Biology (BIOL)

BIOL 1001. FYE: Biological Sciences. 1 Hour.
A First Year Experience course created to help students succeed in the biology major, and assist new freshmen and returning students to make a successful transition to being a college student. The primary objective of this course is to provide students with the resources they will need to succeed in their college careers, particularly in the biology major. Multiple listed with all other sections of First Year Experience (all 1001 courses, ENGR 1000). Students may only take one FYE course for credit. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Know about and where to locate important resources provided by Utah Tech to help students academically and personally. 2. Know proper techniques to enhance their studies through, note taking skills, test taking skills, group study and establish effective study habits. 3. Know ways to best manage time and money. 4. Set and achieve Goals. 5. Plan out their academic career and be comfortable speaking with advisors and professors. 6. Know different career paths offered when obtaining a degree from the biology program. 7. Understand the required and suggestive courses and activities need to obtain a degree in biology program and their post grad plans. FA.

BIOL 1010. General Biology (LS). 3 Hours.
Fulfills General Education Life Sciences requirement. Not for science majors, this course focuses on general principles of Biology, including cell theory, genetics, evolution, and interrelationships of living things, using a variety of teaching methods including lecture/discussion, laboratory, overheads, videos, quizzes and exams. Recommended corequisite: BIOL 1015. Inclusive Access Course Material (electronic book) fees may apply, see Fees tab under each course section for details. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1.Identify the scientific method, including hypothesis, experimental controls, and experimental design. 2. Describe concepts related to cell theory, the genetic basis for life, and the diversity of life, evolution, and ecology. 3. Apply biological concepts to solve real-world scientific problems. 4. Discuss how science is incorporated into daily life and identify ways to engage in the public discussion of biological issues. FA, SP, SU.

BIOL 1015. General Biology Lab (LAB). 1 Hour.
Lab course designed recommended but not required to accompany BIOL 1010. Students will have hands-on experience in a laboratory setting, including the use of microscopes, measurement and simple data analysis, observations of osmosis and diffusion, and other group activities in order to appreciate the true essence of science and the scientific process of acquiring knowledge through inquiry. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Use the scientific method to observe problems, ask questions, make predictions, formulate testable hypotheses, create experiments, and formulate reasonable conclusions. 2. Use a microscope to view and diagram cells and whole organisms, osmosis and diffusion, and the movement of chromosomes. 3. Diagram molecules, and perform experiments that demonstrate some of the functions of photosynthesis and cellular respiration. 4. Calculate simple statistics to determine the patterns of inheritance in Mendelian genetics. 5. Discuss the history and methods of classification, evolution, and ecological principles. FA, SP, SU.

BIOL 1200. Human Biology (LS). 3 Hours.
Fulfills General Education Life Sciences requirement. Covers basic anatomy and physiology of humans for pre-health science majors. Focuses on the general structure and function of the human body including tissues, organs, and systems. Through lecture, videos, models, quizzes, and tests, students become familiar with how the human body functions. Inclusive Access Course Material (electronic book) fees may apply, see Fees tab under each course section for details. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Explain the process and methods of science, including asking testable questions, using inductive and deductive reasoning in forming hypotheses and in making reliable predictions. 2. Explain and apply major concepts of life organisms including: the chemistry of life, the cell, the genetic basis of life, and human evolution. 3. Describe the function and processes of the major body systems including: cardiovascular, immune, digestive, urinary, muscular, skeletal, nervous, endocrine, and reproduction, as well as the coordination between systems in maintaining body homeostasis. FA, SP, SU.

BIOL 1300. Evolution & Ecology. 1 Hour.
Focuses on the fundamental principles of evolution and ecology. Evolution is emphasized as a unifying theme for all of Biology, as an explanation for both the unity and diversity of life. Students will learn how ecology provides the environmental context for adaptive evolution, as well as how our understanding of environmental processes relates to modern-day environmental concerns. Fulfills General Education Life Sciences and Laboratory Sciences requirements if these classes are also completed: BIOL 2320, BIOL 2325, BIOL 2420, BIOL 2425. Offered based on sufficient student need. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Describe Darwinian evolution and the role of natural selection as a key microevolutionary process. 2. Describe ecological concepts and be able to apply them to individual organisms, populations, communities, and ecosystems. 3. Collaborate with their peers in the framing and discussion of questions relating to biodiversity, conservation, and climate change. FA, SP.

BIOL 1610. Principles of Biology I (LS). 4 Hours.
Fulfills General Education Life Sciences requirement. Introductory course required of all Biology majors, pre-veterinary, pre-medical, pre-dental, and other pre-professional majors. Emphasizes the scientific method; cell processes, including basic chemistry, cellular level structure, and function; and the principles of inheritance, evolution and ecology. Fulfills prerequisite to most other Biology courses. Inclusive Access Course Material (electronic book) fees may apply, see Fees tab under each course section for details. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Identify the scientific method, including asking testable questions, forming hypotheses, and using experimental design to evaluate hypotheses. 2. Describe and apply concepts related to the chemistry of life, cell theory, the genetic basis for life, evolution, and ecology. 3. Apply information literacy skills including effectively locating, evaluating, and communicating scientific information. Corequisites: BIOL 1615. FA, SP, SU.

BIOL 1615. Principles of Biology I Lab (LAB). 1 Hour.
Lab portion of BIOL 1610. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Understand and apply basic laboratory safety. 2. Use a compound microscope and a wide-field stereoscope. 3. Understand basic concepts in biology pertaining to scientific methods, microscopy, cell structure and function, enzymatic processes, cellular respiration, cell reproduction, Mendelian genetics, molecular genetics, natural selection, population growth, and evolutionary agents. 4. Apply proper laboratory techniques in measuring materials, making wet mount slide preparations, pipetting, preparing gels for electrophoresis and carrying out gel electrophoresis. 5. Develop and evaluate hypotheses and interpret scientific data. Course fee required. Corequisite: BIOL 1610. FA, SP, SU.

BIOL 1615A. Honors Prin. of Biology Lab. 1 Hour.
Honors course. Lab portion of BIOL 1610A. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Identify the scientific method, including asking testable questions, forming hypothesis, and using experimental design to evaluate hypotheses. 2. Describe and apply concepts related to the chemistry of life, cell theory, the genetic basis for life, evolution, and ecology. Demonstrate information literacy skills including effectively locating, evaluating, applying, and communicating scientific information. Course fee required. Prerequisite: Admission to the Utah Tech Honors Program OR program director permission. Corequisite: BIOL 1610A.

BIOL 1620. Principles of Biology II. 4 Hours.
Required of all Biology majors, including pre-health science, pre-nursing, pre-veterinary, pre-medical, pre-dental, and other pre-professional students. Continues BIOL 1610; emphasizes Evolution, diversity processes, animal structure and function, plant structure and function. Prerequisite to many other Biology courses. Inclusive Access Course Material (electronic book) fees may apply, see Fees tab under each course section for details. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Explain and compare the structural and physiological diversity of viruses and bacteria. 2. Explain and compare the structural and physiological diversity of the protists. 3. Explain and compare the various life cycles and the structural and physiological diversity of fungi. 4. Explain and compare the various life cycles and the structural and physiological diversity of the plants. 5. Explain and compare the various life cycles and the structural, physiological, and evolutionary diversity of the invertebrate and vertebrate animals. Prerequisite: BIOL 1610 (Grade C- or higher). Corequisite: BIOL 1625. FA, SP.

BIOL 1625. Principles of Biology II Lab. 1 Hour.
Lab portion of BIOL 1620. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Deepen understanding of the main groups of living organisms. 2. Develop clear, testable hypotheses. 3. Design proper experiments and analyze and interpret the resulting data. 4. Report experiment results through oral presentations. 5. Report experimental results through writing. Course fee required. Prerequisite: BIOL 1615 or BIOL 1615A (Grade C or higher). Corequisite: BIOL 1620. FA, SP.

BIOL 2060. Principles of Microbiology. 3 Hours.
For health science, pre-pharmacy and other allied health professionals who need an understanding of microbiology. Focuses on essentials of microbiology, including disease control, nomenclature, function of immune system, pathologies, causes and cures, and laboratory methods for safely studying microorganisms. Successful completion of the course gives students an understanding of microbes and their relationship to the human system and health. The material of this course is presented in an advanced manner. Relevant background of basic biology is assumed. Inclusive Access Course Material (electronic book) fees may apply, see Fees tab under each course section for details. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Describe the people who have made important contributions to the understanding of microbiology. 2. Summarize the structure and function of various microbes, how prokaryotic cells survive, communicate, and reproduce. 3. Explain how microbes cause disease states, and describe various clinical outcomes of biological infections of different microbes. 4. Describe various methods used to isolate and identify different types of microbes, and how these methods are currently applied in clinical labs and new research. 5. Outline examples of how microbiology is used as a tool in our everyday lives and various industries, including food production and medicine. Prerequisites: BIOL 1010, BIOL 1200, or BIOL 1610. Corequisites: BIOL 2065. FA SP SU.

