

Course Outline
Majors Biology II (Plant Biology)

Course Description:

BI 130 Majors Biology II (Plant). 5 hours credit. This is part of a two semester course for perspective biology majors; offered spring semester only. Three hours of lecture and four hours of laboratory per week. The concepts covered in this course include: molecular and cellular basis of life, ecology, development and cancer, energy metabolism, evolution, anatomy and physiology of plants, and a survey of microscopic organisms and multi-cellular plants.

Required Textbook:

Mader, S.; Biology, 7th Ed., McGraw Hill, 2001.

Palladino, M. Biologylabs On-line, Addison Wesley, 2000.

Course Objectives:

At the successful completion of this course, the student should be able to:

1. Apply the scientific process, recognize chemical molecules and cell structures.
 - a. Describe the steps in the scientific process and how each relates to a specific area in a scientific paper
 - b. Describe the differences between a hypothesis, fact and interpretation
 - c. Be able to design an experiment in which you can identify the control, independent and dependent variables, state the hypothesis in a predictive form and null and alternative hypothesis
 - d. Describe the difference between a proximate and ultimate question
 - e. Describe the significant parts of Koch's experiment that proved one species causes one disease. Describe the importance of verifying that the bacteria was present or absent in the blood used in the injections and in the injected subjects. Describe what was necessary to prove his point conclusively
 - f. Diagram the structural formula from the empirical formula for a given molecule
 - g. Recognize the structural formulas of the following kinds of molecules: glucose, fructose, sucrose, maltose, starch, fat or triglyceride (saturated and unsaturated), amino acid, protein (primary, secondary and tertiary structure), peptide bond and the structure of nucleic acid and nucleotide
 - h. Describe the following cellular parts: cell wall, cell membrane, nucleus, centriole, ribosome, endoplasmic reticulum (smooth and rough), golgi body, mitochondria, chloroplast, flagella, cilia

- i. Describe the ionic structure of sodium chloride, ionic bond and how it compares with the covalent bond
- j. Describe the three major points of the cell theory and the significance of each
- k. Describe the direction of flow of water across a differentially permeable membrane in hypotonic, hypertonic and isotonic solutions
- l. Describe the structure of the cell membrane and the roles the double phospholipid layer and proteins play in its operation
- m. Describe the difference between diffusion and active transport
- n. Describe the major differences between prokaryote and eukaryote cells
- o. Describe the major differences between eukaryotic plant and animal cells
- p. Describe the basis for the five kingdoms as based on cell structure
- q. Identify the major characteristics, significance and examples of the following classes of organisms: eubacteria, photosynthetic bacteria, gymnocota, euglenoids, dinoflagellates, chyrosophyta, chlorophyta (filamentous and colonial), sarcodina, sporozoa, ciliophora, mastigophora, phaenophyta and rhodophyta.

2. Describe the major events in cell respiration and photosynthesis

- a. Name the four factors that control the rate of reactions and explain how each affects the number of appropriate collisions
- b. Describe the four characteristics of an enzyme and use the reaction between sucrose and sucrase as illustration of each of these characteristics
- c. Describe how the energy of the reactants, products and the energy of activation are related in a chemical reaction
- d. Describe how an oxidation/reduction reaction differs from a reaction between molecules where atoms are exchanged
- e. Describe how cytochrome molecules and carrier molecules differ in function
- f. Describe how photon of light can produce an excited electron and how energy can be obtained from the excited electron in light reactions in photosynthesis
- g. Describe the difference between cyclic and non-cyclic photophosphorylation
- h. Describe the main events that occur in Photosystem I and Photosystem II and how they are related to one another
- i. Describe how the dark reaction is connected to the light reaction
- j. Describe the major events that occur in the dark reaction
- k. Explain how the dark reaction is limited by accumulation of oxygen and how this represents "feedback inhibition"
- l. Describe how the structure of the chloroplast facilitates the process of photosynthesis

- m. Describe the roles of the various pigments play in photosynthesis
- n. Describe the relationship between chemical reactions, products and reactants between photosynthesis and cell respiration
- o. Describe the major differences between aerobic and anaerobic respiration
- p. Describe the major events that occur during glycolysis, bridge reaction, Krebs cycle and electron transport chain
- q. Describe how other carbohydrates, fats and proteins enter into the cell respiration process.

