KINGSBOROUGH COMMUNITY COLLEGE CITY UNIVERSITY OF NEW YORK DEPARTMENT OF BIOLOGICAL SCIENCES

GENERAL BIOLOGY II (BIO 01400) SYLLABUS

Course Co-Coordinators
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COURSE DESCRIPTION:

BIO 1300, 1400 – GENERAL BIOLOGY I AND II (4 credits. 6 hrs. each semester) A one-year, two-semester course for students who plan to major in biological sciences or prepare for a preprofessional program. Classroom and laboratory sessions focus on biological topics as they apply to all life, to recent scientific findings, and how they advance understanding of classical concepts, and the interaction of environmental and biological forces to produce life.
Prerequisites for BIO 1300: Passing scores on the CUNY Reading and Writing exams and the COMPASS Math Skills Test. Prerequisite for BIO 1400: BIO 1300

A.S BIOLOGY PROGRAM LEARNING OUTCOMES

- Apply the methods and process of life science, including common laboratory techniques
- Demonstrate proficiency in quantitative reasoning as it relates to life science data
- Demonstrate an understanding of evolution
- Demonstrate an understanding of the relationship between structure and function
- Demonstrate an understanding of genetics
- Demonstrate an understanding of the pathways of energy and matter that maintain a particular environment
- Demonstrate an understanding of the levels of biological organization and the interactions among these levels
- Develop and test hypotheses

COURSE LEARNING OUTCOMES

Upon completion of the course, students should be able to:

- Demonstrate knowledge of evolution, ecology, and the phylogenetic relationships of organisms.
- Apply biological techniques to compare organisms and document similarities and differences observed.
- Differentiate among the domains (Archaea, Bacteria, and Eukarya) and among the eukaryotic groups (fungi, plants, protists, and animals)
- Formulate hypotheses and design experiments to provide evidence to support or refute the hypotheses.
- Analyze biological data and develop conclusions using scientific reasoning.

GRADES

The General Biology II course will be graded as follows:

50% Lecture (20% of which will be the final examination)
50% Laboratory

Additional details regarding examinations, assignments, *etc*., will be provided by your lecture instructor; details regarding quizzes, papers, other assignments, *etc.,* will be provided by your laboratory instructor.

ATTENDANCE

Refer to the policies in the college catalog. To gain access to the college catalog, visit the Academic Information, Examination, and Grades website.

TEXTBOOKS

The required textbook readings and lab manual for this course are both provided online by the instructor.

ADDITIONAL REQUIREMENTS

Students must purchase a knee-length laboratory coat, a dissecting kit, disposable gloves & goggles. Laboratory coats will be worn at all times during classes in the laboratory. Students that do have a laboratory coat will not be allowed into a biology laboratory. Gloves will not be provided but may be purchased by students if they wish to use gloves.

ACCESSIBILITY

Access-Ability Services (AAS) serves as a liaison and resource to the KCC community regarding disability issues, promotes equal access to all KCC programs and activities, and makes every reasonable effort to provide appropriate accommodations and assistance to students with disabilities. Please contact this office if you require such accommodations and assistance. Your instructor will be glad to make the accommodations you need, but you must have documentation from the Access-Ability office for any accommodations.

CIVILITY

The following statement is from KCC's Website on Civility: "Kingsborough Community College is committed to the highest standards of academic and ethical integrity, acknowledging that respect for self and others is the foundation of educational excellence. Civility in the classroom and respect for the opinions of others is very important in an academic environment. It is likely you will not agree with everything that is said or discussed in the classroom. Courteous behavior and responses are expected. Therefore, in this classroom, any acts of harassment, and/or discrimination based on matters of race, gender, sexual orientation, religion, and/or ability is not acceptable. Whether we are students, faculty, or staff, we have a right to be in a safe environment, free of disturbance and civil in all aspects of human relations."

