BIO 121 and BIO 345
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/)

BIO 449 Biotechnology Lab (3 Credits)
Arts & Sciences
Double-numbered with BIO 649
Provides an essential foundation in laboratory techniques and protocols used in modern biotechnology. Emphasis is placed on precision, accuracy, and adherence to standard protocols, which prepares students for professional laboratory work.

BIO 450 Seminar in Evolutionary Genetics (3 Credits)
Arts & Sciences
Double-numbered with BIO 650
Topics relating to the fundamental principles underlying the evolution and genetics of complex traits. Current and/or classic examples from the primary research literature will be chosen for discussions. Additional work is required of graduate students.
Prereq: BIO 326 and BIO 345

BIO 452 Neurodegenerative Disease (3 Credits)
Arts & Sciences
Double-numbered with BIO 652
This seminar course is intended to review and to stimulate discussion about the current status of our knowledge about neurodegenerative disease, emphasizing distinctions between pathological and healthy brain aging. Jrs. & Srs. only; others by permission.

BIO 453 Ecology Laboratory (3 Credits)
Arts & Sciences
This course addresses the process of ecological research. Labs and fieldtrips emphasize student-driven hypothesis generation and project design, statistical analysis, scientific writing, data presentation and literature reading. Lectures focus on ecosystems, communities and global change.
Prereq: BIO 323 or BIO 345

BIO 454 Evolution (3 Credits)
Arts & Sciences
Origins and theory; genetics and mechanisms; speciation and phylogeny; rates and trends, including molecular and macro evolution.
Prereq: BIO 345

BIO 455 Physiology Laboratory (3 Credits)
Arts & Sciences
Experiments on function of cells: muscle contraction, action potential, synaptic transmission, active transport, hormone receptors, intermediary metabolism. Independent research project.
Prereq: (BIO 355 or 327) and CHE 106 and 116

BIO 456 Seminar in Human Disease Genomics (3 Credits)
Arts & Sciences
Double-numbered with BIO 656
Introduces students to influential genomic studies of the etiology & epidemiology of human disease. Recent insights into the genetic basis of human adaptation & its potential relevance to disease predisposition will be discussed. Additional work required of graduate students.
Prereq: BIO 326 and 327
Shared Competencies: Communication Skills (https://coursecatalog.syracuse.edu/shared-competencies/communication-skills/)

BIO 457 Principles of Human Toxicology (3 Credits)
Arts & Sciences
Cross-listed with FSC 457
Double-numbered with BIO 657, FSC 657
This course examines key aspects of human toxicology, including dose-response relationships, absorption, distribution, biotransformation, elimination, toxicokinetics, molecular mechanisms of toxicity, pesticides, metals, and toxic responses in specific organ systems. Additional work required of graduate students.
Prereq: (BIO 327 or BIO 322) and CHE 275 and MAT 285
Shared Competencies: Scientific Inquiry and Research Skills (https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/)

BIO 458 Seminar in Animal Communication (3 Credits)
Arts & Sciences
Double-numbered with BIO 658
Fundamental principles underlying how and why animals communicate with each other. Examination of the behavioral role of signaling, the conflicts that arise when senders and receivers have differing interests, and the behavioral strategies that result from these conflicts. Additional work required of graduate students.
Prereq: BIO 345
Shared Competencies: Communication Skills (https://coursecatalog.syracuse.edu/shared-competencies/communication-skills/); Scientific Inquiry and Research Skills (https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/)

BIO 459 Plants & People (3 Credits)
Arts & Sciences
Double-numbered with BIO 659
Focus on plant biology, the role of plants in the environment and society, and current topics surrounding plants and people. Additional work is required of graduate students.
Prereq: BIO 121
Shared Competencies: Critical and Creative Thinking (https://coursecatalog.syracuse.edu/shared-competencies/critical-and-creative-thinking/); Communication Skills (https://coursecatalog.syracuse.edu/shared-competencies/communication-skills/)

BIO 460 Research in Biology (1-4 Credits)
Arts & Sciences
Laboratory or field research under direct supervision of biology department faculty. Projects incorporate use of the scientific method, experimentation, data analysis, presentation and interpretation, and the responsibilities of scientific integrity.
Repeatable

BIO 461 Experience in Biology (0 Credits)
Arts & Sciences
Internship or work experience supervised by a faculty mentor. Projects may include experimentation, data analysis, presentation, and responsibilities of scientific integrity. Development and analysis of business plans or intellectual property in biotechnology focused companies, agencies or law firms is also possible.
Repeatable 6 times for 0 credits maximum

