

Lecture Contact Hours: 64-72; Homework Hours: 128-144;
 Laboratory Contact Hours: 48-54; Homework Hours: 0;
 Total Student Learning Hours: 240-270

CUYAMACA COLLEGE
COURSE OUTLINE OF RECORD

BIOLOGY 240 – PRINCIPLES OF ECOLOGY, EVOLUTION AND ORGANISMAL BIOLOGY

4 hours lecture, 3 hours laboratory, 5 units

Catalog Description

Study of the origin and nature of the different forms of life utilizing evolution as a unifying theme and presenting organismal diversity within a phylogenetic framework. The relationships of environment and fundamental ecological principles, trophic roles and lifestyles to form and function will be explored through examination of comparative structure and the physiology, nutrition, circulation, gas exchange, reproduction, and development of organisms found in the three domains of life. The laboratory component emphasizes the systematics and diversity of prokaryotes, protists, fungi, plants and animals, as well as activities investigating ecological and evolutionary processes using the methods of scientific inquiry. This course along with BIO 230 is the recommended biology sequence for life science majors. It is suggested that students contact the anticipated transfer institution to ascertain specific transfer requirements for their major. *Not open to students with credit in BIO 210.*

Prerequisite

Appropriate Placement or Intermediate Algebra

Recommended Preparation

“C” grade or higher or “Pass” in ENGL 120 or equivalent

Entrance Skills

Without the following skills, competencies and/or knowledge, students entering this course will be highly unlikely to succeed:

- 1) Add, subtract and multiply polynomials.
- 2) Graph equations of lines, slope, rate of change functions and their inverses.
- 3) Use scientific notation.
- 4) Use exponents and logarithms.
- 5) Solve for variables in equations.
- 6) Counting and probability.
- 7) Solve basic algebraic equations.
- 8) Solve quadratic equations.
- 9) Produce essays substantially free of major spelling, grammar, punctuation, sentence structure and usage errors that seriously interfere with communication.
- 10) Write a multi-paragraph essay focusing on a thesis statement and demonstrating an understanding of the concepts of an introduction, a body and conclusion as well as adequate development, unity of idea and coherence.
- 11) Write a position paper that asserts a thesis and provides adequate documented support from at least one source
- 12) Use the MLA format to document sources in writing.

Course Content

- 1) Scientific inquiry as a way of knowing; differences between observational/discovery science; hypothesis/theory

- 2) The shared characteristics of living things including the fundamental life processes of metabolism, reproduction, homeostasis, and adaptation
- 3) The origin of life and of diversity
 - a. Origins of life on Earth and characteristics of early Earth as a biotic environment
 - b. Major events in the history of life on Earth including origin of major single-celled and multi-celled plant, fungal, and animal groups
 - c. Major climatic periods and catastrophic events in the Earth's history and their effect on the evolution, diversity, and distribution of life on the planet
 - d. Explanations for the diversity and distribution of life on the planet
 - e. The theory of evolution
 1. Contributions by Darwin, Wallace and others
 2. Mechanism of natural selection as a force of adaptive evolution and lines of evidence supporting the theory
 3. Sources of genetic variation and factors causing changes in allele frequencies in populations
 4. The Hardy-Weinberg equilibrium
 5. The biological species concept and modes of speciation and macroevolution, including species isolating mechanisms
 6. Biodiversity, the scope, causes and consequences of loss of biodiversity, and methods of ameliorization
 - f. Systematics and Phylogenetics
 1. Systematics and taxonomy
 2. Phylogenetics as the basis of species classification
 - (1) Construction and interpretation of phylogenetic trees
- 4) Fundamentals of ecology and its relationship to biodiversity
 - a. Climatic, oceanographic and geologic characterizations of the world's major biomes
 - b. Energy flow and nutrient dynamics in the ecosystem, primary productivity and trophic structure
 - c. Types of inter-specific interactions including competition, predation, and symbioses
 - d. Biotic communities, change in communities over time, and predictive models of species assemblages
 - e. Mathematical models of population growth and regulation, human population dynamics
 - f. How biotic and abiotic factors determine the distribution of species, as mediated by dispersal and disturbance regimes
 - g. Human impacts on the environment, diversity and distribution of life
- 5) Survey of the origin and characteristics of representatives of the three domains of life and associated taxa including an analysis of environment and lifestyle as related to form and function
 - a. The hypothesized evolutionary relationships between animal groups under different taxonomic methods
 - b. The structure, function, and evolutionary relationships among the Prokaryotes, and their metabolic and ecological adaptations
 - c. The structure, function, and evolutionary relationships among the Protistis, their life cycles and ecological roles
 - d. The life cycles of, structures of, and characteristics distinguishing major groups of the Kingdom Fungi including their evolutionary relationships and ecological roles
- 6) The evolution of land plants, vascular plants, seed plants, and flowering plants
 - a. The life cycles of, structures of, and characteristics distinguishing major divisions of the Plant Kingdom, and their ecological roles
 - b. Plant tissues (roots, shoots, and leaves) and their functions in metabolism, transport, and nutrition
 - c. Plant reproductive structures (flowers, fruits, and seeds) including their ecological significance and adaptive value
 - d. Plant growth, development, and hormones
- 7) The evolutionary history of the Animal Kingdom including body plans, distinguishing features and developmental characteristics of the major Phyla (Classes and Orders as appropriate), and their ecological roles