BIOL 2065. Principles of Microbiology Lab. 1 Hour.
Lab portion of BIOL 2060, stressing safety; sterile technique; methods of staining; preparing, culturing, and transferring microorganisms; and identification of an unknown. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. List individuals that have made important contributions to the understanding of microbiology. 2. Identify the structure and function of prokaryotic cells. 3. Summarize how prokaryotic cells survive and reproduce. 4. Outline information exchange within and between prokaryotic cells. 5. Summarize virus structure, genetics, reproduction, and diversity. Corequisites: BIOL 2060. FA, SP, SU.

BIOL 2070. Introduction to Machine Learning in Biology and Medicine. 3 Hours.
This course explores the transformative intersection of machine learning and biology. It will outline the fundamental principles of artificial intelligence and machine learning, emphasizing their applications in the biological sciences. Students will gain insight into the conceptual foundations of AI algorithms without delving deeply into mathematical intricacies. It will highlight the role of AI in advancing biological research, addressing the capabilities, limitations, and potential future developments in intelligent computing. Through a combination of lectures, live coding demonstrations, and hands-on exercises, students will develop a practical understanding of how AI technologies contribute to various facets of biology. **Course Learning Outcomes (CLOs)** At the successful conclusion of this course students will: 1. Describe concepts of machine learning and how they apply to biology and medical data. 2. Apply machine learning to biological problems. 3. Explore career opportunities within computation and machine learning fields. Prerequisites: BIOL 1610 and Math 1050 (Grade C- or higher) or appropriate placement score to enter Math 1060. FA.

BIOL 2300. Fundamentals of Bioinformatics. 2 Hours.
This course provides students with exposure to broad themes in bioinformatics. Specifically, it is focused on: the objectives of bioinformatics, the overarching techniques of bioinformatics, and bioinformatics-related career opportunities. No coding experience is required for this course. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Explain how bioinformatics is used in diverse research fields; 2. Describe bioinformatics-related career opportunities; 3. Evaluate the scientific literature in bioinformatics and applications in society. FA.

BIOL 2320. Human Anatomy. 3 Hours.
For students pursuing health science fields, including pre-allied health, pre-nursing, pre-physical therapy, pre-dental, pre-medical, and many others. Examines the structures of the human body, including muscles, nerves, blood supply, bones, lymph, internal organs, and reproductive anatomy. Includes lectures supplemented with laboratory examinations of cadavers and physical and virtual models. Successful completers will have advanced familiarity with the nomenclature and locations of structures in the human body. Successful completion of BIOL 1010, BIOL 1200, BIOL 1610, or equivalent recommended prior to enrolling. Inclusive Access Course Material fees may apply, see Fees tab under each course section for details. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Identify structures of the human body on cadavers and models. 2. Explain certain medically important concepts. 3. Apply knowledge of the body in future courses and/or occupations. 4. Identify structures of the human body in all regions, including muscles, with some origins and insertions, ligaments and tendons, bones with some anatomical landmarks, organ systems, circulatory routes, and certain neurological pathways of both the central and peripheral nervous system. Corequisite: BIOL 2325. FA, SP, SU.

BIOL 2325. Human Anatomy Lab. 2 Hours.
Lab portion of BIOL 2320. Includes cadaver study. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Identify structures of the human body. 2. Explain certain medically important concepts. 3. Apply knowledge of the body in future courses and/or occupations. 4. Identify structures of the human body in all regions, including muscles, with some origins and insertions, ligaments and tendons, bones with some anatomical landmarks, organ systems, circulatory routes, and certain neurological pathways of both the central and peripheral nervous system. Course fee required. Corequisites: BIOL 2320. FA, SP, SU.

BIOL 2400. Plant Kingdom (LS, ALPP). 3 Hours.
Fulfills General Education Life Sciences requirement. Surveys the Divisions traditionally studied by botanists, including structure, reproduction, systematic, and evolution of the major prokaryotic, fungal, algal, and plant groups. This course is designated as an Active Learning Professional Practice (ALPP) course. This course allows students to explore and apply content learned in the course in a professional experience away from the classroom. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Identify, diagram, and describe the major concepts that apply to the structure and function of prokaryotic and eukaryotic cells. 2. Identify, diagram, and describe the major concepts that apply to the structure and function of the tissues, tissue systems, and organs of plants. 3. Identify, diagram, and describe the reproductive processes of the prokaryotes, algae, fungi, and plants. 4. Evaluate and assess the geologic timeline as it relates to the prokaryotes, algae, fungi, and plants. 5. Demonstrate a knowledge of the common plant families that are found in the Mojave Desert, Great Basin, and Colorado Plateau region. Corequisite: BIOL 2405. FA.

BIOL 2405. Plant Kingdom Lab (LAB, ALPP). 1 Hour.
Lab portion of BIOL 2400. This course is designated as an Active Learning Professional Practice (ALPP) course. This course allows students to explore and apply content learned in the course in a professional experience away from the classroom. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Identify, diagram, and describe the major concepts that apply to the structure and function of prokaryotic and eukaryotic cells. 2. Identify, diagram, and describe the major concepts that apply to the structure and function of the tissues, tissue systems, and organs of plants. 3. Identify, diagram, and describe the reproductive processes of the prokaryotes, algae, fungi, and plants. 4. Evaluate and assess the geologic timeline as it relates to the prokaryotes, algae, fungi, and plants. 5. Demonstrate a knowledge of the common plant families that are found in the Mojave Desert, Great Basin, and Colorado Plateau region. Course fee required. Corequisite: BIOL 2400. FA.

BIOL 2420. Human Physiology. 3 Hours.
Required for students pursuing a Biology Secondary Education degree, as well as many pre-allied health, pre-nursing, pre-dental, pre-medical, and other pre-professional programs. Examines how the body's functions are carried out utilizing a systems approach, including blood chemistry, nerve impulse transmission, kidney function, muscle contraction, and heart function. Successful completers of this intensive course will have sufficient familiarity with the details of biological functions to enable them to understand disease processes, treatment procedures, research pursuits, and evolutionary consequences of various aspects of physiology. Successful completion of BIOL 1010, BIOL 1200, BIOL 1610, or equivalent recommended prior to enrolling. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Explain biological and medical vocabulary and the importance of its use in science. 2. Describe the overall processes of the major body systems: integument, skeletal, muscular, nervous, endocrine, cardiovascular, lymphatic, respiratory, digestive, reproductive and urinary. 3. Describe cell transport systems, communication, function and how the body systems interact to achieve homeostasis. 4. Apply knowledge gained in the course to clinical cases. Corequisites: BIOL 2425. FA, SP, SU.

BIOL 2425. Human Physiology Lab. 1 Hour.
Lab portion of BIOL 2420. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. At the successful conclusion of this course, students will be able to: 1. Describe the overall processes of the major body systems: integument, skeletal, muscular, nervous, endocrine, cardiovascular, lymphatic, respiratory, digestive, reproductive and urinary. 2. Explain the level of coordination between systems and factors which support homeostasis. 3. Recall biologic and medical vocabulary. 4. Apply the specific knowledge gained in the course to clinical cases. Course fee required. Corequisites: BIOL 2420. FA, SP, SU.

BIOL 2890R. Introductory Life Science Internship. 1-4 Hours.
For students who are granted and accept an internship with an approved employer, or a governmental, non-profit, or private agency, that provides an introductory learning experience in the field of biology. Students must be supervised by an agency representative and a faculty advisor. Variable credit: 1.0 - 8.0. Repeatable up to 8 credits subject to graduation and program restrictions. Offered based upon sufficient student need. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will: 1. Acquire work experience and an insight as to the type of career possible by observing a qualified provider. 2. Employ proficient writing skills by producing a summary paper at the conclusion of the internship. 3. Demonstrate collaborative team skills while participating in the internship experience. Prerequisite: Instructor permission. FA, SP, SU.

