Advanced Placement (AP) Biology

Major Themes: There are eight major themes that recur throughout the AP Biology course.

I. Science as a Process:
Science is a way of knowing. It can involve a discovery process using inductive reasoning, or it can be a process of hypothesis testing.

Example: The theory of evolution was developed based on observation and experimentation.

II. Evolution:
Evolution is the biological change of organisms that occurs over time and is driven by the process of natural selection. Evolution accounts for the diversity of life on Earth.

Example: Widespread use of antibiotics has selected for antibiotic resistance in disease-causing bacteria.

III. Energy Transfer:
Energy is the capacity to do work. All living organisms are active (living) because of their abilities to link energy reactions to the biochemical reactions that take place within their cells.

Example: The energy of sunlight, along with carbon dioxide and water, allows plant cells to make organic materials, synthesize chemical energy molecules, and ultimately release oxygen to the environment.

IV. Continuity and Change:
All species tend to maintain themselves from generation to generation using the same genetic code. However, there are genetic mechanisms that lead to change over time, or evolution.

Example: Mitosis consistently replicates cells in an organism; meiosis (and hence sexual reproduction) results in genetic variability.

V. Relationship of Structure to Function:
The structural levels from molecules to organisms ensure successful functioning in all living organisms and living systems.

Example: Aerodynamics of a bird's wing permits flight.

VI. Regulation:
Everything from cells to organisms to ecosystems is in a state of dynamic balance that must be controlled by positive or negative feedback mechanisms.

Example: Body temperature is regulated by the brain via feedback mechanisms.

VII. Interdependence in Nature:
Living organisms rarely exist alone in nature.

Example: Microscopic organisms can live in a symbiotic relationship in the intestinal tract of another organism; the host provides shelter and nutrients, and the microorganisms digest the food.

VIII. Science, Technology, and Society:
Scientific research often leads to technological advances that can have positive and/or negative impacts upon society as a whole.

Example: Biotechnology has allowed the development of genetically modified plants.

AP Biology Unit Outline: The percentages listed beside the topics on the outline represent the weight given to that topic on the AP exam as determined by the College Board. The 12 AP labs are indentified under the appropriate topic.

I. Molecules and Cells……...25%

A. Unit 1: The Chemistry of Life (Chapter 3, 4, 5, 8)**…..…….7%**
- Water
- Organic molecules in organisms
- Free energy changes
- Enzymes

B. Unit 2A: Cell Structure & Function (Chapter 6, 7, 11, 12) **…….10%**
- Prokaryotic and Eukaryotic cells
- Membranes
- Sub-cellular organization
- Cell cycle and its regulation

C. Unit 2B: Cellular Energetics and the Cell Cycle (Chapter 8, 9, 10)**……...8%**
- Coupled reactions
- Fermentation and Cellular Respiration
- Photosynthesis

D. Labs:
- Diffusion and Osmosis
  - *Measure the water potential of a solution in a controlled experiment*
  - *Determine the osmotic concentration of living tissue*
  - *Describe the effects of water gain or loss in animal and plant cells*
- Enzyme Catalyst
  - *Measure the effects of changes in temperature, pH, ion concentration and enzyme concentration on the reaction rates of an enzyme catalyze reaction in a controlled experiment (energy transfer)*
- Cell Respiration
  - *Relate oxygen consumption to respiration rate*
  - *Test the effect of temperature on the rate of cell respiration rate in ungerminated versus germinated seeds in a controlled experiment*
- Plant Pigments and Photosynthesis
  - *Separate pigments and calculate their R_f values*
  - *Measure percent of light transmitted to determine rate of photosynthesis*
  - *Explain why the rate of photosynthesis varies under different environmental conditions*

II. Heredity and Evolution……..……25%

A. Unit 3A: Heredity (Chapter 13, 14, 15 **)…….…… ……8%**
- Meiosis and gametogenesis
- Eukaryotic chromosomes
- Inheritance patterns

B. Unit 3B: Molecular Genetics (Chapter 16-21**)……..9%**
- RNA and DNA structure and function
- Gene regulation
- Mutations
- Viral structure and replication
- Nucleic acid technology and applications

B. Unit 4: Evolutionary Biology (Chapter 22-26) **…….……8%**
- Early evolution of life
- Evidence for evolution

Mechanisms of evolution

C. Labs:

Mitosis and Meiosis

Recognize the stages of mitosis in plant and animal cells
Calculate the relative duration of the cell cycle stages
Use chromosome models to demonstrate the activity of chromosomes during meiosis I and meiosis II
Describe how independent assortment and crossing over can generate genetic variation among the products of meiosis
Compare and contrast the results of meiosis and mitosis
Calculate the map distance of a particular gene from a chromosome's center or between two genes using a model organism
Compare and contrast the results of meiosis and mitosis in plant cells
Compare and contrast the results of meiosis and mitosis in animal cells

Molecular Biology

Use plasmids as vectors to transform bacteria with a gene for antibiotic resistance in a controlled experiment
Demonstrate how restriction enzymes are used in genetic engineering
Use electrophoresis to separate DNA fragments
Describe the biological process of transformation in bacteria
Calculate transformation efficiency
Design a procedure to select positively for antibiotic resistant transformed cells
Determine unknown DNA fragment sizes when given DNA fragments

Genetics of Organisms

Investigate the independent assortment of two genes and determine whether the two genes are autosomal or sex-linked using a multi-generation experiment
Analyze the data from their genetic crosses using chi-square analysis techniques

III. Organisms and Populations……50%

A. Unit 5: The Evolutionary History of Biological Diversity (Chapter 25-34)**…….8%**
(Diversity of Organisms)

Evolutionary patterns
Survey of the diversity of life
Phylogenetic classification
Evolutionary relationships

B. Unit 6: Plant Form and Function (Chapter 35-39) **&**
Unit 7: Animal Form and Function (Chapter 40-49) **…….....32%**

Reproduction, growth and development
Structural, physiological and behavioral adaptations
Response to the environment

C. Unit 8: Ecology (Chapter 52-56)**……10%**

Population dynamics
Communities and ecosystems
Global issues

D. Labs:

Population Genetics & Evolution

Calculate the frequencies of alleles and genotypes in the gene pool of a population using the Hardy-Weinberg formula
Discuss natural selection and other causes of microevolution and deviations from the conditions required to maintain Hardy-

Weinberg equilibrium

Transpiration

- Test the effects of environmental variables on rates of transpiration using a controlled experiment
- Make thin sections of stem, identify xylem and phloem cells, and relate the function of these vascular tissues to the structures of their cells

Physiology of the Circulatory System

- Describe the effect of changing body position on heart rate and blood pressure
- Explain how exercise changes heart rate
- Discuss and explain the relationship between heart rate and temperature

Animal Behavior

- Lab done as project on individual's own time to explore science as a process
- Describe some aspects of animal behavior, such as orientation, behavior, agonistic behavior, dominance display, or mating behavior
- Interdependence in Nature

Dissolved Oxygen and Aquatic Primary Productivity

- Measure primary productivity based on changes in dissolved oxygen in a controlled experiment
- Investigate the effects of changing light intensity and/or inorganic nutrient concentrations on primary productivity in a controlled experiment
- Continuity and Change