ACADEMIC INTEGRITY

Academic Dishonesty is prohibited in The City University of New York and is punishable by penalties, including failing grades, suspension, and expulsion, as provided herein. Additional information can be found in the College catalog (http://www.kingsborough.edu/sub-registration/Pages/catalog.aspx)

Plagiarism as a violation of academic integrity

Students will be asked to write papers and laboratory assignments. During this endeavor, they should be careful to avoid plagiarism. Plagiarism is the intentional theft(s) of someone else's intellectual property without attribution (proper credit). Determination and penalty – ranging from grade reduction to course failure – will be decided by the instructor.
Internet plagiarism includes submitting downloaded term papers or parts of term papers, paraphrasing or copying information from the internet without citing the source, and "cutting & pasting" from various sources without proper attribution.

VISION AND CHANGE

This course has been aligned with National Science Foundation's Vision and Change. To this end, creative teaching strategies have been developed to facilitate student learning. The objectives of the course are structured to achieve the course learning outcomes. Assessment of some or all course learning outcomes is done every semester, the results are analyzed, and suggestions for improving student learning, and meeting the course learning outcomes, are discussed. In addition, suggestions are provided on assessment strategies. Finally, the incorporation of the following lecture and lab activities, which are important in developing competencies that last beyond the classroom, are encouraged:

1. Lab activities that are inquiry-based
2. Activities that foster critical thinking
3. Activities that promote quantitative competencies
4. Activities that relate the scientific information to real world practices

Recommendations to the Student:

- Textbook pages as well as laboratory assignments should be read before class.
- Observe all safety precautions as instructed in the laboratory. They are for your protection.
- Each student is responsible for the proper and safe maintenance of their laboratory work area. Bench tops and microscopes must be properly cleaned before and after use.

LECTURE TOPIC OUTLINE BIOLOGY 01400

Unit 1: Evolution

Topic	Hours
Principles and mechanisms of evolution	2
Microevolution, speciation, macroevolution	3
Origin & history of life	1.5
Taxonomy & phylogenetics	1
Total	7.5

Unit 2: Organismal biology I

Topic	Hours
Viruses, viroids, & prions	1
Archaea & Bacteria	2
Protists	1.5
Fungi	1.5
Total	6

Unit 3: Organismal biology II: Plants

Topic	Hours
Plant diversity	2
Plant structure and function	1
Plant growth and reproduction	2
Plant nutrition and transport	2
Plant response to the environment	1.5
Total	8.5

Unit 4: Organismal biology II: Animals

Topic	Hours
Animal diversity	2.5
Primate and human evolution	1
Reproduction	1.5
Development	1
Physiology: thermoregulation, feedback mechanisms, etc.	1
Total	7

Unit 5: Ecology

Topic	Hours
Introduction: biomes, levels of organization	1.5
Population ecology	1.5
Community ecology	1
-Biosphere	1.5
Conservation ecology	1.5
Total	7

Note: Students will be asked to write one paper.