- a. Structure and function of body systems for circulation, respiration, digestion, excretion/osmoregulation, and immunity in representative invertebrate Phyla
- b. Basic relationships between form and function in the animal body, tissue types, feedback mechanisms in homeostasis
- c. Animal nutrition, digestion and absorption, the human digestive system
- d. Water balance issues in animals depending on their environment, structures and functions of excretory systems, the kidney, regulation of kidney function
- e. Hormones and their function, the endocrine system, and its regulatory role
- f. Structures for gas exchange and their function, relationships between respiration and circulation, structures and functions of the circulatory system, mammalian circulatory systems
- g. Structure and function of nerve cells and the propagation of nerve impulses via electrical and chemical signals
- h. Structures and their function in the vertebrate nervous system, including sense organs
- i. The origin of the Chordates, evolutionary relationships, and apomorphies of vertebrate groups, including hominid evolution
- j. Muscle cell structure and function, muscular movement and locomotion
- k. Modes of asexual versus sexual reproduction in animals, reproductive structures of humans, gametogenesis and pregnancy in placental mammals
- l. Fertilization and development in animals
- m. Innate versus acquired immunity, the structures and function of the human lymphatic system, types of blood cells with immune role, and antibodies

Course Objectives

Students will be able to:

- 1) Utilize the methods of Scientific Inquiry to solve problems in ecology, evolutionary and organismal biology; distinguish scientific investigation from other methods of inquiry.
- 2) Discuss the shared characteristics of living things including fundamental processes of metabolism, reproduction, homeostasis and adaptation.
- 3) Discuss the evidence for the origins of life on Earth in context of the early biotic environment, and the impact of the major climatic periods and catastrophic events in Earth's history on the subsequent origins, diversity and distribution of single celled and multi celled protist, fungal, plant and animal life.
- 4) Discuss the evidence for the theory of evolution and explain specific examples of the manner in which natural selection acts to increase fitness.
- 5) Compare and contrast microevolution and macroevolution and describe the circumstances under which each would occur.
- 6) Create and interpret phylogenetic tree diagrams and cladograms representing the domains and Kingdoms of life.
- 7) Use the Hardy-Weinberg equilibrium to predict effects on allele frequencies in populations, and discuss the implications of small population size and loss of biodiversity and techniques for protecting endangered species.
- 8) Diagram the pathways of energy, organic and inorganic chemicals in the environment, and discuss ways in which life forms, including the human species, have impacted those pathways and the consequences of those actions.
- 9) Use ecological principles to explain the significance of the sun to life on earth and discuss the distribution and contribution of primary producers, primary consumers and secondary consumers to life on earth.
- 10) Diagram the pathways of energy, organic and inorganic chemicals in the environment; explain the greenhouse effect and its consequences.
- 11) Explain how climatic, biogeographic and ecological conditions impact the life forms found in the major terrestrial and marine biomes, and predict the effects of interspecific interactions, disturbance and habitat area in a community.
- 12) Compare and contrast the organisms from the three domains of life (including invertebrate and vertebrate chordate groups) using anatomical, molecular/genetic, development and metabolic

characteristics and phylogenetic relationships, and correctly categorize unknown specimens into taxonomic groups based on these characteristics.

