

## **AP BIOLOGY**

### **Course Overview**

AP Biology is a college-level course taught in high school. All students are expected to work at a post-high school level. The goal of this course is to provide students with a learning environment that enables them to develop a solid understanding of the principal concepts of biology.

The eight major themes (*Science as a Process, Evolution, Energy Transfer, Continuity and Change, Relationship of Structure and Function, Regulation, Interdependence in Nature, and Science, Technology and Society*) are evident throughout the course. Every unit includes discussions on how the current topic relates to each theme.

The modern theory of evolution is emphasized in all units throughout year. Evolution is the underlying theme for understanding biology. Evolution as the foundation of modern biological and thought is stressed throughout the course. For example, during the topic of ‘Molecules and Cells’ we discuss the endosymbiotic theory of the origin of eukaryotic cells. In the ‘Heredity and Evolution’ section of the course, the Hardy-Weinberg theory is analyzed to examine population genetics. During the ‘Organisms and Populations’ section of the course, the evolution of land plants and the evolution of animals is discussed.

Students need grounding in the facts and vocabulary of biology, but the study of biology should not be limited to the memorization of disjointed facts. This course will stress understanding science as a process. Greater than twenty-five percent of the instructional time is dedicated to hands-on laboratory work. The students will complete all twelve AP Labs. All twelve of the labs are ‘wet-labs’. Students must answer the questions in the lab manual. A formal lab report is also required for the labs. Students must be able to formulate and test a hypothesis. They need to be able to collect, analyze, and present the data. Finally, students must be able to clearly discuss the results. Students will complete additional labs also. It is essential that the students understand science is a process rather than an accumulation of facts.

Throughout the course students will examine societal and environmental concerns. Students will use their biological knowledge and critical thinking skills to analyze and discuss solutions to various societal and environmental issues. For example, the

first lab activity of the year is titled, 'Oil Hungry Bacteria'. Students research and apply their knowledge to analyzing how bacteria can be used to clean oil spills. Students then design a lab to investigate what type of oils can be cleaned-up using the provided bacteria for the lab activity. There are numerous other times throughout the year that students will apply their biological knowledge and critical thinking to societal and social concerns. For example, during the molecular genetics unit, the students research and present a current topic in molecular genetics and discuss biotechnology topics.

This course meets for eighty-four minutes for the first two marking periods of the year, and then every other day for eighty-four minutes for the third and fourth marking periods.

### **Prerequisites**

Students entering AP Biology must have completed a biology class with a grade of 80 or above. Students should have also completed a chemistry course with a grade of 80 or above.

### **Grading**

Students will be evaluated on their performances on quizzes, tests, essays, laboratory activities, and homework assignments.

### **Texts**

Campbell, Neil A. and J. Reece. *Biology*. Sixth ed., Benjamin-Cummings. 2002.

Taylor, Martha R. Student Study Guide for Biology. Sixth ed., Benjamin-Cummings. 2002.

The College Board, *AP Biology Lab Manual for Students*, The College Board, 2001

Pack, Phillip C. *Cliffs Advanced Placement Biology Preparation Guide*. Second ed., 2001.

The following table covers the major areas of AP Biology

- I. Molecules and Cells
- II. Heredity and Evolution
- III. Organisms and Populations

<b><u>I. Molecules and Cells</u></b>
<b>Unit-</b> Introduction
<b>Chapters in Text</b> <ul style="list-style-type: none"><li>• Ch 1- Introduction: Ten Themes in the Study of Life</li></ul>
<b>Reading Assignments</b> <ul style="list-style-type: none"><li>• pp. 1-25</li></ul>
<b>Topics/Content</b> <ul style="list-style-type: none"><li>• <b><u>Eight Major Themes</u></b><ul style="list-style-type: none"><li>I. Science as a Process</li><li>II. Evolution</li><li>III. Energy Transfer</li><li>IV. Continuity and Change</li><li>V. Relationship of Structure and Function</li><li>VI. Regulation</li><li>VII. Interdependence in Nature</li></ul></li></ul>

VIII. Science, Technology and Society

**Students will apply biological knowledge and critical thinking skills to environmental and social concerns**

**Labs and Activities**

- Oil hungry bacterial lab (Covers themes I., II., III., IV., V., VI, VII., VIII.)