LABORATORY OUTLINE BIOLOGY 01400

Week	Topic	Objectives
1	Evolution: Geological Time, Primate and Human Evolution, and Molecular Evolution	• Identify major geological and evolutionary events • Create a scaled timeline of major evolutionary events and indicate the approximate date of each • Calculate the proportion of earth's history for which various groups of organisms have existed • List derived characteristics of primates and humans • Distinguish between primitive and advanced characteristics in primate facial and skull bones • Analyze evolutionary relationships using molecular (DNA) evidence
2	Evidence of Evolution Population Genetics	• Describe evidence of evolution that is based on microevolution and population genetics • Define and use the terminology of population genetics correctly • Use the equations of the Hardy-Weinberg equilibrium to calculate allele and genotype frequencies • Graph allele frequencies using Microsoft Excel and identify changes in allele frequencies • Draw graphs and explain three types of selection
3	Taxonomy, Phylogenetics, and Bacteria	• Explain how the following evidence is used for phylogenetic reconstruction: the fossil record, DNA, and biogeography. • Describe specific examples of phylogenetic reconstruction, such as the relationship of humans to other primates. • Build and analyze a phylogenetic tree, identifying patterns of shared ancestry. • Differentiate between the allopatric and sympatric modes of speciation. • Identify and define common bacterial shapes and features, including: cocci, bacilli, spirilli, pili, capsule, spore, fimbriae, flagella, plasmid, Gram positive cell wall, Gram negative cell wall. • Describe various bacterial metabolic processes, including: photosynthesis, chemosynthesis, methanogenesis, nitrogen fixation. • Identify and describe at least three vital roles that bacteria play in their ecosystems, such as primary production, decomposition, nitrogen fixation, and disease.
4	Protists	• Define the term "protist" and explain why this is not a monophyletic group. • Identify representatives from each supergroup Excavata, "SAR" clade, Archaeplastida, and Unikonta • Draw a phylogenetic tree for the eukaryotes and explain why the eukaryote supergroups form a polytomy. • Indicate the position of plants, animals, and fungi on the eukaryote tree, and identify the group of protists most closely related to each. • Give examples of protist species from each eukaryote supergroup. • Give two examples of the significant impact of specific protists on their ecosystems.
5	Fungi	• Describe fungal classification into phyla, and provide a phylogeny of Kingdom Fungi. • In a sentence or two, describe the characteristics of the three largest phyla in the Kingdom Fungi (Zygomycota, Ascomycota, Basidiomycota). • Using images, explain the life cycle of typical multicellular fungi. • Give three examples of how humans benefit from specific uses of fungi.
6	Plants I: Seedless Plants	• Distinguish members of Kingdom Plantae from their nearest relatives (charophyte algae) • Draw a basic phylogeny for Kingdom Plantae • Diagram and explain the life cycle of plants (alteration of generations) • Differentiate the characteristics of nonvascular plants versus seedless vascular plants • Using images, explain the life cycles of moss (a nonvascular plant) and ferns (a seedless vascular plant)

7	Plants II: Seed Plants	• Be able to describe alternation of generations in plants • Learn the classification of gymnosperms and angiosperms • Identify reproductive structures in gymnosperms and angiosperms • Summarize differences between monocots and eudicots • Label the reproductive and non-reproductive structures of a flower
8	Animals I: Invertebrates	• Distinguish members of the Kingdom Animalia from their closest living relative (Choanoflagellates and Fungi). • Explain the basic body plan of members in the Kingdom Animalia. • Identify members of the Phyla Porifera, Cnidaria, Platyhelminthes, Rotifera, Annelida, Mollusca, Nematoda, Arthropoda, Echinodermata. • Compare two types of invertebrate life cycles. • Compare the structure and function of invertebrates.
9	Animals II: Vertebrates	• List characteristics found in the Subphylum Vertebrata of Kingdom Animalia • List characteristics of each of the major tetrapod groups: amphibians, reptiles, birds, mammals; and provide examples of each • Identify homologous structures in vertebrates, and explain the functions of each structure • Identify representatives from the eight vertebrate clades, Agnatha, Chondrichthyes, Osteichthyes (comprised of Actinopterygii and Sarcopterygii), Amphibia, Reptilia, Aves, and Mammalia • Identify and list eleven organ systems in vertebrate animals, their main organs, and provide the major function(s) of each (integumentary, skeletal, muscular, nervous, endocrine, digestive, respiratory, cardiovascular, lymphatic/immune, urinary, & reproductive) • Compare the life cycles of amphibians and mammals • Identify structures in dissected specimens of representative vertebrates (frog and fetal pig)
10	Ecology I: Biomes, Population Growth, and Predator-Prey Dynamics	• Identify the characteristics of Earth's major terrestrial biomes, and describe the impacts humans have had on these biomes. • Explain the relationships between climate (temperature and precipitation) and terrestrial biome type. • Apply the concepts of biotic potential and environmental resistance to human population growth. • Explain the difference between exponential and logistic growth, and define carrying capacity. • Identify major events that have affected human population growth and explain how they have increased carrying capacity. • Explain the dynamics in population size in a real-life predator-prey relationship. • Explain the difference between density-dependent and density-independent factors that affect population growth. • Interpret real-life predator-prey population data as depicted in a graph.
11	Ecology II: Community and Ecosystem Dynamics	• Explore the concept of an ecological niche and the difference between a fundamental niche and a realized niche using an example of two barnacle species competing for the same resource. • Using the same two competing barnacle species, demonstrate how limiting factors (predation and desiccation tolerance) interact to result in competitive exclusion, resource partitioning and realized niches. • Define the trophic levels in an ecosystem, and identify the trophic level of specific organisms in various ecosystems. • Compare the number of individuals, biomass, amount of energy, and the efficiency of energy transfer (i.e., the percentage of energy transferred and converted to new biomass between levels) at each trophic level. • Investigate the concept of trophic cascades, and explain how a keystone species can indirectly affect the biodiversity and nutrient cycling of an entire ecosystem.
12		Student presentations

