BIOL A185: INTRODUCTION TO BIOLOGY FOR MAJORS 2: ECOLOGY, EVOLUTION, DIVERSITY, AND PHYSIOLOGY

Item	Value
Curriculum Committee Approval Date	10/16/2024
Top Code	040100 - Biology, General
Units	5 Total Units
Hours	162 Total Hours (Lecture Hours 54; Lab Hours 108)
Total Outside of Class Hours	0
Course Credit Status	Credit: Degree Applicable (D)
Material Fee	No
Basic Skills	Not Basic Skills (N)
Repeatable	No
Open Entry/Open Exit	No
Grading Policy	Standard Letter (S)
Associate Arts Local General Education (GE)	• Area 5 Physical and Biological Sciences, Scientific Inquiry, Life Science (OB)
Associate Science Local General Education (GE)	• Area 5 Physical and Biological Sciences, Scientific Inquiry, Life (OSB)
California General Education Transfer Curriculum (Cal-GETC)	• Cal-GETC 5B Biological Sciences (5B) • Cal-GETC 5C Laboratory Activity (5C)
Intersegmental General Education Transfer Curriculum (IGETC)	• IGETC 5B Biological Sciences (5B) • IGETC 5C Laboratory Activity (5C)
California State University General Education Breadth (CSU GE-Breadth)	• CSU B2 Life Science (B2) • CSU B3 Laboratory Activity (B3)

Course Description

An introduction to the evolution, ecology, physiology, anatomy, and life history of all major groups of organisms, including bacteria, archaea, fungi, plants, animals, other eukaryotes, and viruses. Students also develop their scientific experimentation skills, including statistical data analysis and writing. Fieldtrip required. PREREQUISITE: BIOL A180. Transfer Credit: CSU; UC. C-ID: BIOL 140.**C-ID:** BIOL 140.

Course Level Student Learning Outcome(s)

1. Apply the processes of scientific inquiry, phylogenetic analysis, and experimental design to the diversity of organisms. This includes the demonstrated ability to design, conduct, and write about a controlled, replicated experiment using modern laboratory equipment, the results of which differentiate between student-created hypotheses.
2. Describe and identify key characteristics of representative specimens, and compare and contrast major anatomical, physiological and life cycle characteristics of the major taxa of organisms.
3. Discuss the tenets of evolution (including the mechanisms that cause the diversification of life /speciation) and apply evolutionary theory to real-life scenarios.
4. Evaluate the relationships of organisms to each other and their environments.

Course Objectives

- 1. Demonstrate knowledge of the taxonomic and evolutionary relations between various organisms at different levels of organization (e.g. division, kingdom, phylum, species, etc.).
- 2. Relate the major groups of organisms currently extant on Earth and explain the evolutionary mechanisms that created this diversity.
- 3. Demonstrate knowledge of the ecological relationship between organisms and the environment, and describe the methods organisms use to overcome these problems.
- 4. Explain the major physiological systems of each of the kingdoms of organisms.
- 5. Relate the link between structure and function using examples from all kingdoms of organisms.
- 6. Describe the trade offs associated with solutions to specific physiological problems.
- 7. Create and critically analyze scientific questions, hypotheses, experimental designs, predictions, results, and conclusions.
- 8. Write in a scientific style and critically analyze and summarize existing biological knowledge.
- 9. Demonstrate how to use laboratory equipment, as well as field and lab procedures introduced in the lab, and know their limitations.

Lecture Content

Students will meet in a lecture context for three hours each week and in a lab context for six hours each week for the entire semester. Overall, the course will cover: Evolution Ecology Diversity of all life, including a detailed study of animal and plant taxonomy, anatomy, and life cycles / reproductive biology (a primary reason why the lab meets for 6 hours each week) Physiology, focusing on the physiology of animals and plants The process of science, including literature research, scientific experimentation, scientific data analysis, and scientific writing The lecture portion of the course will cover the following topics; each topic will include information about plants, animals, and other organisms. Some of these topics may be covered in lab instead of in lecture. Evolution Basics of evolution and all the various mechanisms underlying it (natural selection, genetic drift, migration, mutation) Details of natural selection and genetic drift, including population genetics and the Hardy Weinberg principle. Evolution of biodiversity and mechanisms of diversification Speciation (allopatric and sympatric; reproductive isolation mechanisms; possible results of isolated populations reconnecting; etc.) Advanced evolutionary topics (selected per instructor desire; possible topics include evolution of altruism, sexual selection, evolution of viruses) Examples of the topics above, including data supporting evolutionary theory Application of evolutionary theory to hypothetical and real scenarios. The diversity of life Discussion of the major hypotheses for life's history Taxonomic nomenclature, including both traditional taxonomic levels (domain, kingdom, phylum, etc.) and cladistics. The evolutionary relationships between different organisms and how