BIOL 2991R. Careers in Biology. 1 Hour.
Seminar course aimed to help students who have declared a Biology major prepare for future careers in their field. Seminar and workshop activities will include potential career paths with in the biological sciences and professional medicine, professional development and research experience opportunities, preparing cover letters and resumes/CVs, managing your online presence and how to apply for internships and jobs. Repeatable up to 2 credits subject to graduation and program restrictions. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Identify potential opportunities as a biology degree graduate. 2. Prepare and evaluate professional materials that will be needed to apply for summer and post-graduate internships, jobs and graduate programs. 3. Interact and collaborate with faculty, peer students, and guest speakers in a professional setting. 4. Develop professional skills for interviews and collaborative settings. Prerequisites: Declared major in Bioinformatics or Biology. SP.

BIOL 3000R. Advanced Utah Health Scholars Students. 1 Hour.
Helps prepare pre-medical, pre-dental, pre-pharmacy, pre-physician assistant, pre-optometry, pre-physical or occupational therapy, pre-veterinary, pre-nursing, pre-dental hygiene, pre-medical laboratory science, and other undergraduate health students for entry into professional schools. Includes opportunities to hear guest speakers, participate in health-related service learning projects, gain patient exposure and research opportunities, perform job shadowing and volunteer work, visit an international clinic Mexican and/or Navajo medical clinics, receive help with professional school applications, practice mock interviews, receive mentoring, one-on-one advisement/evaluation, and much more. Students must be willing to adhere to a student contract and participate in scheduled activities. Maximum 2 credits may be applied toward Bachelor of Science in Biology degree. Repeatable up to 7 credits subject to graduation and program restrictions. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Associate a civic educational component to their education; 2. Apply needed service, healthcare exposure and leadership in the community. 3. Connect service-based learning to academic studies for pre-health students. 3. Relate to speakers who will discuss a variety of career choices and current pertinent healthcare topics, trends, issues, etc. 4. Develop tools, knowledge, and opportunities to become competitive candidates for a variety of health care training programs. Course fee required. Prerequisite: HLOC 2000. FA, SP, SU.

BIOL 3010. Evolution. 3 Hours.
Required of all Biology majors. Focuses on evolution as a fundamental principle of Biology. Emphasizes evidence for evolution in nature; evolutionary change, including elementary population genetic analysis; evolution of major groups of life forms; natural selection and speciation and their importance in establishing the life forms on Earth. Inclusive Access Course Material (electronic book) fees may apply, see Fees tab under each course section for details. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Demonstrate a thorough understanding of the meaning of evolution, including evidence of evolution in nature. 2. Demonstrate detailed understanding of the mechanisms of evolutionary change, including elementary population genetic analysis. 3. Demonstrate a thorough understanding of the evolution of major groups of life forms. 4. Demonstrate detailed knowledge of natural selection and speciation, and their importance in establishing the life forms on our planet. Prerequisites: BIOL 1620 (Grade C or higher). FA, SP.

BIOL 3030. Principles of Genetics. 3 Hours.
Required for all Biology degrees and programs. Exploration of the nature of genetic systems from the molecular to organismal level. Detailed investigations into heredity, information flow, chromatin architecture, gene regulation, and epigenetics as well as examination of genetics from a developmental, evolutionary, and medical perspective. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Describe the basic principles of inheritance at the molecular, cellular, organismal, and population levels. 2. Explain the basic principle of how genetic material is arranged and transmitted. 3. Describe how changes in genetic material occur and their consequences. 4. Relate population genetics to evolution. 5. Articulate the importance of genetics to societal, medical, and personal issues. Prerequisite: BIOL 1610 (Grade C or higher). FA, SP.

BIOL 3040. General Ecology. 3 Hours.
Required of all Biology majors. Focuses on the nature and development of local, regional, and world communities and their relation to environmental factors controlling them. Covers organisms and their geographical distribution, inter-organismic interactions, speciation, and ecological methods of study in aquatic and terrestrial ecosystems. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Outline the four principle perspectives of biology including the dynamic interaction of living systems with each other and their environments. 2. Employ scientific methods to acquire, analyze and apply knowledge of biological phenomena. 3. Develop scientific literacy through extensive exposure to the primary research literature, expected to become adept at deriving information from the data presented in its various forms (e.g. graphs, charts, figures, etc.), and use appropriate scientific terminology (Reading Comprehension). 4. Produce well- written reports and/or research papers covering topics in biology which will be presented in the accepted formats of scientific research articles. (Written Communication) 5. Formulate scientific information covering specific topics in the biological sciences in a clear and logical format. Prerequisites: BIOL 1620 (Grade C or higher). FA, SP.

BIOL 3045. General Ecology Lab. 1 Hour.
Lab portion of BIOL 3040. Includes frequent field trips. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Explain the natural history of deserts. 2. Compare animal and plant adaptations to arid environments. 3. Collect biological field data using plant surveys and mark- recapture techniques. 4. Analyze and interpret biological field data. 5. Create and communicate the results of field work. Course fee required. Prerequisites: BIOL 1620 (Grade C or higher). Corequisites: BIOL 3040. FA, SP.

BIOL 3050. Head/Neck Anatomy/Oral Anatomy, Histology, Embryology. 4 Hours.
THIS COURSE IS CURRENTLY ON HIATUS AND IS NOT BEING TAUGHT - Covers the structure and anatomical systems of head and neck. Emphasizes bones, muscles, blood supply, glandular tissue, TMJ, nervous system, lymphatic's, fascia and spaces, dental infection, the eye, the ear, and local dental anesthesia that have dental significance. Comprehensive presentation of embryonic and general histological fetal and postnatal development of tissues and structures of the head and oral cavity, including tooth development. (EVEN years) Prerequisites: BIOL 2320 and BIOL 2325.

BIOL 3070. Applied Machine Learning in Biology and Medicine. 1 Hour.
Building upon the foundational knowledge from BIOL 2070, this course delves deeper into the practical applications of machine learning in biology. This course emphasizes the hands-on application of various AI and machine learning techniques, with a focus on advanced methodologies like deep learning. Students will explore real-world biological and medical challenges, applying sophisticated technologies to diverse datasets. Through a combination of intuitive teaching methods and practical exercises, students will gain proficiency in addressing complex biological problems using AI/ML. **COURSE LEARNING OUTCOMES (CLOs)** At the successful conclusion of this course students will: 1. Apply concepts of machine learning to biological and medical datasets. 2. Perform all steps associated with machine learning algorithm development. 3. Build upon previous courses to develop advanced skills in machine learning to be career ready. Prerequisites: BIOL 2070 (Grade C- or higher). SP.

BIOL 3100. Bioethics. 3 Hours.
Open to all students. An examination of the recent advancements in medicine and biological sciences in relation to basic ethical theories and traditional value systems, focusing on human reproduction, medical care, genetic engineering, humans as experimental subjects, environmental issues, and death and dying. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Describe and discuss various concepts and issues in contemporary bioethics. 2. Apply critical thinking skills in analyzing, evaluating, and making decisions regarding complex issues in bioethics. 3. Critique and debate various bioethical issues during class presentations/discussions. 4. Demonstrate tolerance of differing and multiple viewpoints on bioethical issues. Prerequisites: BIOL 3010 or BIOL 3030 or BIOL 3040 (Grade C or higher).

BIOL 3110. Scientific Writing. 3 Hours.
Augments research, writing, and communication skills of science majors. On successful completion, students will be able to effectively use scientific literature databases; find, read, understand, and critically assess primary scientific literature; write in a clear, concise, scientific style that will be required in upper-level science classes, including Senior Thesis, and in graduate study or future professions. In order to enter BIOL 3110 with the needed experience in scientific writing, students are required to have completed or be currently enrolled in a Biology course that requires an original, student-designed research project and paper (Examples: BIOL 3150, BIOL 4260, BIOL 4270, BIOL 4350, BIOL 4820, BIOL 4830, or BIOL 4910) or must obtain instructor permission before enrolling. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Effectively use scientific literature databases. 2. Find, read, understand, and critically assess primary scientific literature effectively and efficiently. 3. Write in a clear, concise, scientific context for all types of communication that you will be required to do in upper-level science classes (including senior thesis) and in your professional life (e.g., research reports for publication in primary literature and for corporate distribution). Prerequisites: ENGL 2010 and BIOL 3010 OR BIOL 3030 OR BIOL 3040 with a grade of C or better. SP.

BIOL 3120. Science Communication. 3 Hours.
THIS COURSE IS ON HIATUS. Introduction to creative science communication styles and techniques. Students will produce written, audio, and visual representations of scientific ideas for a general audience. Emphasizes fact checking, ethics in journalism, avoiding pseudoscience, and effective communication towards increasing public engagement with science. **COURSE LEARNING OUTCOMES (CLOs) ** At the successful conclusion of this course, students will be able to: 1. Describe effective science communication across multiple platforms. 2. Discriminate verifiable evidence-based information from pseudoscience. 3. Apply skills learned in class to produce written and recorded materials clearly explaining scientific phenomena. 4. Demonstrate an understanding of the value of communicating science to the public in an increasingly complex and technological world. Prerequisites: ENGL 2010 and BIOL 3010 or 3030 or 3040 (Grade C or higher).