BIO 462 Molecular Genetics (3 Credits)
Arts & Sciences
Double-numbered with BIO 662
An introduction to gene and genome functions, mechanisms of gene regulation, epigenetics and the molecular basis of human disease. An emphasis will be placed on genomic, transcriptomic and epigenomic systems level approaches to these topics. Additional work required of graduate students.
Prereq: (BIO 326 and 327) or BIO 322
Shared Competencies: Communication Skills (https://coursecatalog.syracuse.edu/shared-competencies/communication-skills/); Scientific Inquiry and Research Skills (https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/)

BIO 463 Molecular Biotechnology (3 Credits)
Arts & Sciences
Double-numbered with BIO 663
Molecular Biotechnology is the 1st course of a two-course Biotechnology series. The other course, Applied Biotechnology, is offered in spring. These courses complement each other but one is not required for the other. Additional work required of graduate students.
Prereq: BIO 224, BIO 322, and BIO 326

BIO 464 Applied Biotechnology (3 Credits)
Arts & Sciences
Double-numbered with BIO 664
The second of a two-course Biotechnology series intended to introduce students to the scientific background necessary for applying tools of biotechnology for improvement of animal and human health, agriculture and environment. Additional work required of graduate students.
Prereq: BIO 322 and BIO 326

BIO 465 Molecular Biology Laboratory (3 Credits)
Arts & Sciences
Double-numbered with BIO 665
Basic experimental techniques: isolation of DNA, restriction endonuclease cleavage of DNA, cloning of DNA, isolation of clones from DNA libraries, in vitro mutagenesis and other techniques to manipulate nucleic acids. Additional work required of graduate students.
Prereq: BIO 326 and (327 or BIO 322)

BIO 467 Advances in Biotechnology Research & Ideas (3 Credits)
Arts & Sciences
Double-numbered with BIO 667
This course surveys a variety of cutting-edge biotechnology research areas and explores current applications of biotechnology research. Additional work required for graduate students.
Prereq: (BIO 326 and 327) or BIO 322

BIO 468 Microbiomes in Biotechnology and Medicine (3 Credits)
Arts & Sciences
Double-numbered with BIO 668
In this course, we will survey the microbial communities that live on and in humans from a genetic, biochemical, and molecular perspective. Additional work is required for graduate students.
Prereq: (BIO 326 and 327) or BIO 322

BIO 469 Science of Countering Weapons of Mass Destruction (3 Credits)
Arts & Sciences
Cross-listed with FSC 469
Double-numbered with FSC 669, BIO 669
Scientific basis and means for countering WMDs, including biological systems. Protective measures, proven doctrines, practical questions, and problem solving. Additional work required of graduate students.
Prereq: B- or better in both BIO 327 and CHE 275

BIO 470 Experience Credit (1-6 Credits)
Arts & Sciences
Participation in a discipline or subject related experience. Student must be evaluated by written or oral reports or an examination. Permission in advance with the consent of the department chairperson, instructor, and dean. Limited to those in good academic standing.
Repeatable

BIO 471 Cell and Developmental Biology Laboratory (3 Credits)
Arts & Sciences
Double-numbered with BIO 671
Survey of current methods employed in cell and developmental biology, including microscopy and imaging techniques, spatial analysis of gene expression, protein expression and localization, cell fractionation, and immunocytochemistry. Review general laboratory methods, data analysis, reporting.
Prereq: BIO 224, BIO 326, BIO and 327
Shared Competencies: Communication Skills (https://coursecatalog.syracuse.edu/shared-competencies/communication-skills/); Scientific Inquiry and Research Skills (https://coursecatalog.syracuse.edu/shared-competencies/scientific-inquiry-and-research-skills/)

BIO 472 Advanced Light Microscopy (3 Credits)
Arts & Sciences
Cross-listed with FSC 472
Double-numbered with BIO 672, FSC 672
Theory and practice of modern light microscopy, including the fundamentals of image formation and applications in the biological and biomedical sciences, including reviews of microscopy methods and analog and digital image capture. Additional work required of graduate students.
Prereq: BIO 327

BIO 473 Pharmaceuticals and Cells (3 Credits)
Arts & Sciences
Double-numbered with BIO 673
This course begins with an introduction to basic principles of pharmacology and drug discovery/development, followed by a thorough exploration of current research in signal transduction-related pharmaceuticals. Additional work for graduate students.
Prereq: BIO 326 and BIO 327

BIO 474 Experimental Design & Interpretation (3 Credits)
Arts & Sciences
Double-numbered with BIO 674
Seminar class where students (1) evaluate published papers for rigorous design, statistics and interpretation to determine their validity and contributions and (2) compose a series of mini grants to design and propose future experiments and studies. Additional work required for graduate students.
Prereqs: BIO 326 and BIO 327