COURSE OBJECTIVES

UNIT 1: EVOLUTION

EVOLUTION: STUDY & MECHANISMS

- In no more than three sentences, define biological evolution.
- Explain in a series of steps how natural selection results in evolution.
- Define and provide one example for each of the following terms: Fossils, morphological homology (homologous and vestigial structures), embryological homology, biochemical homology, biogeography, and analogous structures.
- In a paragraph, explain how each of the above provides evidence for the occurrence of evolution, and more specifically convergent and divergent evolution.

MICROEVOLUTION, SPECIATION, & MACROEVOLUTION

- Define, population genetics, gene pool, alleles, & genetic variability.
- State the five conditions required for Hardy-Weinberg equilibrium.
- In a paragraph, describe the significance of the Hardy-Weinberg principle as it relates to evolution.
- In a paragraph, define each term and then describe how nonrandom mating, mutation, genetic drift, gene flow, and natural selection alter allele frequencies in populations.
- Define p, q, p^2, q^2, and 2pq in the Hardy-Weinberg equation.
- Given data, use the Hardy-Weinberg equation to determine the frequencies of two alleles, and of the genotypes they produce, hence to predict the percentage of the population that is homozygous dominant, heterozygous, or homozygous recessive for that trait.
- In a paragraph, state how mutation and genetic recombination provide the variation needed for evolution to occur.
- In a paragraph, describe how each of the following mechanisms affects the genetic variability of a population: natural selection, genetic drift (including the founder effect and bottlenecks), and gene flow.
- In one or two sentences, explain how each of the above mechanisms leads to evolution (i.e., a change in allele frequencies) in a population.
- Use a graph with an example to demonstrate stabilizing, directional, and disruptive selection.
- Define sexual selection and give one example.
- Define the biological species concept and state its limits.
- Define adaptation and in two sentences explain the role of the environment in adaptation.
- In a paragraph, explain the significance of reproductive isolating mechanisms and give three examples of isolating mechanisms.
- Define allopatric and sympatric speciation. Give one example for each in both animals and plants.

THE ORIGIN AND HISTORY OF LIFE

- In a paragraph, describe the conditions that are thought to have existed on early Earth just prior to the origin of life.
- Outline the major steps hypothesized to have occurred in the origin of cells and state four conditions required for life to occur (Oparin hypothesis).
- Explain at least two alternative hypotheses for the origin of the first living things. Identify the most likely candidate for the first living organism relative to the organisms found on Earth today.
- State the origin of O_2 and its consequences on life.
- List two organelles whose origin is explained by the endosymbiont theory and in a paragraph summarize the evidence supporting it.
- Draw a timeline indicating five major events reflecting the transitions in the history of life on Earth from the formation of the cell to the development of fungi, plants and animals.
- In three sentences, explain the use of radiometric dating to determine the ages of fossils and rocks in the geologic record.
- List, in order, a minimum of five steps to summarize how life originated on Earth, from the formation of organic monomers through the rise of eukaryotic organisms.