BIOL 3140. Comparative Vertebrate Anatomy. 3 Hours.
Fulfills a program elective for all Biology majors. Covers the evolution of vertebrate design, surveying the tissue types that have changed to allow vertebrates to perform specific functions; emphasizing bones and muscles along with special tissues such as feathers, fur, and scales; and highlighting comparisons between groups of vertebrates to reveal different evolutionary pathways. Successful completers will clearly understand and be able to explain major evolutionary trends among vertebrates as well as specific instances where particular adaptations have allowed special functions to develop very efficiently like flying, digging, deep diving, and great running speed. Prerequisites: BIOL 3010. Corequisites: BIOL 3145. SP (odd).

BIOL 3145. Comparative Vertebrate Anatomy Lab. 1 Hour.
Lab portion of BIOL 3140. Requires dissection of representative vertebrates to learn the 3-dimensional anatomy, emphasizing similarities and differences among large vertebrates and identify major anatomical features. Corequisites: BIOL 3140. SP (odd).

BIOL 3150. Biostatistics and the Scientific Method. 3 Hours.
Required of students pursuing a Bachelor of Science in Biology. Includes experimental design, methods of data collection, statistical concepts, probability, testing of hypotheses, graphing techniques, estimation, discrete and continuous distributions, chi-square tests, linear regression and correlation, analysis of variance, and parametric and nonparametric tests. Successful completers will be able to identify and apply the proper statistical test(s) in the analysis of given data sets. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Demonstrate the ability to reason scientifically. 2. Apply the scientific methods in problem solving and evaluating hypotheses. 3. Describe data numerically and graphically. 4. Apply the rules of probability to given situations or events. 5. Perform a variety of parametric and nonparametric tests. Prerequisites: MATH 1050, BIOL 3010, and BIOL 3030 (All grade C or higher). FA, SP.

BIOL 3155. Scientific Method and Experimental Design. 1 Hour.
Lab designed to provide opportunities to learn and practice experimental design. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Demonstrate the ability to reason scientifically. 2. Apply the scientific method in problem-solving and evaluating hypotheses through experimental design. 3. Describe data numerically and graphically. 4. Apply appropriate statistical analysis to data sets. Course fee required. Prerequisites: BIOL 3010 and BIOL 3030 (Both grade C or higher) and BIOL 3150 (Can be concurrently enrolled or Grade C or higher). FA, SP.

BIOL 3200. Invertebrate Zoology. 3 Hours.
Fulfills a program elective for all Biology majors. General study of invertebrate animal phyla including sponges, cnidarians, flatworms, roundworms, rotifers, mollusks, annelids, arthropods, echinoderms, and others, emphasizing characteristics, variations in body plans, life cycles, adaptations, and evolutionary relationships among major groups of animals. Successful completers will identify major invertebrate animal phyla and discuss evolutionary trends pertaining to them. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Describe the basic ground plan of the major higher invertebrate taxa. 2. Discuss unique features of the major higher invertebrate taxa including phylogeny, classification, anatomy, development, physiology, behavior, ecology, natural history, and biomechanics. 3. Identify major invertebrate animal phyla and discuss the diversity and evolutionary trends pertaining to them. Prerequisites: BIOL 3010 and BIOL 3030 (Grade C or higher). FA (odd).

BIOL 3205. Invertebrate Zoology Lab. 1 Hour.
Lab portion of BIOL 3200, provides hands-on opportunities to dissect and study representatives of the various invertebrate animal phyla, including field trips. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Apply and use proper microscope and dissection techniques when manipulating and dissecting small invertebrate organisms. 2. Identify, draw/sketch, and describe anatomical structures of the invertebrate organisms dissected or observed in the lab. 3. Examine and compare anatomical structures among related invertebrate organisms observed in the laboratory. Course fee required. Prerequisites: BIOL 3010 and BIOL 3030 (Grade C or higher). Corequisite: BIOL 3200.

BIOL 3230R. Cadaver Practicum. 2 Hours.
For students who desire more experience in human dissection. Students will be instructed in the maintenance, dissection, and demonstration of the human cadaver. Requires six hours of dissection per week. Limited enrollment course. Repeatable up to 8 credits subject to graduation restrictions. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Prepare a prosected cadaver for use in lower division courses. 2. Apply appropriate prosection techniques. 3. Identify structures of the human body in all regions, including muscles, with origins and insertions, ligaments and tendons, bones with some anatomical landmarks, organ systems, circulatory routes, and certain neurological pathways of both the central and peripheral nervous system. Course fee required. Prerequisites: BIOL 2320; AND BIOL 2325; AND Instructor permission. FA, SP.

BIOL 3250. Cancer Biology. 3 Hours.
For Biology majors, and other interested students. Examines "Cancer," a catch-all term for hundreds of diseases that share the common feature of cells that forgo the normal regulatory systems of control and proliferate within the body. Focuses on general principles of molecular nature and cell behavior common in the disease state. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Compare the molecular, cellular, and environmental mechanisms that lead to the development of cancer. 2. Explain the steps leading to cancer metastasis. 3. Contrast the treatment of cancer and the different cellular pathways targeted by treatment methods. 4. Evaluate information regarding the development and treatment of cancer and present your findings to a general audience. Prerequisites: BIOL 3030 (Grade C or higher). FA.

BIOL 3300. Introduction to Bioinformatics. 3 Hours.
This course is intended to be a basic introduction to Bioinformatics. At the core the main goal is for the students to understand what Bioinformaticians do and the types of jobs available. The class further allows the student to learn and gain experience in processing next generation sequencing data (NGS) and gives them an introduction to tools used by Bioinformaticians. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Contrast job and career opportunities available to Bioinformaticians; 2. Demonstrate proficiency in basic unix commands to process data; 3. Utilize NCBI blast and databases; 4. Perform pairwise alignments and homology; 5. Contrast different types of NGS data; 6. Perform basic QC on FASTQ files; 7. Summarize genome assembly and genome mapping; 8. Describe variant calling and outline the VCF format. Prerequisite: CS 1400 and IT 1100 (IT 1100 can be taken concurrently). SP.

BIOL 3360. Developmental Biology. 3 Hours.
Fulfills a program elective for students pursuing a Bachelor of Science in Biology degree. Covers major development patterns of animal embryos, stressing recent advances in the roles played by organizational genes and interactions among chemical gradients that cause tissue differentiation, and emphasizing constraints posed by developmental necessities on evolutionary change. Successful completers will be able to describe the evolution of different body plans, with similarities and differences among major animal taxa, and the crucial importance of early stages of development in the proper functioning of mature organisms. Recommended prerequisite course, BIOL 3550. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Describe the mechanisms of development at the molecular and cellular level. 2. Describe the major processes involved in the formation of organisms. 3. Successfully communicate scientific information as it pertains to developmental biology. 4. Critically evaluate and discuss scientific material. Prerequisites: BIOL 3010 and BIOL 3030 (Grade C or higher). SU.

BIOL 3420. Advanced Human Physiology. 3 Hours.
Advanced detail-oriented course that examines how mechanistically the body functions. It begins with cell transport, communication and how the body achieves homeostasis and commences with body systems and how they function. Successful completers of this intensive course will have a sufficient familiarity with the details of biologic functions to enable them to understand disease processes, treatment procedures, and research pursuits of various aspects of physiology. ** COURSE LEARNING OUTCOMES (CLOs). At the successful conclusion of this course, students will be able to: 1. Demonstrate the proper vocabulary and use of the terminology used in physiology. 2. Describe cell transport systems, communication, function and how the body systems interact to achieve homeostasis. 3. Summarize in detail the overall processes of major body systems: nervous, special senses, endocrine, musculoskeletal, cardiovascular, blood, immune, respiratory, urinary, digestive, and reproductive. 4. Apply and integrate knowledge gained in the course to biomedical and clinical cases. Prerequisites: BIOL 1620 (Grade C or higher). SP.

BIOL 3450. General Microbiology. 3 Hours.
Can be used to fulfill a core requirement for Biology majors. Emphasizes relationships between microbes and their ecosystems, and biotechnological applications including food production, spoilage and preservation, fermentation technology, agriculture, waste disposal, water lecture/discussion. Successful completion of the course gives students an understanding of the importance of microbes to biological communities. Inclusive Access Course Material (electronic book) fees may apply, see Fees tab under each course section for details. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Learn about the people who have made important contributions to the understanding of microbiology. 2. Learn the structure and function of prokaryotic cells. 3. Learn how prokaryotic cells survive and reproduce. 4. Learn about information exchange within and between prokaryotic cells. 5. Learn about virus structure, genetics, reproduction, and diversity. Prerequisites: BIOL 3030 and CHEM 1220 (Grade C or higher). Corequisite: BIOL 3455. SP.