BIO 475 Biochemistry Laboratory (4 Credits)
Arts & Sciences
Double-numbered with BIO 675
Experiments on amino acids, proteins, enzymes, fatty acids and nucleic acids, illustrating modern biochemical techniques applied to the chemistry of living cells. Titrations; electrophoresis; gel filtration; kinetics; spectrophotometric assays; cellular fractionation and analysis. Additional work required of graduate students.
Prereq: BIO 326 and 327; Coreq: BCM 475

BIO 476 Cold Cases (3 Credits)
Arts & Sciences
Cross-listed with FSC 476
Double-numbered with FSC 676, BIO 676
Methods and practice in solving unsolved cases using fundamental science, court documents, and other sources of information. Will include work on real cases. Additional work required of graduate students.
Prereq: B- or better in both BIO 327 and CHE 275

BIO 477 Personalized Medicine (3 Credits)
Arts & Sciences
Double-numbered with BIO 677
This course will address topics related to providing effective, personalized therapeutic treatment of diseases based on the genomic and proteomic profile of an individual. Additional work required for graduate students.
Prereq: BIO 326 and BIO 327

BIO 478 Biochemistry Laboratory (3 Credits)
Arts & Sciences
Cross-listed with BCM 478
Experiments on amino acids, proteins, enzymes, fatty acids and nucleic acids, illustrating modern biochemical techniques applied to the chemistry of living cells. Titrations; electrophoresis; gel filtration; kinetics; spectrophotometric assays; cellular fractionation and analysis.
Prereq: (BIO 326 and 327) or BIO 322 Coreq: BCM 475

BIO 479 Mind the Gap: Inclusion, Diversity, Equity and Accessibility in STEM (3 Credits)
Arts & Sciences
Double-numbered with BIO 679
History of exclusion and bias that led to underrepresentation of women, people of color, people with disabilities and those with lower socioeconomic status in STEM fields and actionable steps that promote inclusion, diversity, equity, and accessibility. Additional work required of graduate students.
University Requirement Course: IDEA Requirement Eligible
Shared Competencies: Communication Skills (https://coursecatalog.syracuse.edu/shared-competencies/communication-skills/); Ethics and Integrity (https://coursecatalog.syracuse.edu/shared-competencies/ethics-and-integrity/)

BIO 480 International Course (1-12 Credits)
Arts & Sciences
Offered through SUAbroad by educational institution outside the United States. Student registers for the course at the foreign institution and is graded according to that institution's practice. SUAbroad works with the S.U. academic department to assign the appropriate course level, title, and grade for the student's transcript.
Repeatable

BIO 482 Neuroanatomy Lab (3 Credits)
Arts & Sciences
Students will explore the basic structures of the central and peripheral nervous systems through lectures and hands-on laboratory experiences.
Prereq: NEU 211 and (BIO 216 or BIO 316)

BIO 490 Independent Study (1-6 Credits)
Arts & Sciences
Exploration of a problem, or problems, in depth. Individual independent study upon a plan submitted by the student. Admission by consent of supervising instructor(s) and the department.
Repeatable

BIO 495 Distinction Thesis in Biology (1-3 Credits)
Arts & Sciences
For students preparing a thesis in partial fulfillment of the requirements for the Distinction in Biology Program. It normally will be taken by Distinction students in the semester prior to graduation.

BIO 499 Honors Capstone Project (1-3 Credits)
Arts & Sciences
Completion of an Honors Capstone Project under the supervision of a faculty member.
Repeatable 3 times for 3 credits maximum

BIO 500 Selected Topics (1-6 Credits)
Arts & Sciences
Exploration of a topic (to be determined) not covered by the standard curriculum but of interest to faculty and students in a particular semester.
Repeatable

BIO 501 Biology of Cancer (3 Credits)
Arts & Sciences
Classifications and model systems in cancer. Oncogenes; viral and chemical oncogenesis. Growth control, genetic and epigenetic changes, progression, invasion, metastasis, and tumor immunobiology. Cancer biochemistry, host-tumor interactions, chemotherapy, immunotherapy, and host-response modification.
Prereq: (BIO 326 and 327) or BIO 322

BIO 503 Developmental Biology (3 Credits)
Arts & Sciences
Regulation of form and differentiation in eucaryotic organisms. Control of development at the molecular, cellular, and organismal levels. Experimental approaches to provide an understanding of developmental processes.
Prereq: BIO 326 and 327

BIO 565 Cellular Physiology (3 Credits)
Arts & Sciences
A lecture course on basic problems of cell function, including energetics, membrane transport, contractility, and properties of excitable membranes.
Prereq: BIO 326 and 327

BIO 580 International Course (1-12 Credits)
Arts & Sciences
Offered through SUAbroad by educational institution outside the United States. Student registers for the course at the foreign institution and is graded according to that institution's practice. SUAbroad works with the S.U. academic department to assign the appropriate course level, title, and grade for the student's transcript.
Repeatable