GROSSMONT COLLEGE

COURSE OUTLINE OF RECORD

Curriculum Committee Approval: 05/18/2021

GCCCD Governing Board Approval: 06/15/2021

BIOLOGY 240 – PRINCIPLES OF ECOLOGY, EVOLUTION, AND ORGANISMAL BIOLOGY

1. Course Number Course Title Semester Units

BIO 240 Principles of Ecology, Evolution and 5

Organismal Biology

Semester Hours

4 hours lecture 64-72 hours 128-144 outside of class hours 3 hours lab 48-54 hours

240-270 total hours

1. Prerequisites

A “C” grade or higher or Pass in MATH 110 or equivalent.

Corequisite

None

Recommended Preparation

A “C” grade or higher or Pass in Biology 120 and English 120 or equivalent.

1. Catalog Description

This course along with Biology 230 is the recommended biology sequence for life science majors. It surveys the general principles of biology at an advanced level. Emphasis is placed on the following topics: the history of life on Earth and modern biodiversity; structures for reproduction, nutrition, respiration, transport, regulation of the internal environment, and response to the environment, the diversity of structures that perform these processes, how these structures allow adaptation to different environments and trophic roles; fundamental ecological principles, including population growth and regulation, nutrient cycling, succession and interspecific interactions; human impacts on the environment; and the theory of evolution, including population genetics, the mechanisms of evolution, and the evolutionary basis of species classification. The course includes a laboratory component emphasizing the systematics and diversity of prokaryotes and eukaryotes, including fungi, plants and animals, as well as activities investigating ecological and evolutionary processes using the scientific method. It is suggested that students contact the anticipated transfer institution to ascertain specific transfer requirements for their major.

1. Course Objectives

The student will:

1. Distinguish between science as a ‘way of knowing things’ and non-science, and have the ability to distinguish scientific investigation from other methods of inquiry.
2. Define the scientific terms used in written materials and discussions of modern biology covered in the lectures, labs and readings for this course.
3. Calculate and interpret mathematical and graphical representations and summaries of biological data.
4. Use the shared characteristics of living things to distinguish life from non-life.
5. Explain the evidence for the origins of life on Earth and list and describe the major events in the history of life on Earth and their consequences.
6. Compare and contrast the ways in which life forms, including the human species, have changed and continue to change the physical and chemical characteristics of the planet.
7. Compare and contrast the three Domains of life using anatomical, molecular and metabolic characteristics and discuss the evolutionary relationships between and within them.
8. Relate the differences in life forms found in the major terrestrial and marine biomes to climatic, biogeographic, and ecological conditions.
9. Use the principles of ecology to compare and contrast the distribution and roles 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. Use the principles of ecology to predict the effects of interspecific interactions, disturbance, and habitat area in a community.
12. Illustrate the history of human populations on the planet and predict, from life history strategy and population growth models, the future dynamics of human populations on Earth.
13. Explain the importance of biodiversity and the consequences of its loss.
14. Relate species’ characteristics and population size to extinction risk and describe techniques for protecting endangered species.
15. List and explain the lines of evidence for the theory of evolution.
16. Explain how natural selection acts to increase fitness, and be able to give examples of the process using life history strategies and behavior.
17. Apply the Hardy-Weinberg equilibrium predictions to data and calculate and interpret the results of a chi-square test on allele frequency data.
18. Distinguish between microevolution and macroevolution, and explain the circumstances under which each happens, and the relationship between them.
19. Interpret the meaning of phylogenetic tree diagrams.
20. Sketch cladograms of the different branches of the tree of life, indicating apomorphies for the Domains and Kingdoms, the Divisions of plants, and the Phyla (Classes and Orders for selected Phyla) of animals.
21. For the chordates, explain the evolutionary history and relationships between the invertebrate and vertebrate groups based on morphology, development and genetic data.
22. Examine diagrams or dissected specimens and identify the major structures of the digestive, nervous, respiratory, excretory, circulatory, and reproductive systems of representative invertebrate animal phyla and the vertebrates.
23. Explain how 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.
24. Relate structure to function in, and be able to label on diagrams or dissected specimens, the cell types and organs of plants, including roots, shoots, leaves, flowers, fruits, and seeds.
25. Distinguish taxonomic groups of unknown specimens of plants, animals, and fungi based on their physical characteristics.
26. 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 different plant divisions and animal phyla.
27. Describe the events of fertilization, cleavage, organogenesis, morphogenesis, growth and maturation in animal development.
28. Relate the functions of muscle cells and the musculoskeletal systems of each animal phylum to their role in locomotion.
29. Identify the structures of the central and peripheral nervous systems and describe the function of sensory structures in vertebrates.
30. Illustrate the role of hormones in within- and between-individual signaling and maintenance of homeostasis in vertebrates with examples.
31. Demonstrate knowledge of the components of the vertebrate immune system and explain how they interact to produce innate and acquired immunity.
32. Instructional Facilities