these relationships are experimentally determined The major taxons / clades of all life Detailed coverage of plant diversity Detailed coverage of animal diversity. Fungi, bacteria, archaea, and a full discussion of the evolutionary history of eukaryotes and their major supergroups (including why the term "protists" no longer defines a kingdom, and suggested alternate naming approaches) Viral diversity (naked/enveloped; genome sense; genome molecule; etc.) Viral life cycles (lytic, lysogenic (transformative), latent, quasispecies) Ecology, including the diversity of habitats/environments on the planet Introduction to ecology; review of the major areas of the field (organismal, population, community, ecosystem) Organismal ecology (including micro vs. macro climates, biotic and abiotic environmental variables, and niches) Population ecology basics Community ecology ((ompetition/commensal/consumptive/mutualistic relationships, succession, etc.) Ecosystem ecology: nutrient cycling and an example of it (e.g., the nitrogen cycle) Biomes and what defines them Terrestrial habitat variability (tropical wet forest, temperate forest, desert, tundra, etc.) including California biomes Aquatic habitat variability (lentic, lotic, wetlands, intertidal, pelagic, benthic, photic, aphotic, etc.) Conservation restoration ecology Comparative physiology and anatomy of animals, plants, and other organisms Digestion and nutrient absorption Basic nutrient types for organotrophs (nitrogen/amino acids, carbon/carbohydrates, lipids) Nutrient requirements and nutrient absorption of phototrophs / autotrophs Nutrient requirements and processes of absorpt ion/consumption/digestion of organotrophic heterotrophs. Structure and function of the vertebrate digestive tract, including selected variations The role of mutualistic organisms in nutrient absorption for selected organisms Respiration Gas exchange in plants; plant anatomical structures relating to gas exchange Gas exchange in animals and related physiological adaptations, including animals with no respiratory system (diffusion based), insect trachea, mammalian lungs, and more Gas exchange in microbes and fungi Osmoregulation and water balance Review of the basics of osmosis and ion regulation Mechanisms of osmoregulation in multicelled organisms (e.g. plants, animals) Animal osmoregulatory systems to include at least freshwater fish, saltwater fish, insects, and humans Metabolic waste production and the mechanisms used to expel them Mechanisms of osmoregulation in unicellular organisms Inter cell signaling (nerves, hormones, etc.) Hormones / signaling chemicals in plants, both within and between individual plants Endocrine system: Hormone and pheromone function in selected animals Nervous system: Nervous tissue and its function in selected animals Intra-cell signaling in prokaryotes and other single celled organisms Circulation Circulation strategies of plants (xylem and phloem) Circulation strategies of animals (no circulatory system, open circulatory system, closed circulatory system). Circulation needs and solutions of unicellular organisms (cytoplasmic streaming, cytoskeletal systems, etc.) Sensory systems Animal sensory systems: structure and function of selected examples Plant sensory mechanisms: structure and function of selected examp les Development, growth, and reproduction Growth and development of plants, animals, and fungi; including life cycles from all kingdoms along with larval, immature, and haploid/dikaryotic stages (often covered in lab) General reproductive mechanisms of multicelled organisms (budding, fragmentation, sexual, etc.) Growth and cell division in single celled organisms (binary and multiple fission) Support and movement Comparison and details of vascular and non vascular plants Comparison of support and locomotory structures of animals Support structures of single celled organisms (cell wall, cytoskeleton, etc.) Immune system Mammalian immune system (innate vs. adaptive, cytotoxic and humoral, with details of the MHC systems, T-cell library creation, clonal selection, and how both cell-mediated and humoral-immunity works) Comparison of immune systems of various animals Diversity of energy generating mechanisms of life Overall diversity of energy generation and carbon aquisition: autotroph/heterotroph; lithotroph/organotroph; chemotroph/phototroph; anaerobic/aerobic; etc. Metabolism (chemotrophism): aerobic vs. anaerobic, prokaryotic metabolic diversity (including chemolithotrophs), eukaryotic metabolic diversity, and biogeochemsitry Photosynthesis (phototrophism): Diversity of photosynthesis in eukaryotes and prokaryotes, autotrophism, along with a definition of photosynthesis that is biologically accurate and taxonomically inclusive