BIOL 3455. General Microbiology Lab. 1 Hour.
Lab portion of BIOL 3450; provides basic and applied methodologies, including isolation of commercially useful strains and production and purification of industrial products. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Describe the structural and metabolic characteristics of various microbes, and apply basic techniques for culturing different microbes in the laboratory. 2. Demonstrate proper safety procedures used for culturing and transferring microorganisms in a microbiology laboratory. 3. Develop skills for proper microscope technique (including oil immersion and calibration) using Bright field microscopes. 4. Develop skills using fundamental staining techniques such as: simple stain, gram stain, and endospore stain. 5. Demonstrate the ability to identify unknown bacterial through microscopic and biochemical analysis and present your findings in written and oral form. Course fee required. Corequisite: BIOL 3450. SP.

BIOL 3460. Biology of Infectious Disease. 3 Hours.
For Biology majors. Provides a modern view of bacterial and viral diseases in order to build a foundation for more advanced studies in microbiology, microbial pathogenesis, and immunology. The agents of infectious diseases demonstrate excellent examples of natural selection. The various adaptations of the pathogen and defenses of the host illustrate some of the most amazing mechanisms in biology. Covers characteristics of microbes, corresponding defense mechanisms evolved by hosts of these microbes, and mechanisms of pathogenesis during infection. Molecular, cellular, and physiological concepts will be developed through use of both clinical and epidemiological pictures of selected diseases. Successful completers will have an understanding of the importance of microbes to biological communities and how evolution has impacted and continues to influence aspects of disease transmission and control. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Describe the various stages of the host-agent relationship and their importance in transmission dynamics. 2. Describe the epidemiology of several infectious diseases of contemporary importance. 3. Explain the important properties of infectious agents and the host defenses used against them. 4. Outline the categories and characteristics of infectious agents and transmission. 5. Summarize the main features of the current global burden of infectious disease and the public health movement that has evolved to reduce its impact. Prerequisites: BIOL 3010 and BIOL 3030 (Grade C or higher).

BIOL 3470. Introduction to Immunology. 3 Hours.
For Biology majors who desire more coverage of the immune system and its response to microbes and viruses. General properties of immune responses, cells and tissues of the immune system, antibody-mediated and cell-mediated mechanisms of immunity, immunity to microbes, immunodeficiency and AIDS, autoimmune diseases, and transplantation will be discussed. Uses a variety of teaching methods including lecture/discussion, review of scientific journal articles, writing assignments, videos, quizzes, and exams. Successful completion of the course gives students a better understanding of the importance of the immune system to overall health and wellness of humans and other mammalian systems. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Expand knowledge of the cells and tissues of the immune system, and the chemical interactions among them. 2. Understand the differences and complimentary roles of the innate and acquired immune systems. 3. Evaluate historical advances and current problems in the field of immunology. 4. Apply knowledge gained in scientific communication. Prerequisites: BIOL 3010 and CHEM 3510 (all Grade C or higher).

BIOL 3550. Eukaryotic Cell Biology. 3 Hours.
Can be used to fulfill a core requirement for Biology majors. Incorporating biochemistry and molecular biology, provides a solid background in cell biology, a dynamic area of study in Biology that merges studies of cell structure and cell function. Includes the basics of cell structure, function, metabolism, signaling, and communication, using textbook material and primary literature sources. Successful completers will be prepared for further study in histology, pathophysiology, and developmental biology. Inclusive Access Course Material (electronic book) fees may apply, see Fees tab under each course section for details. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Remember the internal organization of the structure of the cell, the cell cycle, the role of stem cells engineering, the techniques for visualizing cells. 2. Understand the relationship between internal elements of the cell in relation to the outside environment, the cell transformation process that leads to manifestation of cancer. 3. Identify the nature of cellular dysfunction(s) in a given case scenario including causes of diseases. 4. Formulating hypotheses based on the function of proteins, enzymes, messengers. 5. Assessing and concluding best techniques to study cellular conditions, alterations of cellular mechanisms, impact of cellular behaviors and diseases. Prerequisites: BIOL 3030 and CHEM 2310 (Grade C- or higher). Corequisites: BIOL 3555. FA.

BIOL 3555. Eukaryotic Cell Biology Lab. 1 Hour.
Lab portion of BIOL 3550, introducing modern cell biology techniques. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Outline the internal organization of the structure of the cell, the cell cycle, the role of stem cells engineering, the techniques for visualizing cells. 2. Explain the relationship between internal elements of the cell in relation to the outside environment, the cell transformation process that leads to manifestation of cancer. 3. Identify the nature of cellular dysfunction(s) in a given case scenario including causes of diseases. 4. Formulate hypotheses based on the function of proteins, enzymes, messengers. 5. Assess and conclude best techniques to study cellular conditions, alterations of cellular mechanisms, impact of cellular behaviors and diseases. Course fee required. Prerequisites: CHEM 2315 (Grade C- or higher). Corequisites: BIOL 3550. FA.

BIOL 3700. Advanced Medical Terminology. 2 Hours.
Strongly recommended for students entering pre-professional programs including pre-medicine, pre-dental, pre-veterinary, pre-chiropractic, pre-physician assistant; very useful for biology majors; open to all students. Emphasizes word roots, suffixes, and prefixes of both Greek and Latin origin, medical abbreviations, as well as proper pronunciation and spelling of medical terms. Medical case studies and narratives will be analyzed. Material is organized according to body systems, some basic anatomy and physiology is included along with pathologic terminology, laboratory tests, and clinical procedures. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Analyze and understand simple to advanced medical terms, alone and in the context of applying them to medical case studies, reports, and medical narratives. 2. Develop facility in the correct spelling and pronunciation of medical terms. 3. Learn and understand commonly used medical abbreviations. 4. Associate medical terms with the proper body systems, laboratory tests, and clinical procedures. 5. Describe symptoms and manifestations of some medical conditions. FA.

BIOL 3750. Microbial Ecology. 3 Hours.
In this course, students will develop an understanding of microbial diversity and how various microbes interact with their environment and other organisms. This course pays particular emphasis on the vital foundational role played by microorganisms in all ecosystems. Discussions will focus on microbial interactions with other microbes, complex organisms, and the environment, and how these interactions have shaped the biome over evolutionary time. Attention will also be paid to the tools used to evaluate microbial diversity and function, and applications of microbial ecology. The material of this course is presented in an advanced manner. Relevant background of basic biology is assumed. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Develop a knowledge base of tools to read and comprehend primary literature in microbial ecology. 2. Distinguish the structure and function of various microbes, how prokaryotic cells survive, communicate, and reproduce. 3. Explain various roles played by bacteria, archaea, and microbial eukaryotes in different ecosystems including the human microbiome, aquatic, and terrestrial ecosystems. 4. Explain the ways microorganisms interact with abiotic environments. 5. Describe the methods used to evaluate and model microbial diversity and function. Prerequisites: BIOL 1610/1615 (Grade C- or higher); AND either CHEM 1110/1115 OR CHEM 1210/1215 (Grade C- or higher). Corequisite: BIOL 3755. SP (odd).

BIOL 3755. Microbial Ecology Laboratory. 1 Hour.
The Principles of Microbiology Laboratory accompanies the BIOL 3750 lecture section. You must be registered for both lecture and lab. Laboratory exercises will focus on microbial interactions within ecosystems, how microbial communities influence biotic and abiotic factors in the environment, and how these relationships impact global element cycles. A variety of techniques will be used to explore these processes, including culture methods, bioinformatics, molecular biology, and phylogenetic analysis. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Apply proper safety procedures used for culturing and transferring microorganisms in a microbiology laboratory. 2. Utilize different staining techniques such as: simple stain, gram stain, and endospore stain. 3. Prepare cultures of aerobic and anaerobic bacteria, slime molds, and fungi. 4. Assess the metabolic capabilities of microbial communities. 5. Demonstrate skills to investigate microbial interactions using culture-dependent and culture-independent methods. Corequisite: BIOL 3750. SP (odd).