TAXONOMY & PHYLOGENETICS

- Draw a diagram to show the biological hierarchy (domain, kingdom, phylum, etc.).
- Explain how organisms are classified in the biological hierarchy.
- State how binomial nomenclature is used to identify species.

- Explain the difference between shared primitive and shared derived characteristics.
- Write a paragraph to describe how various types of evidence are used to reconstruct phylogeny, including the fossil record, morphological traits, and molecular traits.

UNIT 2: VIRUSES, PROKARYOTES, PROTISTS AND FUNGI

BACTERIA, ARCHAEA AND VIRUSES

- List 3 significant roles of bacteria in the environment.
- Name the 3 most common bacterial shapes.
- Prepare a table comparing the chemical differences between Gram positive and Gram negative cell walls.
- Define the following bacterial structures and state the advantages of each: (a) capsule; (b) plasmid: and (c) endopsores.
- Describe in a series of steps the most common mechanism of bacterial cell multiplication.
- Distinguish between the organization of genetic material in prokaryotic and eukaryotic cells.
- Name 3 mechanisms by which cells generate genetic diversity.
- In a series of steps, describe the following bacterial processes: (a) transformation; (b) transduction; (c) conjugation.
- List 5 properties used to distinguish bacteria from Archaea.
- Prepare a drawing of a virus and label the following parts: (a) genome; (b) capsid; (c) envelope.
- Prepare a table to compare viruses, prions, and viroids.

PROTISTS AND FUNGI

- In one paragraph, explain the role of primary and secondary endosymbiosis in the evolution of the protists.
- For the four supergroups of protists, make a table listing the characteristics of and three examples for each supergroup (Excavata, "SAR" clade, Archaeplastida, and Unikonta).
- Name two different protists that play a key role in their ecological community, and in one paragraph describe that role.
- Define the following fungal structures: (a) hyphae; (b) mycelium and explain in two to three sentences the nutritional mode employed by fungi.
- State one difference between the cell walls of fungi compared to the cell walls of plants.
- Explain the reproductive cycle of a typical fungus
- State 2 significant industrial uses of fungi.

UNIT 3: PLANTS

PLANT DIVERSITY

- List four defining characteristics of plants that distinguish them from charophytes.
- In one or two paragraphs, list and define adaptations that plants might have to a terrestrial environment.
- Draw a diagram and use it to describe, in a short paragraph, alternations of generations and distinguish between a gametophyte and a sporophyte.
- Draw a phylogenetic tree that shows the relationship between nonvascular seedless, seedless vascular, and seed plants including both gymnosperms and angiosperms.
- State the differences between the life cycles of nonvascular plants, seedless vascular plants, and seed plants.
- List six characteristics that are used to distinguish between monocots and eudicots. In one sentence for each, describe how each characteristic differs between the two.

PLANT STRUCTURE AND FUNCTION

- Draw a diagram of a plant and identify the root and shoot systems and the following respective organs; stem, leaf, flower, tap root, and fibrous root.
- List three types of tissue in a vascular plant, and identify the location and function of each.
- For each vascular plant tissue type above, list the types of cells of which they are made, and the characteristics of those cells.
- Define meristem, and state the difference between apical and lateral meristems.
- Identify and state the function of the following: root hairs, cuticle, epidermis, endodermis, plasmodesmata, xylem, phloem, companion cells, cortex, palisade mesophyll, spongy mesophyll.
- Distinguish between simple and compound leaves.

PLANT GROWTH AND REPRODUCTION

- Define primary and secondary growth.
- In one or two sentences, distinguish between monoecious and dioecious plants and describe the implication for pollination.
- Draw diagrams and in one paragraph for each describe the life cycles of gymnosperms and angiosperms.

- Draw a diagram to identify the following structures and define each in a short sentence: stamen, anther, pollen, carpel, pistil, style, stigma, ovary, ovule, sepal, petals, calyx, corolla, embryo sac, endosperm, seed coat, and fruit.
- Draw a diagram and in a short paragraph describe the process of pollination and fertilization in flowering plants.
- Prepare a labeled drawing of a seed including the following parts: the embryo sac, endosperm, and seed coat.
- Define the following terms in relation to plants: annual, biennial, and perennial.