Lab Content

Students will meet for six hours a week in lab throughout the semester; many core concepts of the course (e.g., diversity, life cycles, reproductive techniques) will be covered in detail in the lab. The lab will include multiple lab exams and written assignments detailed elsewhere in this outline. The laboratory will include experiments/observations on at least the following topics: Taxonomy, anatomical features (microscopic, gross/macro, and dissected), functional morphology, developmental stages, and life histories of major lineages from each kingdom. A total of at least 10 three-hour labs will focus on these topics, not including lab exam days, and multiple labs will include dissections. Labs in this section will focus on individual groups on any given day, introducing key elements of each group with real specimens (micro- or macro-scopic) in a hands-on manner. Labs include at a minimum: Plant diversity, life cycles, and anatomy Non seed plants, including: Bryophytes, Marchantiophytes, Lycopodiophytes, Pteridophytes Seed plants, including: Ginkgophytes, Pinophytes, Cycadophytes, Gnetophytes, Magnoliophytes (including magnoliids, monocots, eudicots) Plant identification, including identifying selected plants down to species (choosing relevant plants, such as natives to the area or plants likely to be observed in the field). Plant anatomy, including Macroscopic anatomy: Root, stem, leaf, flower, nodes, meristems, fruit type, plant part modifications Microscopic anatomy: Root, meristems, leaf, flower, ovary/anther and their reproductive cycles, etc. Animal diversity, life cycles, and anatomy Groupings of animal phyla: radiata / bilateria, deuterostomes, protostomes, lophotrochozoa, ecdysozoa, and other relevant groups. Major phyla, including subphyla a nd classes of many lineages: Ctenophora, Porifera, Cnidaria, Platyhelminthes, Annelida, Nematoda, Rotifera, Arthropoda, Mollusca, Echinodermata, and Chordata Detailed coverage of arthropods (down to insect orders) and chordates (including all subphyla and classes). At least one full lab to cover chordate diversity and comparative anatomy Fungal diversity, life cycles, and anatomy Including: Chytridiomycota, Neocallimastigomycota, Glomeromycota, Ascomycota, Basidiomycota, Mucoromycotina Other eukaryote diversity, life cycles, and anatomy Including: Alveolata, Stramenopiles, Rhizaria, Archaeplastica, Excavata, Amoebozoa, Opisthokonta Prokaryote diversity and anatomy Including: Euryarchaeota, Crenarchaeota, Proteobacteria, Actinobacteria, Firmicutes, Cyanobacteria, Chlamydiales, Spirochetes, Green sulfur bacteria Scientific experimentation, scientific writing, and statistical analysis of data A total of at least 10 three-hour labs will involve student-designed experiments that involve some type of written summary of their lab work, including question and hypothesis generation, experimental design, data collection, and scientific data analysis. Experimental labs will be run in a process-of-science, inquiry-oriented style focusing on teaching students how to apply the scientific method using open-ended, student-designed experiments wherever possible. Includes specific labs on Scientific data analysis (including using spreadsheet programs and running T-Tests, ANOVAs, regression, and Chi-square tests) Scientific writing (including detailed discussion of writing both scientific journal articles and scientific grant proposals) will be included. Lab notebooks in biological labs Phylogenetics and determining evolutionary relationships between organisms Habitat diversity and ecological concepts Sensitivity of various organisms to environmental conditions (e.g. plants, animals,

bacteria) Animal experimentation (e.g., metabolic rates), including handling techniques and protocols for live animal experimentation Plant growth, including long-term observation of plants germinating from seedlings under varying experimental conditions. At least one instructor-supervised, hands-on field trip to a natural habitat will be run each semester, where students will conduct a self-designed experiment including ecological or diversity components. Microbial diversity in the environment, including aseptic technique, serial dilutions, and colony identification (most likely by having students extract bacteria from soil samples they've collected and brought into the lab).