- 13) Explain how the digestive, nervous, respiratory, excretory, circulatory, and reproductive systems function from the cell, organ, organ system and organismal perspectives, and their contributions to metabolism and/or homeostasis; identify and label on diagrams or dissected specimens the major structures of each system in representative invertebrate and vertebrate phyla.
- 14) On diagrams or dissected specimens, label and discuss the functions of the cell types and structures of plants including roots, shoots, leaves, flowers, fruits, and seeds.
- 15) Explain the advantages and disadvantages the various forms of asexual and sexual reproduction found in the three domains of life, and diagram the life cycles of the representative plant divisions and animal phyla.
- 16) Describe the events of fertilization, cleavage, organogenesis, morphogenesis, growth and maturation in animal development.
- 17) Compare and contrast the function of muscle cells and the musculoskeletal systems of each animal phylum, and their role in locomotion.
- 18) Identify the structures of the central and peripheral nervous systems and describe the function of sensory structures in vertebrates.
- 19) Explain the role of hormones in within- and between-individual signaling and maintenance of homeostasis in vertebrates.
- 20) Describe the components of the vertebrate immune system and explain how they interact to produce innate and acquired immunity.

Methods of Evaluation

A grading system will be established by the instructor and implemented uniformly. Grades will be based on demonstrated proficiency in subject matter determined by multiple measurements for evaluation, one of which must be essay exams, skills demonstration or, where appropriate, the symbol system.

- 1) Quizzes and exams that measure students' ability to recognize, explain and provide examples of the concepts, principles, techniques and technologies associated with the course content and learning outcomes.
- 2) Independent and team research projects/papers that require students to formulate a strategy for problem solving, assessing and reporting data, drawing relationships and conclusions.
- 3) Laboratory and field exercises, reports and notebooks that demonstrate research, writing, data analysis and critical thinking skills.

Special Materials Required of Student

- 1) Dissection kit which may contain a hand lens, forceps, probes, razor blades or scalpel, pins and colored pencils
- 2) Calculator

Minimum Instructional Facilities

- 1) Smart lecture classroom with overhead projector/screen
- 2) Standard laboratory classroom with overhead projector/screen
- 3) Access to computer lab with software for research, multimedia and data analysis
- 4) Special requirements: compound and dissecting microscopes, charts and models, preserved and living specimens for dissection and observation, prepared microscope slides, CD or DVD based images, greenhouse facility

Method of Instruction

- 1) Lecture and demonstration
- 2) Reading assignments including literature review
- 3) Study questions and homework assignments
- 4) Laboratory and field exercises
- 5) Group discussion and interactive problem-solving

Out-of-Class Assignments

- 1) Homework assignments that require reading and analysis of concepts in ecology, evolution and organismal biology.
- 2) Preparation of Laboratory assignments and reports.
- 3) Researching and writing research papers on topics in ecology, evolution and organismal biology.

Texts and References

- 1) Required (representative examples):
 - a. Solomon et al. *Biology*, 11th Edition, Cengage. 2019.
 - b. McMillan, Victoria. *Writing Papers in the Biological Sciences*, 7th Edition, MacMillan Learning. 2021
 - c. Adams, Byron and John Crawley. *Van de Graff's Photographic Atlas for the Biology Laboratory*, 8th edition, Morton Publishing Company. 2018.
- 2) Supplemental: None

Student Learning Outcomes

Upon successful completion of this course, students will be able to:

- 4) Apply the methods and tools of scientific inquiry to analyze organ system integration, adaptations and biodiversity.
- 5) Identify organisms' key characteristics across the Tree of Life, and generate conclusions related to their evolutionary history.
- 6) Describe the process of evolution through the mechanism of natural selection