BIOL 3800. Biology of Sex. 3 Hours.
Introduction to reproductive modes across a broad range of organisms, emphasizing evolutionary theory, genetics, physiology, ecology, and medicine for biology majors and non-majors. Emphasizes the scientific method and combines basic theory with case studies and problem solving to address reproductive questions. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Describe asexual and sexual reproduction across multiple taxa. 2. Describe reasons sexual reproduction evolved. 3. Explain the role of reproduction in the natural world and how they affect the ecology of the planet. 4. Apply the specific factual knowledge gained in the course to clinical cases. FA (odd).

BIOL 4010. Molecular Evolution. 3 Hours.
Introduction to computational techniques used for studying evolution using genetic sequence data. This course will teach both (A) principles of molecular evolution and (B) computational techniques for examining molecular evolution through population genetics (e.g., Hardy-Weinberg Equilibrium, Fst, Dxy, Tajimas D, dN/dS, and coalescence) and phylogenetics (distanced-based approaches, parsimony, maximum-likelihood, Bayesian, and comparative methods). Students examine molecular evolution in the context of (1) pathogen evolution, (2) genetic disease evolution, and (3) evolutionary ecology. No coding experience is required prior to this course; students will learn coding techniques while taking the course. **COURSE LEARNING OUTCOMES (CLOs) ** At the successful conclusion of this course, students will (1) perform statistical analyses of genetic data in the context of evolution, (2) search, read, and interpret primary literature in molecular evolution, (3) explain the utility (and necessity) of evolutionary genetics in diverse fields of science and medicine. Prerequisites: Principles of Genetics (BIOL 3030) grade C- or higher. FA (odd).

BIOL 4040. Medical Ecology. 1 Hour.
Medical Ecology includes those aspects of the environment that have a direct bearing on human health. The environments and habits of people affect their risk of disease and well-being. The concept of ecosystem functions and services helps to describe global processes that contribute to our health, helping to cleanse the air we breathe, the water we drink, and the food we eat. Environmental degradation often leads to alterations in these aspects, leading to various states of ill health. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Understand basic epidemiological concepts. 2. Demonstrate a familiarity with a variety of infectious diseases. 3. Understand the relationship between urbanization and emerging infectious disease. 4. Understand the role of vaccines and immunization in community health. 5. Be able to explain the relationship between climate change and infectious diseases 6. Understand basic atmospheric science and the effect of the atmosphere on health. 7. Be able to explain basic hydrology and the effect of water quality on health. 8. Be able to explain the impact of farming on the local environment and food safety. Prerequisite: BIOL 1620 (Grade C or higher).

BIOL 4200. Plant Taxonomy (ALPP). 2 Hours.
Fulfills a program elective for Biology majors who desire experience in plant systematics. Focuses on the collecting of plants and systems of classification. Successful completers will identify plants in the field using diagnostic techniques including the use of dichotomous keys. This course is designated as an Active Learning Professional Practice (ALPP) course. This course allows students to explore and apply content learned in the course in a professional experience away from the classroom. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Demonstrate a knowledge of, and use the terminology and nomenclature necessary for, the identification of vascular plants. 2. Identify, diagram, and describe the organs and reproductive structures of vascular plants. 3. Evaluate, identify, and classify vascular plants based on physical characteristics. 4. Use dichotomous keys and other literature in the identification of vascular plants, in the lab, and in the field. 5. Demonstrate a knowledge of the common plant families that are found in the Mojave Desert, Great Basin, and Colorado Plateau region. Prerequisites: BIOL 1620 (Grade C or Higher). Corequisites: BIOL 4205. SP.

BIOL 4205. Plant Taxonomy Lab (ALPP). 2 Hours.
Lab portion of BIOL 4200 designed so students gain hands on experience collecting and classifying plants through field trips, plant dissection, study of herbarium samples, microscopy, and the use of dichotomous keys. Field trips and plant collection required. This course is designated as an Active Learning Professional Practice (ALPP) course. This course allows students to explore and apply content learned in the course in a professional experience away from the classroom. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Demonstrate a knowledge of, and use the terminology and nomenclature necessary for, the identification of vascular plants. 2. Identify, diagram, and describe the organs and reproductive structures of vascular plants. 3. Evaluate, identify, and classify vascular plants based on physical characteristics. 4. Use dichotomous keys and other literature in the identification of vascular plants, in the lab, and in the field. 5. Demonstrate a knowledge of the common plant families that are found in the Mojave Desert, Great Basin, and Colorado Plateau region. Corequisites: BIOL 4200. SP.

BIOL 4260. Herpetology. 2 Hours.
Fulfills a program elective for Biology majors. Covers the biology of amphibians and reptiles including evolutionary history, functional morphology, physiological ecology, biogeography, reproductive, and population ecology. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Discuss the biology of amphibians and reptiles. 2. Synthesize and present scientific information orally. 3. Appraise and critique scientific literature. 4. Evaluate scientific information in writing. 5. Evaluate sources of scientific information. Prerequisite: BIOL 3040 and BIOL 3045 (Grade C or higher). Corequisite: BIOL 4265. FA (odd).

BIOL 4265. Herpetology Lab. 1 Hour.
Lab portion of BIOL 4260, covering systematics, natural history, and collecting/sampling techniques. Field trips required. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Use unique characteristics to classify common species of amphibians and reptiles in southern Utah after brief examination. 2. Demonstrate proper and safe handling of non- venomous species of frogs, salamanders, lizards, snakes, and turtles. 3. Describe the adaptations of amphibians and reptiles and explain how these relate to their life histories and ecology. 4. Explain the importance of amphibians and reptiles through the roles they play in natural ecosystems. Course fee required. Prerequisites: BIOL 3040 and BIOL 3045 (Grade C or higher). Corequisite: BIOL 4260. FA (odd).

BIOL 4270. Ichthyology. 2 Hours.
Fulfills a program elective for Biology majors. Covers the biology of fishes, including evolutionary history, functional morphology, physiological ecology, and biogeography, with an emphasis on Utah species. Successful completers will be able to identify various fishes, especially those found locally. Offered upon sufficient student need. **COURSE LEARNING OUTCOMES (CLOs) After successfully completing this course, students will be able to: 1. Identify and classify the major classes and orders of fish, especially those found locally. 2, Label and identify external and internal morphology. 3. Describe basic fish physiology, behavior and ecology. 4. Describe methods of fish conservation. 5. Critically read and evaluate primary literature on ichthyological topics. 6. Write an effective review paper. 7. Design and implement scientifically sound experiments. 8. Analyze and interpret data and draw logical conclusions from that data. 9. Disseminate data and conclusions in scientifically appropriate manners. Prerequisite: BIOL 3040 and BIOL 3045 (Grade C or higher). Corequisite: BIOL 4275. FA (even).

BIOL 4275. Ichthyology Lab. 1 Hour.
Lab portion of BIOL 4270, covering identification, systematic and natural history. Field trips required. Lab fee required. Offered upon sufficient student need. **COURSE LEARNING OUTCOMES (CLOs) After successfully completing this course, students will be able to: 1. Identify and classify the major classes and orders of fish, especially those found locally. 2, Label and identify external and internal morphology. 3. Describe basic fish physiology, behavior and ecology. 4. Describe methods of fish conservation. 5. Critically read and evaluate primary literature on ichthyological topics. 6. Write an effective review paper. 7. Design and implement scientifically sound experiments. 8. Analyze and interpret data and draw logical conclusions from that data. 9. Disseminate data and conclusions in scientifically appropriate manners. Prerequisite: BIOL 3040 and BIOL 3045 (Grade C or higher). Corequisite: BIOL 4270. FA (even).

BIOL 4280. Marine Biology. 3 Hours.
For students in the physical and biological sciences, covers global oceans with an introduction to oceanography and ocean processes; major marine ecosystems, with an emphasis on the Pacific Coast of California; marine ecology, emphasizing energy flow, populations and community structure and formation; and human impacts on the seas by considering positive and negative human activities that alter or enhance marine resources and environments. Field trip required. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Understand the biology of marine organisms. 2. Synthesize scientific information on marine organisms and present it orally. 3. Appraise and critique scientific literature on marine organisms. 4. Evaluate and synthesize scientific information on marine organisms in writing. 5. Evaluate sources of scientific information. Course fee required. Prerequisite: BIOL 3040 (All grade C or higher). SP.

BIOL 4300. Molecular Biology. 3 Hours.
The objective of this course is to help students develop a thorough understanding of the fundamentals of modern molecular biology from the standpoint of recognized molecular mechanisms for controlling basic processes in a cell, and also from an applied standpoint for using molecular biology as a tool in the laboratory. The course will take an in-depth look at traditional subjects, like manipulation of nucleic acids, the polymerase chain reaction, recombinant vectors, DNA replication, mutation and repair. It will also address some rapidly evolving fields including next-generation sequencing, microarrays, processing of RNA, microRNA and proteomics. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Understand the evolution of the science of Molecular Biology from 1953 to present. 2. Understand the technical terminology associated to Molecular Biology. 3. Apply, analyze, and evaluate Molecular Biology techniques and the corresponding outcomes. Prerequisites: BIOL 3030 and CHEM 1220. Corequisites: BIOL 4305. SP.