Method(s) of Instruction

- Lecture (02)
- Lab (04)

Instructional Techniques

1. Instructor aided exploration and application of concepts in class (lecture and lab) activities, including possibly the discovery of new concepts in laboratory before their introduction in lecture. 2. Hands on instructor guidance during open-ended experiments involving significant amounts of student input regarding experimental design and implementation in the laboratory. 3. Laboratory exercises conducted in small groups or individually with instructor guidance. 4. Lab manual and instructor guidance of direct laboratory observation of different types of organisms, including their taxonomy and relevant physiological and/or anatomical features. 5. Instructor demonstrations of relevant biological techniques, including but not limited to organism care, graph design, specific physiological lab techniques, and microscope use. 6. PowerPoint, video, or other multimedia presentations of concepts introduced in lecture and laboratory. 7. In-class activities in lecture to promote active learning and student involvement during the lecture. 8. Instructor presentation and summarization of critical course material. 9. The creation of a friendly environment where student-to-student and student-to-faculty interaction is encouraged in both lecture and laboratory (through interaction during laboratory experiments, lecture activities, office hours, etc.).

Reading Assignments

Reading assignments require approximately 2 hours/week. 1. Reading the textbook, lab manual, and other instructor-provided materials to prepare for the course. 2. Library/web research to discover background research on topics related to the course (often for written assignments).

Writing Assignments

1. Appropriate laboratory evaluations will be used; these will include writing scientific papers, laboratory reports, laboratory notebook entries, summaries of data collected, and evaluations of experimental design. 2. Written reports will be assigned that will require the discovery of outside scientific material and the ability to summarize, use, and critically analyze that material in a logical fashion. 3. At least a portion of all in class examinations will require some form of written responses requiring the analysis and explanation of course material in full sentences. 4. At least one experiment will have a written proposal due before the experiment is carried out, requiring the student to do background research into the topic of their experiment and to propose their expeirment in a grant-proposal style paper. 5. At least one full paper written in the style of a scientific journal article will be completed by students individually based on an experiment they have conducted in class.

Out-of-class Assignments

Out-of-class assignments require approximately 4 hours/week. 1. Preparing for exams and quizzes in lecture and lab. 2. Completing regularly-scheduled out-of-class assignments designed to help the students review the material (e.g., online quizzes, online activities, or written worksheets) 3. Completing the writing and reading assignments detailed elsewhere.

Demonstration of Critical Thinking

1. In-class lecture examinations. 2. In-lab exams. A major component of exams will be requiring students to identify taxonomic, anatomical, life history, and other features on specimens they observed during lab; the majority of questions will require students to write the answers without a term list, and will test spelling. 3. Regular assignments outside of class time reviewing and/or preparing students for material presented in the course in a way that uses critical thinking skills.

Required Writing, Problem Solving, Skills Demonstration

1. Regular written assignments in the laboratory requiring a basic understanding of and some analysis of experiments and exercises conducted in lab. 2. In depth laboratory reports, written in the format of a scientific paper, for selected labs. These reports will require the discovery, analysis, and summarization of currently existing scientific knowledge. 3. Evaluation during lab of techniques learned in the course.

Eligible Disciplines

Biological sciences: Master's degree in any biological science OR bachelor's degree in any biological science AND master's degree in biochemistry, biophysics, or marine science OR the equivalent. Master's degree required.

Textbooks Resources

1. Required Freeman, Quillin, Allison, Black, et al. Biological Science [or equivalent comprehensive majors biology textbook, such as Campbell et al.'s Biology, 12th ed or OpenStax Biology, 2nd ed], 7th ed. Boston: Pearson, 2020 Rationale: - 2. Required Perkins, Marc C.. Exploring Biological Diversity [or equivalent comprehensive lab manual aimed at biology majors], 8th ed. Costa Mesa: Orange Coast College / Open Educational Resource, 2020 Rationale: -

Other Resources

1. Selected handout materials will be provided and distributed by the instructor as needed.