Standard Classroom

* 1. Standard laboratory classroom with overhead projector, screen, black or white board, sink, hood, gas, proximity to biology laboratory prep room, student access to computerswith internet access**.** 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, a greenhouse facility.

1. Special Materials Required of Student

Scientific Calculator

7. Course Content

All course content is covered in both lecture and lab. There are no topics exclusively taught in lab.

* 1. Scientific method as a way of knowing entails, including observation and discovery, manipulative experiments, observational studies, predictive calculation, theory.
  2. The shared characteristics of living things, including the fundamental life processes of metabolism, reproduction, homeostasis, and adaptation.
  3. Origins of life on Earth and characteristics of early Earth as a biotic environment.
  4. Major events in the history of life on Earth, including origin of major single-celled and multi-celled plant, fungal, and animal groups.

e. 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.

f. Explanations for the diversity and distribution of life on the planet.

g. Climatic, oceanographic, and geologic characterizations of the world’s major biomes.

h. Human impacts on the environment, diversity and distribution of life.

i. Energy flow and nutrient dynamics in the ecosystem, primary productivity and trophic structure.

j. How biotic and abiotic factors determine the distribution of species, as mediated by dispersal and disturbance regimes.

k. The roles of behavior and communication in homeostasis and in individual and inclusive fitness.

1. Types of inter-specific interactions, including competition, predation, and symbioses.
2. Biotic communities, change in communities over time, and predictive models of species assemblages.
3. Mathematical models of population growth and regulation, human population dynamics.
4. Demography, life history strategies, and how natural selection acts on them.
5. Biodiversity, the scope and causes of loss of biodiversity, its consequences, and methods to ameliorate it.
6. Development of the theory of evolution by Darwin, Wallace, and others.
7. Mechanism of natural selection as a force of adaptive evolution.
8. Lines of evidence supporting the theory of evolution.
9. Sources of genetic variation and factors causing change in allele frequencies in populations.
10. Testing for genetic change against the Hardy-Weinberg equilibrium.
11. The biological species concept.
12. Modes of speciation and macroevolution, including species isolating mechanisms.
13. Construction and interpretation of phylogenetic trees.
14. The structure, function, and evolutionary relationships among the Prokaryotes, and their metabolic and ecological adaptations.
15. The structure, function, and evolutionary relationships among the Eukaryotes, their life cycles and ecological roles.
16. The life cycles of, structures of, and characteristics distinguishing major groups of the Fungus Kingdom, their evolutionary relationships and ecological roles.
17. The evolution of land plants, vascular plants, seed plants, and flowering plants.
18. The life cycles of, structures of, and characteristics distinguishing major divisions of the Plant Kingdom, and their ecological roles.
19. The evolutionary history of animals, focusing on development and body plans.
20. The body plans, distinguishing features, and developmental characteristics of the major Phyla (Classes and Orders as appropriate) of the Animal Kingdom, and their ecological roles.
21. The hypothesized evolutionary relationships between animal groups under different taxonomic methods.
22. Structure and function of body systems for circulation, respiration, digestion, excretion/osmoregulation, and immunity in representative invertebrate Phyla.
23. The origin of the Chordates, evolutionary relationships, and apomorphies of vertebrate groups, including hominid evolution.
24. Plant tissues (roots, shoots, and leaves) and their functions in metabolism, transport, and nutrition.
25. Plant reproductive structures (flowers, fruits, and seeds), including their ecological significance and adaptive value.
26. Plant growth, development, and hormones.
27. Basic relationships between form and function in the animal body, tissue types, feedback mechanisms in homeostasis.
28. Animal nutrition, digestion and absorption, the human digestive system.
29. Structures for gas exchange and their function, relationships between respiration and circulation, structures and functions of the circulatory system, mammalian circulatory systems.
30. Water balance issues in animals depending on their environment, structures and functions of excretory systems, the kidney, regulation of kidney function.
31. Hormones and their function, the endocrine system, and its regulatory role.
32. Structure and function of nerve cells and the propagation of nerve impulses via electrical and chemical signals.
33. Structures and their function in the vertebrate nervous system, including sense organs.
34. Muscle cell structure and function, muscular movement and locomotion.
35. Modes of asexual versus sexual reproduction in animals, reproductive structures of humans, gametogenesis and pregnancy in placental mammals.
36. Fertilization and development in animals.
37. Innate versus acquired immunity the structures and function of the human lymphatic system, types of blood cells with immune role, and antibodies.