BIOL 4305. Molecular Biology Laboratory. 1 Hour.
The laboratory component of BIOL 4300. It reinforces basic laboratory skills and techniques in molecular biology and introduces students to advanced techniques. Students will learn principles and practice of nucleic acid purification (plasmid and genomic DNA, RNA), DNA restriction digestion and analysis, polymerase chain reaction (PCR), and more. Students will also learn the technical applications of polymerases, modifying enzymes, restriction enzymes and the different DNA cloning vectors. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Understand the evolution of the science of Molecular Biology from 1953 to present. 2. Understand the technical terminology associated to Molecular Biology. 3. Apply, analyze, and evaluate Molecular Biology techniques and the corresponding outcomes. Corequisites: BIOL 4300. SP.

BIOL 4310. Advanced Bioinformatics. 3 Hours.
Builds on topics covered in BIOL 3300. Analyze and interpret large biological data sets. Genome- and transcriptome-based quantitative methods. Data management techniques. Exercises in evaluating research studies and in developing computational methods for research. Semester project. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Describe a data analysis process. 2. Create computer programs that facilitate biological data analysis. 3. Interpret the analysis results biologically and explain the implications of them. Prerequisite: BIOL 3300 (Grade C or higher). FA.

BIOL 4320. Scripting for Biologists. 3 Hours.
In this course, students learn techniques in computational biology to apply their computer science skillset to biological data. Specifically, it is focused on learning best-practices to design scripts for computational biology through hands-on coding exercises. These exercises will allow students to refine their ability to analyze data using essential concepts in computer science such as conditionals, loops, functions, classes, regular expressions, and recursion. Topics of version control, code readability, and documentation design are used to highlight the importance of reproducibility in science. While the course is taught using Python, students are allowed to explore and use other scripting languages. *** COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will (1) implement best practices in script development for computational biology, (2) design computer programs to analyze their own (and other) biological data, (3) critically review coding scripts used in the primary literature, (4) create reader-friendly documentation to help others implement their code for similar datasets (or to simply reproduce their results). Prerequisites: BIOL 3300 (Introduction to Bioinformatics). FA.

BIOL 4350. Animal Behavior. 3 Hours.
Fulfills a program elective for all Biology majors. Covers the definition of behavior and how it is measured, the evolution and genetics of behaviors, and the wide spectrum of behaviors demonstrated by animals that help them survive and reproduce. Successful completers will be able to explain the many aspects of animal behavior, why those behaviors exist, and some specific examples of current research in each area of behavior. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Design and carry out experiments using unbiased behavioral data collection. 2. Apply evolutionary reasoning to create testable hypotheses in answering questions about animal behavior. 3. Explain Tinbergen's four types of questions regarding animal behavior. 4. Critique important published research in the field of ethology. Prerequisites: BIOL 3010 and BIOL 3030 (Grade C or higher). Corequisite: BIOL 4355. SP (odd).

BIOL 4355. Animal Behavior Lab. 1 Hour.
Lab portion of BIOL 4350. Students will learn how behavior can be measured based on a clear definition of what behavior involves and will be shown the various techniques used by researchers to study behavior, in both field and laboratory settings, and the proper design of such studies. Students will design and carry out their own research projects on a particular behavior and write up the results of their study in journal article format. Successful completion will help students to create a simple research study of animal behavior in the field or in a laboratory setting, and can explain strengths and weaknesses of each. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Design and carry out experiments using unbiased behavioral data collection. 2. Apply different methods of unbiased behavioral data collection, and explain the limitations of each. 3. Explain optics used in behavioral data collections and demonstrate correct use of binoculars and spotting scopes. 4. Evaluate various behavioral data collection devices, and list the pros and cons of recording behavioral data for later use. Course fee required. Prerequisites: BIOL 3010 and BIOL 3030 (Grade C or higher). Corequisite: BIOL 4350. SP (odd).

BIOL 4380. Ornithology. 2 Hours.
Fulfills a program elective for all Biology majors, covers the biology of birds including their origin, evolution, structure, habits, adaptations, distribution, and classification. Successful completers will identify various birds, especially those found locally, and to discuss evolutionary and ecological relationships among them. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Describe evolutionary adaptations of the class Aves. 2. Explain the basic classification and phylogeny of birds and explain bird evolution. 3. Describe the basic life processes, characteristics and behaviors unique to birds. 4. Identify common species found within the Intermountain West. Prerequisite: BIOL 3040, BIOL 3010. Corequisite: BIOL 4385. SP.

BIOL 4385. Ornithology Lab. 1 Hour.
Lab portion of BIOL 4380. Occurs during the second block of the semester. Field trips required. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Identify common species found within the Intermountain West using field and taxonomic guides. 2. Conduct visual and auditory field identifications. 3. Describe the interrelationships between birds and their environment. Course fee required. Corequisite: BIOL 4380. SP.

BIOL 4400. Pathophysiology. 3 Hours.
Review of homeostasis pathways that maintain normal physiology of organ systems, with an emphasis on the disruption of these homeostatic pathways that result in disease. Pathophysiology fulfills a program elective for students pursuing a Bachelor of Science in Biology degree. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Explain in detail the physiological systems associated with defense and healing. 2. Describe the processes and effects of disrupted physiology. 3. Demonstrate a thorough understanding of the functioning of major body processes. 4. Demonstrate a basic understanding of how different vertebrate taxa accomplish the functions of organ systems in different ways and in different environments. Prerequisites: BIOL 2320/2325 and BIOL 2420/2425. FA, SP.

BIOL 4411. Mammalogy. 3 Hours.
Fulfills a program elective for all Biology majors. Covers the unique adaptations and life histories of mammals, and surveys each order of mammal, describing evolution (where known), natural histories, and geographical ranges of representatives of that order. Successful completers will be able to describe what makes a mammal, its evolution, the adaptations that enabled mammals to dominate the earth for the last 65 million years, and current problems facing many mammals as well as possible solutions to those problems. Completion of BIOL 3140/3145 Comparative Vertebrate Anatomy/Lab is recommended before enrolling in this course. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Show proficiency in five principle perspectives of biology including the coordinated regulation of integrated cellular systems and their effect on the physiological functioning of organisms; the dynamic interaction of living systems with each other and their environments; and the transforming role of evolution in changing life forms and how evolution explains both the unity and diversity of life. 2. Develop a critical skepticism of ideas and information while maintaining receptivity to potential alternative predications. 3. Produce well-written reports and/or research papers covering topics in biology which will be presented in the accepted formats of scientific research articles. Corequisite: BIOL 4415. FA.

BIOL 4415. Mammalogy Lab. 1 Hour.
Lab portion of BIOL 4411, includes training to skin and stuff representative mammals collected by instructors, review of skins and skeletons for identification, and in articulation of mammalian skeletons for display, as well as observation of mammals and their signs in the wild. Successful completers will obtain a strong background of general knowledge about mammals, and specific knowledge of representatives of each taxon, especially local species and those of economic importance. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Explain the evolution, diversity, and classification of mammals. 2. Describe and apply the basic methodology of Mammalian Systematics and cladistics. 3. Produce, analyze, interpret and report on mammalian base-line field data. Course fee required. Prerequisite: BIOL 3045 (Grade C or higher). Corequisite: BIOL 4411. FA (even).

BIOL 4440. General Entomology. 3 Hours.
Fulfills a program elective for all Biology majors. Includes study of the structure, development, classification, and life histories of insects, as well as ecological, economic, and management considerations. Successful completers will be able to identify common insects and discuss the economic and ecological impacts of insects. Offered upon sufficient student need. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. List the important classes and orders of arthropods. 2. Differentiate an insect from other life forms. 3. Classify insects and explain the importance of taxonomy to other disciplines. 4 Describe basic insect morphological characteristics and physiology. 5. Explain the value and importance of insects and describe the ecological roles insects have in different ecosystems. Prerequisites: BIOL 1620. SP (odd).

BIOL 4445. General Entomology Lab. 1 Hour.
HIATUS - This course is not currently being taught - Lab portion of BIOL 4440. Offered upon sufficient student need. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Collect insects for study using a range of aquatic, aerial and terrestrial field collecting techniques. 2. Identify all orders and common families of insects. 3. Create a photographic collection of local insects. Course fee required.