3. Describe process of development and relate it to cancer.

- a. Relate the mitosis, growth, meiosis and reproduction to the life cycle
- b. Differentiate between haploid and diploid states
- c. Describe the major events in each phase of the cell cycle
- d. Describe the major events that occur during fertilization and why this represents such a unique process
- e. Describe how cleavage differs from normal cell division
- f. Describe the major events that occur during gastrulation and how this differs in a chicken egg and frog egg
- g. Describe the major kinds of system that subsequently develop from ectoderm, mesoderm and endoderm
- h. Describe significance of cloning to the idea of what happens during development
- i. Describe Spemann's classic experiment that led to the idea of induction. Be sure to identify the controls and the evidence that proved that induction occurred
- j. Describe induction process for the development of the eye, front limb of a bird, digits of vertebrates. Relate diffusion gradient to the process of development
- k. Describe potency and specialization as it applies Waddington's epigenetic landscape and channeled patterns of development
- l. Describe the significance of the Homeobox genes to the development of anterior/posterior axis
- m. Describe basis of gene regulation
- n. Describe how gene regulation of Homeobox genes fit into the pattern of development
- o. Describe how gene regulation, development and cancer may be related.

4. Describe diversity of structure and reproduction

- a. Describe the life cycle stages of green algae *Ulva* using the terms: meiosis, fertilization, diploid (2N), haploid (1N), sporophyte, gametophyte

- b. Describe the life cycle of the bread mold, *Rhizopus*, for both sexual and asexual reproduction
- c. Describe the major structures of Basidiomycetes group: gills, stalk, basidium, basidiospores
- d. Describe the unique anatomical and reproductive processes found in the Kingdom Fungi
- e. Describe the major structural advances found in Bryophytes over algae
- f. Describe the life cycle stages in a typical moss using the terms: meiosis, fertilization, diploid (2N), haploid (1N), sporophyte, gametophyte, protonema, archegonium, antheridium
- g. Describe the major structural advances found in ferns over bryophytes
- h. Describe the major stages and processes in the life cycle of ferns using the terms: meiosis, fertilization, diploid (2N), haploid (1N), sporophyte, gametophyte, prothallus
- i. Describe the major stages and processes in the life cycle of gymnosperms using the terms: meiosis, fertilization, diploid (2N), haploid (1N), sporophyte, gametophyte, microsporangium, macrosporangium, microgametophyte, macrogametophyte, seed cone, staminate cone, pollen, seed
- j. Using the life cycles of bryophytes, ferns and gymnosperms describe the major evolutionary trends in life cycles of plants.

5. Describe the structure and physiology of plants.

- a. Describe the roles of the various parts of the flower and the process of how pollination and fertilization lead to the development of a seed and a fruit
- b. Describe the major structural differences between monocots and dicots in terms of seed structure, flower, leaf, and stem structure
- c. Describe the functions of the epidermis, vascular bundle (phloem and xylem), pith in stem structure
- d. Describe how shoot apical meristem and lateral buds lead to development of shoots and leaves
- e. Describe the structure of root tissue and explain how root elongation and lateral roots develop
- f. Describe the structure of a woody stem and explain how growth occurs in woody branches producing the "rings"
- g. Describe the structure of leaf and relate it to transpiration
- h. Describe the movement of water
- i. Describe the transport of solutes
- j. Describe double fertilization
- k. Outline the events in seed germination
- l. Describe the effects of plant hormones
- m. Describe day length and flowering process.

6. Describe the evidences and process of evolution

- a. Describe the Hardy-Weinberg principle and the assumptions underlying it
- b. Describe which factors cause changes in gene frequencies in a population and the effect of each
- c. Describe Linnean system of classification and definition of a species
- d. Compare the assumptions and prediction of the fixed and evolving species models
- e. Describe the four steps involved in the process of natural selection
- f. Describe how the fossil record, comparative anatomy, comparative embryology, comparative biochemistry all provide evidence for common ancestry
- g. Describe the significance of make-shift adaptations to Paley's contention to idea of perfectly designed organisms
- h. Describe convergent evolution and use examples from placental and marsupial mammals to support the idea
- i. Describe the evidence of natural selection in the peppered moth
- j. Describe the evidence in the Galapagos finches
- k. Describe the steps involved in speciation process
- l. Describe how flightless birds originated according to the fixed species and evolving species models
- m. Describe the evidences that the Archaeopteryx represents a missing link
- n. Choose the fixed or evolving species model and use characteristics of a good model to support your choice.