8. Method of Instruction

* 1. Lecture notes.
  2. Reading assignments.
  3. Film/video/internet presentations.
  4. Study questions.
  5. Literature review.
  6. Field trips.
  7. Class discussions.

9. Methods of Evaluating Student Performance

* 1. Quizzes.
  2. Essay examinations.
  3. Objective examinations.
  4. Final examination which includes essay, short answer, and multiple choice.
  5. Class participation, such as discussions on “Science and Society” or “Science in the News” topics.
  6. Term paper or other written assignments on selected topics in ecology, evolution or conservation biology requiring literature search and review of primary literature.
  7. Laboratory assessments, including practical identifications of specimens and skill-based tasks.

10. Outside Class Assignments

* 1. Textbook reading assignments and reading quizzes.
  2. Homework assignments, including mathematical problems, drawing diagrams and using interactive software.
  3. Field trips to zoos, museums, aquaria, rocky intertidal zone and/or chaparral habitats.

d. Topic research using library and Internet on selected topics in conservation biology (such as the impact of captive breeding) and/or medical science (such as studies of diet and exercise on Type II diabetes)

11. Representative Texts

* 1. Representative Text(s):
     1. Lisa A. Urry, Michael L. Cain, Steven A. Wasserman, Peter V. Minorsky and Jane B. Reece. *Campbell Biology*. 12thedition, San Francisco, CA: Pearson Education Inc., 2020.
     2. OpenStax, Biology. OpenStax CNX. Mar 28, 2018 https://openstax.org/details/books/biology-2e. Licensed under a Creative Commons Attribution 4.0.
     3. Ripley, B., *Biology 240 Lab Manual*. 5th edition, Grossmont College, El Cajon, CA 2019
  2. Supplementary texts and workbooks:

Byron J. Adams, *Van de Graaf’s Photographic Atlas for Biology Laboratory*. Morton Publishing, 8th edition, 2018.

Addendum: Student Learning Outcomes

Upon completion of this course, our students will be able to do the following:

1. Explain how differences between populations/species are the result of changes in characteristics due to natural selection and other forces of evolution;
2. Compare and contrast the ways that different kinds of cells, organisms, the community take in, use, transfer and transform energy and matter to meet their metabolic needs;
3. Explain how cells, tissues, organs and organ systems of organisms perform the functions of homeostasis and reproduction based on their structural characteristics;
4. Explain how molecules, cells, organs and/or organisms interact with one another and their environments as systems.