BIOL 4500. Comparative Vertebrate Physiology. 3 Hours.
Fulfills a physiology elective for students pursuing a Bachelor of Science in Biology degree. Covers physiological adaptations of vertebrates, including general functions of each organ system and enlightening examples of specific adaptations in those systems in certain taxa. Successful completers will demonstrate a thorough, broad understanding of how vertebrate organisms accomplish the necessary tasks of regulating the internal environment in a variety of ways. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Explain the normal functions of the major body systems of vertebrates. 2. Describe common disorders of vertebrate systems, and the biochemistry underlying these disorders. 3. Explain the fundamental importance of heat, water availability, and body size in the evolution of vertebrates. 4. Apply knowledge gained in the course to human physiology where appropriate. Prerequisites: BIOL 3010, BIOL 3030 and CHEM 1220 (Grade C or higher). Corequisite: BIOL 4505. FA.

BIOL 4505. Comparative Vertebrate Physiology Lab. 1 Hour.
Lab portion of BIOL 4500. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Design and conduct original laboratory experiments measuring physiological data to evaluate relevant hypotheses. 2. Explain the advantages and limitations of various methods used by vertebrate physiologists. 3. Design and present original, hypothesis-driven research in a university setting. Course fee required. Prerequisite: CHEM 1225 (Grade C or higher). Corequisite: BIOL 4500. FA.

BIOL 4520. Psychobiology. 3 Hours.
Psychobiology is a senior-level course with a laboratory component. Nerve cell conduction, neurotransmission, and neuroanatomy are investigated in the context of human cognition and behavior through lecture, discussion, neural simulation, and lab dissection. A research-based approach is used throughout the course, and students complete research projects in lab using neural simulation software. Ethical issues in brain research are integrated into discussions when relevant. Dual listed with PSY 4520. Students may only take one course for credit. Co-requisite: PSY 4525 or BIOL 4525. Prerequisites: PSY 3710 OR BIOL 2420 (either Grade C or higher); AND PSY 3000 OR BIOL 3150 (either Grade C or higher); AND Psychology major, Biology major, or Integrated Studies major with Psychology or Biology emphasis. SP (Even.

BIOL 4525. Psychobiology Lab. 1 Hour.
Lab portion of PSY 4520 / BIOL 4520. Dual listed with PSY 4525. Students may only take one course for credit. Course fee required. Prerequisites: PSY 3710 OR BIOL 2420 (either Grade C or higher); AND PSY 3000 OR BIOL 3150 (either Grade C or higher); AND Psychology major, Biology major, or Integrated Studies major with Psychology or Biology emphasis. Corequisites: PSY 4520 or BIOL 4520. SP (even).

BIOL 4600. Plant Physiology. 3 Hours.
Fulfills a physiology elective for students pursuing a Bachelor of Science in Biology degree who desire more coverage of botany topics. Emphasizes physical and chemical basis of plant life relative to absorption, transpiration, manufacture of foods, growth, and reproduction. Successful completers will have an understanding of the interaction between the structure and function of plants. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Describe and apply the fundamental concepts of plant physiology. 2. Describe the physiological mechanisms of plant growth, function, and development. 3. Explain how plants respond to their environment and apply the information to scientific and agricultural scenarios. Prerequisites: BIOL 3010, BIOL 3030; and CHEM 1220 (Grade C or higher). Corequisite: BIOL 4605. SP.

BIOL 4605. Plant Physiology Lab. 1 Hour.
Lab portion of BIOL 4600, providing hands-on activities involving observation and measurement of various plant functions and requiring students to collect and summarize data in reports. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Apply and experiment with the fundamental concepts of plant physiology. 2. Describe the physiological mechanisms of plant growth, function, and development. 3. Compare how different plants respond to their environment and apply the information to scientific and agricultural scenarios. Course fee required. Prerequisite:CHEM 1225 (Grade C or higher). Corequisite: BIOL 4600. SP.

BIOL 4810R. Independent Research. 1-6 Hours.
Individual areas of study will be assigned to students based on preparation and interest. Students will be expected to write a paper (using supporting scientific sources) related to the problem studied. No more than 6 credits in any combination of internship, independent research, or senior thesis can count toward Biology degree requirements. Variable credit: 1.0 - 6.0. Repeatable up to 6 credits subject to graduation and program restrictions. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Articulate a clear biological research question or problem and formulate testable hypotheses. 2. Define and articulate terminology, concepts, and theory relevant to a particular research project. 3. Define and apply various research methodologies and when to apply them. 4. Identify problems and effectively problem solve to circumvent research setbacks. 5. Report on research to those in the field and broader audiences through research publications and/or public presentations. Prerequisites: Advanced standing; AND Instructor permission. FA, SP, SU.

BIOL 4890R. Life Science Internship. 1-8 Hours.
For students who are granted and accept an internship with an approved employer, or a governmental, non-profit, or private agency, that provides an extensive learning experience in the field of biology. Students must be supervised by an agency representative and a faculty advisor. Written contracts of expectations and terms and permission of the Biology Department Chair are required. No more than 6 credits in any combination of internship, independent research, or senior thesis can count toward Biology degree requirements. Variable credit: 1.0 - 8.0. Repeatable up to 8 credits subject to graduation and program restrictions. Offered based upon sufficient student need. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will: 1. Acquire work experience and an insight as to the type of career possible by observing a qualified provider. 2. Employ proficient writing skills by producing a summary paper at the conclusion of the internship. 3. Demonstrate collaborative team skills while participating in the internship experience. Prerequisites: Advanced standing; and Instructor permission. FA, SP, SU.

BIOL 4910. Senior Seminar. 1 Hour.
Senior Seminar is required of students pursuing a Bachelor of Science in Biology degree. Topics and themes will vary. Each student will be expected to lead the class in a current research and literature in the general fields of biological science for one week and submit a synthesis paper on a selected topic. Limited enrollment course. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Demonstrate the ability to utilize a scientific journal database to obtain information about a specific biological question or interest. 2. Paraphrase, interpret, and evaluate scientific papers. 3. Demonstrate effective communication of current topics in biology to the public in both written and oral forms. 4. Demonstrate the use of current presentation software. 5. Develop skills to summarize information learned from scientific literature and oral presentations and ask relevant questions. Course fee required. Prerequisites: ENGL 2010 and Advanced Standing in the Biology Program. FA, SP.

BIOL 4930R. Senior Thesis. 1-4 Hours.
For Biology majors who wish to write a scientific paper of publishable quality that details an extended individual research project planned and carried out by the student under faculty supervision, approved by a committee of at least two faculty members and the department chair. Usually, a semester or two of independent research (BIOL 4810, BIOL 4820, and/or BIOL 4830) will precede registration for the senior thesis. Students will be expected to present oral and written reports of experimental results. Final draft of the thesis will be due two weeks before the beginning of final exams. No more than 4 credits in any combination of internship, independent research, independent study, and senior thesis can count toward Biology degree requirements. Permission of the Biology Department Chair is required. Variable credit: 1 - 4. Repeatable up to 4 credits subject to graduation and program restrictions. Offered based upon sufficient student need. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will be able to: 1. Demonstrate the correct use of the necessary tools and techniques needed to complete a research project. 2. Produce a paper suitable for publication at the end of the project. 3. Demonstrate independent learning of new technologies and concepts in order to complete the project. 4. Synthesize and analyze information from a variety of sources. 5. Produce independent scholarly work of professional or near professional quality in their field. Prerequisites: BIOL 3110 (can be concurrently enrolled), and Senior standing; and Instructor permission.

BIOL 4990R. Seminar in Biology. 0.5-3 Hours.
For students wishing instruction that is not available through other regularly scheduled courses in this discipline. Occasionally, students request some type of non-traditional instruction, or an unanticipated opportunity for instruction presents itself. This seminar course provides a variable-credit context for these purposes. As requirements, this seminar course must first be pre-approved by the department chair; second, it must provide at least nine contact hours of lab or lecture for each credit hour offered; and third, it must include some academic project or paper (i.e., credit is not given for attendance alone). This course may include standard lectures, travel and field trips, guest speakers, laboratory exercises, or other non-traditional instruction methods. Note that this course is an elective and does not fulfill general education or program requirements. Variable credit: 1.0 - 3.0. Repeatable as topics vary. No more than six credits will count toward degree requirement. Offered based upon sufficient student need. **COURSE LEARNING OUTCOMES (CLOs) At the successful conclusion of this course, students will: 1. Discuss issues associated with selected scientific topics. 2. Demonstrate an ability to critically read, reflect upon, and summarize scientific information. 3. Summarize and synthesize scientific information on a specific subject related to the course topic in a paper and/or oral presentation.