PLANT NUTRITION AND TRANSPORT

- In five or six sentences, explain how water is transported in vascular plants, including the concepts of root pressure, transpiration, and the cohesion-tension mechanism.
- Write a short paragraph describing the mechanism of phloem transport (mass transport, translocation).

PLANT RESPONSE TO THE ENVIRONMENT

- Define tropism, gravitropism, phototropism, and thigmotropism.
- Define photoperiodism and in one to two sentences describe its importance in flower production.
- In two sentences for each, state the action and significance of auxins, gibberellins, ethylene, cytokinins, and abscisic acid in plants.

UNIT 4: ANIMALS

ANIMAL EVOLUTION AND DIVERSITY

- List five characteristics of organisms in the Kingdom Animalia, including at least three traits unique to animals.
- In one to two paragraphs, provide an explanation for the origin of the Kingdom Animalia.
- From an evolutionary perspective, state the differences between: metazoan and eumetazoa, radial & bilateral symmetry; diploblastic & triploblastic embryos; ectoderm, mesoderm & endoderm; coelomate, pseudocoelomate & acoelomate body plans; and protostome & deuterostome development.
- Classify each of the following phyla as metazoan, eumetazoa, bilateria, protostomes, or deuterostomes: Porifera, Cnidaria, Platyhelminthes, Rotifera, Ectoprocta (Bryozoa), Brachiopoda, Echinodermata, Chordata, Nematoda, Annelida, Mollusca, Arthropoda.
- Prepare a list of the main characteristics used to identify each of the following major phyla: Cnidaria, Echinodermata, Chordata, Annelida, Mollusca, and Arthropoda.
- Provide examples of three different organisms for each of the following phyla: Cnidaria, Echinodermata, Chordata, Annelida, Mollusca, Arthropoda.
- Prepare a table listing the traits, the definition of traits, and three examples of each of the following: chordates, vertebrates, tetrapods, and amniotes.
- List three characteristics of each of the major tetrapod groups: amphibians, reptiles, birds, mammals; and provide three examples of each.

PRIMATE AND HUMAN EVOLUTION

- State the evolutionary trends that lead to the evolution of primates and humans.
- State five major characteristics that distinguish hominids from other mammals.
- Diagram a basic timeline for the evolution of hominids (from 7 Ma to present). Write a paragraph explaining your timeline.

PHYSIOLOGY

- In a sentence or two, distinguish between anatomy and physiology.
- In a table, list the organ systems in vertebrate animals, their main components, and provide the function(s) of each.
- List the four major tissue classes in animals and state the unique features and functions of each.
- Define homeostasis.
- Define endothermy, ectothermy.

REPRODUCTION

- In 2-4 sentences, distinguish between asexual reproduction and sexual reproduction.
- Define: egg, sperm, fertilization, and zygote.
- In a paragraph, state the features of the following forms of asexual reproduction: fission, budding, parthenogenesis.
- In a paragraph, distinguish between external fertilization and internal fertilization.

DEVELOPMENT

- Define each of the following terms: fertilization, cleavage, gastrulation, cell differentiation, morphogenesis, organogenesis.
- Describe in a series of steps the process of early embryogenesis (from fertilization through neurulation) using the following terms: zygote, blastocoel, blastula, gastrula and neurula.
- Prepare a table listing the tissues and organs derived from the ectoderm, endoderm, and mesoderm in vertebrates.

UNIT 5: ECOLOGY

INTRODUCTION TO ECOLOGY

- Define ecology.
- List three biotic and three abiotic factors that determine the distribution of organisms on Earth.
- List ten of Earth's major terrestrial and/or aquatic biomes and list three characteristics of each.
- Identify two factors that dictate the distribution of all terrestrial biomes and explain the importance of each in one sentence.
- List in the correct order and define in a sentence the different levels of ecological organization (individual, population, species, community, ecosystem, biome, biosphere).
- Explain, in one paragraph, how ecological complexity, redundancy and biodiversity contribute to ecosystem stability.

