

Advanced Placement Biology Topic Outline

2004-2005

Instructor: Mrs. K. King

I. Molecules and Cells

25% of course

Cells are the structural and functional units of life; cellular processes are based on physical and chemical changes.

A. Chemistry of Life

1. Water (Chapters 1-3)

- How do the unique chemical and physical properties of water make life on Earth possible?
- Be able to explain how some life processes directly rely on these properties.

2. Organic molecules in organisms (Chapter 4 and 5)

- What is the role of carbon in the molecular diversity of life?
- How do cells synthesize and break down macromolecules?
- How do structures of biologically important molecules account for their functions?

3. Free energy changes (Chapter 6)

- How do the laws of thermodynamics relate to the biochemical processes that provide energy to living systems?
- What is activation energy and why is it needed?

4. Enzymes (Chapter 6) **Lab #2**

- How do enzymes regulate the rate of chemical reactions?
- How does the specificity of an enzyme depend on its structure?
- How is the activity of an enzyme regulated?

B. Cells

1. Prokaryotic and eukaryotic cells (Chapter 7)

- What are their similarities and differences?
- What are their evolutionary differences?

2. Subcellular organization (Chapter 7)

- How does compartmentalization organize a cell's function?
- How are the structures of various subcellular organelles related to their functions?
- How do organelles function together in cellular processes?
- What factors limit cell size?

3. Membranes (Chapter 8) **Lab #1**
 - What is the current model of the molecular architecture of membranes?
 - How do variations in this structure account for functional differences among membranes?
 - How does the structural organization of membranes provide for transport and recognition?
 - What are various mechanisms by which substances cross membranes?

4. Cell Cycle and its regulation (Chapter 12) **Lab #3**
 - How does the cell cycle assure genetic continuity?
 - How does mitosis allow for the even distribution of genetic information to new cells?
 - What are the mechanisms of cytokinesis?
 - How is the cell cycle regulated?
 - How can aberrations in the cell cycle lead to tumor formation?

C. Cellular Energetics (Chapter 6)

1. Coupled reactions
 - What is the role of ATP in coupling the cell's anabolic and catabolic processes?
 - How does chemiosmosis function in bioenergetics?

2. Fermentation and cellular respiration (Chapter 9) **Lab #5**
 - How are organic molecules broken down by catabolic pathways?
 - What is the role of oxygen in energy-yielding pathways?
 - How do cells generate ATP in the absence of oxygen?

3. Photosynthesis (Chapter 10) **Lab #4**
 - How does photosynthesis convert light energy into chemical energy?
 - How are the chemical products of the light-trapping reactions coupled to the synthesis of carbohydrates?
 - What interactions exist between photosynthesis and cellular respiration?

II. Heredity and Evolution

25% of course

Heredity events control the passage of structural and functional information from one generation to the next.

A. Heredity

1. Meiosis and gametogenesis (Chapter 13)

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- What features of meiosis are important in sexual reproduction?
 - Why is meiosis important in heredity?
 - How is meiosis related to gametogenesis?
 - What are the similarities and differences between gametogenesis in animals and gametogenesis in plants?
2. Eukaryotic chromosomes (Chapter 15 and 19)
- How is genetic information organized in the eukaryotic chromosome?
 - How does this organization contribute to both continuity of and variability in the genetic information?
3. Inheritance patterns (Chapter 14) **Lab #7**
- How did Mendel's work lay the foundation of modern genetics?
 - What are the principle patterns of inheritance?
- B. Molecular Genetics
1. RNA and DNA structure and function (Chapter 16 and 17)
- How do the structures of nucleic acids relate to their functions of information storage and protein synthesis?
 - What are the similarities and differences between prokaryotic and eukaryotic genomes?
2. Gene regulation (Chapter 18)
- What are some mechanisms by which gene expression is regulated in prokaryotes and eukaryotes?
3. Mutation (Chapter 16)
- In what ways can genetic information be altered?
 - What are some effects of these alterations?
4. Viral structure and replication (Chapter 18)
- What is the structure of viruses?
 - What are the major steps in viral reproduction?
 - How do viruses transfer genetic material between cells?
5. Nucleic acid technology and application (Chapter 20) **Lab #6**
- What are some current recombinant technologies?
 - What are some practical applications of nucleic acid technology?
 - What legal and ethical problems may arise from these applications?

C. Evolutionary Biology

1. Early evolution of life (Chapter 26)
 - What are the current biological models for the origins of biological macromolecules?
 - What are the current models for the origins of prokaryotic and eukaryotic cells?
2. Evidence for evolution (Chapter 23 and 24)
 - What types of evidence support an evolutionary view of life?
3. Mechanisms of evolution (Chapter 24) **Lab #8**
 - What is the role of natural selection in the process of evolution?
 - How are heredity and natural selection involved in the process of evolution?
 - What mechanisms account for speciation and macroevolution?
 - What different patterns of evolution have been identified and what mechanisms are responsible for each of these patterns?

III. **Organisms and Populations**

50% of course

The relationship of structure to function is a theme that is common to all organisms; interaction of organisms within their environment is the major theme in ecology.

A. Diversity of Organisms

1. Evolutionary patterns (Chapter 40)
 - What are the major body plans of plants and animals?
2. Survey of the diversity of life (Chapters 27-34)
 - What are representative organisms from the Bacteria, Archaea, and Eukarya?
 - What are representative members of the major animal phyla and plant divisions?
3. Phylogenetic classification (Chapters 27-34)
 - What are the distinguishing characteristics of each group (domains, kingdoms, and the major phyla and divisions of animals and plants)?
4. Evolutionary relationships (Chapter 25)
 - What is some evidence that organisms are related to each other?
 - How do scientists study evolutionary relationships among organisms?
 - How is this information used in classification of organisms?

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B. Structure and Function of Plants and Animals

1. Reproduction, growth, and development (Chapters 35, 38, 46, and 47) **Lab #9**
 - What patterns of reproduction and development are found in plants and animals and how are they regulated?
 - What is adaptive significance of alternation of generations in major groups of plants?
2. Structural, physiological, and behavioral adaptations (Chapters 36, 37, 42, and 51) **Lab #10 and #11**
 - How does the organization of cells, tissues and organs determine structure and function in plant and animal systems?
 - How are structure and function related to various organ systems?
 - How do the organ systems of animals interact?
 - What adaptive features have contributed to the success of various plants and animals on land?
3. Response to the environment (Chapters 39, 48, and 49)
 - What are the responses of plants and animals to environmental clues, and how do hormones mediate them?

C. Ecology

1. Population Dynamics (Chapter 52)
 - What models are useful in describing the growth of a population?
 - How is population size regulated by abiotic and biotic factors?
2. Communities and ecosystems (Chapter 53 and 54) **Lab #12**
 - How is energy flow through an ecosystem related to trophic structure (trophic levels)?
 - How do elements (carbon, nitrogen, phosphorous, sulfur, and oxygen) cycle through the ecosystems?
 - How do organisms affect the cycling of elements and water through the biosphere?
 - How do biotic and abiotic factors affect community structure and ecosystem function?
3. Global issues (Chapter 55)
 - In which ways are humans affecting biogeochemical cycles?