7. Describe the concepts involved in ecology and relate them to man's activities

- a. Define what a species represents ecologically and explain how this definition reflects the underlying philosophy of the Endangered Species Act
- b. Describe the interactions involved in the following kinds of ecological interactions and give examples of each from El Dorado Lake field trip and from the Aspen film: competition, mutualism, predation, parasitism, commensalism
- c. Describe the differences between food chain and food web and be able to give examples of each
- d. Describe the roles of the following trophic levels play in an ecosystem in terms of energy transfer: producers, consumers (primary, secondary and tertiary) and decomposers. Be able to give examples from the El Dorado field trip and Krill of Antarctica film
- e. Describe the kinds of energy states that exist in the flow of energy through an ecosystem
- f. Describe the nutrient cycle through an ecosystem

- g. Be able to describe what an ecosystem represents, give examples of energy flow and nutrient cycles through Antarctic Ocean or forest along nature trail at El Dorado Lake
- h. Describe the rule of energy transfer and explain why the maximum amount of transfer is 10% or less
- i. Describe what bioaccumulation represents and give and interpret an example
- j. Describe the carbon cycle in the biosphere. Include the chemical reactions involved in respiration and photosynthesis and explain how plants and animals are interdependent. Also describe other sources of carbon sources and sinks (losses of carbon from biosphere)
- k. Describe how the carbon cycle is related to greenhouse warming effect. Be specific
- l. Describe the major consequences of global warming and some ways to prevent or slow this down from happening
- m. Diagram and explain the population growth curves and what they mean
- n. Describe the four factors that affect population changes
- o. Describe what carrying capacity represents and give examples
- p. Describe how population structure, number of offspring and age of females affects the rate of population growth
- q. Describe the role of the ozone layer, what has caused its destruction in our atmosphere and the consequences.

Topical Outline of Units:

I. Scientific process, chemistry and cells

- a. scientific process
- b. application of scientific method
- c. structural and empirical formula
- d. molecular molecules
- e. cell components
- f. ionic versus covalent bond
- g. cell theory
- h. diffusion
- i. cell membrane structure
- j. cell membrane function
- k. diffusion versus active transport
- l. five kingdoms
- m. classification

II. CELLULAR METABOLISM

- a. chemical reaction dynamics
- b. enzyme characteristics

- c. enzyme reactions
- d. oxidation-reduction reaction
- e. cytochromes and carrier molecules
- f. excited electrons
- g. cyclic and non-cyclic photophosphorylation
- h. photosystems I and II
- i. light and dark reactions in photosynthesis
- j. feedback inhibition
- k. chloroplast structure and function
- l. pigments
- m. comparison photosynthesis and cell respiration
- n. aerobic and anaerobic respiration
- o. components of cell respiration
- p. other molecules and cell respiration

III. Development

- a. life cycles
- b. cell cycle
- c. fertilization
- d. pre-organ development
- e. cloning
- f. history of induction
- g. examples of induction
- h. potency
- i. homeobox
- j. Gene regulation as related to development
- k. Cancer stages and relation to development

IV. PLANT DIVERSITY

- a. algal life cycles
- b. fungi life cycles
- c. fungi characteristics
- d. bryophyte life cycle
- e. fern life cycle
- f. comparison of bryophyte and fern
- g. gymnosperm life cycle
- h. trends in life cycles
- i. Flowering plants
- j. Trends in plant structure and life cycles

V. PLANT STRUCTURE AND FUNCTION

- a. flower life cycle
- b. monocot and dicot

- c. apical meristem and growth
- d. root growth
- e. woody stem structure
- f. movement of water
- g. movement of solutes
- h. Plant hormones
- i. Flowering Process

VI. Evolution

- a. Hardy-Weinberg principle
- b. factors that cause change
- c. classification system
- d. fixed versus evolving species model
- e. evidences of evolution
- f. process of natural selection
- g. peppered moth
- h. steps in speciation
- i. flightless birds

VII. Ecology

- a. species concept
- b. ecological interactions
- c. ecosystem components
- d. nutrient cycle
- e. energy flow
- f. bioaccumulation
- g. carbon cycle
- h. global warming
- i. growth curves
- j. factors of population growth
- k. carrying capacity
- l. ozone problem
- m. Water Pollution

Methods of Evaluation:

The following activities will be used during the course: lecture, class discussions, small work groups, field trips, guest lecturers, demonstrations and textbook reading assignments.

Methods of Instruction:

The following activities will occur during the course: lecture, field trips, demonstrations, discussions, videos and textbook reading assignments.