POPULATION ECOLOGY

- Define the term population in a sentence.
- In a paragraph, apply the concepts of biotic potential and environmental resistance to human populations using real life examples.
- Define each of the following in a sentence: demography, density, distribution, and size as they relate to population ecology.
- Explain, in one paragraph, the four key factors that affect population size (immigration, emigration, births and deaths).
- Calculate for a given population the growth rate (r), and explain why the growth of that population is always exponential if r is above zero.
- Draw both a J and S shaped growth curve on a single graph and explain in a short paragraph how they are related.
- Define the term carrying capacity (K) and describe in one sentence what happens to a population when K is exceeded.
- In a paragraph discuss four differences between r-strategists to K-strategists
- In two sentences differentiate between density-dependent and density-independent forces and their impact on population size.
- In a paragraph discuss the key differences between the three types of survivorship curves (Type I, Type II and Type III); give one example of an organism that exhibits each pattern and state in a sentence for each what traits inform you that it exhibits that strategy.
- State seven ways humans make an impact on the environment through population size and/or the ecological footprint of its citizens.

COMMUNITY ECOLOGY

- Define the term "community" in one sentence.
- Identify three important interactions between organisms within a community.
- List three types of resources for which organisms might compete.
- Using one organism as an example, describe the difference between a fundamental niche and a realized niche in one or two sentences.
- Using one or two sentences, compare and contrast resource partitioning and the exclusion principle.
- Describe in one sentence the concept of symbiosis, and define in two sentences the concepts of parasitism, commensalism and mutualism using a pair of organisms to exemplify each.
- Describe in a short paragraph why a predator and prey can exhibit a cyclical relationship in terms of population oscillations.
- In one sentence define the term keystone species, and using a real-life example in a brief paragraph specify its roles in shaping the structure of its community.
- Define the term co-evolution in terms of predator and prey, and explain in one paragraph how predation pressure has led to an evolutionary biological "arms race."
- Define the term "ecological succession" in one sentence.

ECOSYSTEMS AND THE BIOSPHERE

- Define the term "ecosystem" in one sentence.
- Describe in one short paragraph the general flow of energy and the cycling of nutrients through ecosystems.
- Name and define each trophic level in an ecosystem and cite an example for each level, using the following terms: producer, primary consumer, secondary consumer, tertiary consumer, decomposer, herbivore, carnivore, omnivore, autotroph, and heterotroph.
- Make a table that compares the number of individuals, biomass, amount of energy, and the efficiency of energy transfer (i.e., the percentage of energy transferred and converted to new biomass between levels) at each trophic of an ecological food pyramid.
- Using one sentence for each element, state the key functions of carbon, hydrogen, oxygen, and nitrogen in living things.
- Describe in a series of steps each of the following biogeochemical cycles: hydrological, carbon, nitrogen, and phosphorus.

- List at least three effects of humans on the cycling of nutrients in the biosphere.
- Using one or two sentences for each item, define each of the following environmental issues and explain the contribution of human technological advances to each: eutrophication, thermal pollution, acid rain, the greenhouse effect, deforestation, and the introduction of invasive species.

CONSERVATION BIOLOGY

- Define the following terms using one sentence for each term: conservation biology, restoration ecology, and biodiversity (including genetic diversity, species diversity, and ecosystem diversity).
- List the key benefits of biodiversity, and discuss in one short paragraph several threats to biodiversity.
- Define population conservation, and explain in three to four sentences the goals of this endeavor.
- Using one or two sentences, state the meaning and consequences of the extinction vortex.
- List the objectives of restoration ecology.
- Define sustainable development and explain its benefits in three to four sentences.

WRITTEN REPORT AND ORAL PRESENTATION

The instructor will give the format and topic for the written and oral presentation.