**Tests and Other Assessments**

- Study guide assignment

**Dates**

- 9/5-9/7

**Unit- 1- Chemistry of Life**

**Chapters in Text**

- Ch 2- The Chemical Context of Life
- Ch 3- Water and the Fitness of the Environment
- Ch 4- Carbon and the Molecular Diversity of Life
- Ch 5- The Structure and Function of Macromolecules
- Ch 6- An Introduction to Metabolism

**Reading Assignments**

- pp.26-103

**Topics/Content**

- Atomic structures
- Chemical bonding

- Molecule's biological function is related to its shape
- Characteristics of water
- Biological role of water
- Importance of water
- Functional groups
- Diversity of organic compounds
- Structure and function of carbohydrates, lipids, proteins, and nucleic acids
- Metabolic Pathways
- Transfer of Energy
- Structure and Function of Enzymes
- Control of Metabolism

#### **Labs and Activities**

- Water investigation lab
- Molecular models lab
- Enzyme/substrate models
- Toothpickase Lab
- AP Lab 2- Enzyme Catalysis

#### **Tests and Other Assessments**

- Study guide assignment
- Essays on isotopes, water, and organic compounds

- Test Chapters 1-5
- Enzymes thinking critically activity

**Dates**

- 9/8- 9/28

**Unit- 2- Cells****Chapters in Text**

- Ch 7- A Tour of the Cell
- Ch 8- Membrane Structure and Function

**Reading Assignments**

- pp. 106-151

**Topics/Content**

- Role of technology and the study of cells
- Characteristics of prokaryotic and eukaryotic cells
- Maximizing surface area to volume ratio concepts
- Cell organelles- structures and functions
- Compartmentalization
- Relationships amongst the organelles
- Endosymbiosis
- Cell surface interactions

- Structure and function of membranes
- Regulation of the transport of materials across membranes

**Labs and Activities**

- Creation of Cell Organelle Cards
- AP Lab 1- Diffusion and Osmosis
- Plasma Membrane Models

**Tests and Other Assessments**

- Cell cards
- Essays on cells, plasma membrane, and cell cycle
- Test Ch. 7, 8, 12

**Dates**

- 9/29-10/13

**Unit- 3- Cellular Energetics****Chapters in Text**

- Ch 9- Cellular Energetics
- Ch 10- Photosynthesis

**Reading Assignments**

- pp. 155-193

**Topics/Content**

- Energy yielding pathways

- ATP structure and function
- Coupled Reactions
- Process of cellular respiration including: glycolysis, Krebs cycle, electron transport
- Role of the inner mitochondrial membrane
- Fermentation
- Feedback mechanisms
- Role of chloroplasts
- Light reactions including: photosystem I and photosystem II
- Noncyclic vs. cyclic electron flow
- Comparison of chemiosmosis in mitochondria and chloroplasts
- Calvin cycle
- Alternate mechanisms of carbon fixation including: photorespiration, C<sub>4</sub> plants, CAM plants
- Endosymbiosis

**Labs and Activities**

- AP Lab 4- Plant Pigments and Photosynthesis
- AP Lab 5- Cellular Respiration
- Microscope plant lab- C<sub>4</sub> leaf anatomy sketches and how it relates to the C<sub>4</sub> pathway

**Tests and Other Assessments**

- Cellular respiration and photosynthesis thinking critically activity
- Essays on photosynthesis and cellular respiration
- Test on Ch. 9 and 10



**Dates**

- 10/16-10/31

**II. Heredity and Evolution****Unit 4- Heredity****Chapters in Text**

- Ch. 12- The Cell Cycle
- Ch 13- Meiosis and Sexual Life Cycles
- Ch 14- Mendel and the Gene Idea
- Ch 15- The Chromosomal Basis of Inheritance

**Reading Assignments**

- pp. 215-283

**Topics/Content**

- Structure of chromosomes
- Role of cell division
- Cell cycle and regulation of the cell cycle
- Mitosis in plants and animals
- Cancer cells escape cell cycle controls
- Role of meiosis in sexual life cycles
- Reduction of chromosome number
- Genetic variation amongst offspring

- Mendel
- Law of segregation, law of independent assortment
- Probability
- Genotype and phenotype relationship
- Pedigree analysis
- Technology and genetic testing
- Relationship between Mendelism and chromosomes
- Morgan's work
- Linked genes
- Crossing over
- Gene loci
- Sex-linked genes
- Genetic analysis of *Drosophila*
- Genetic disorders

**Labs and Activities**

- Human Chromosome Spread Lab
- Complete Lab 3- Mitosis and Meiosis
- Genetics word problems
- Analysis of pedigrees
- M and M Chi-Square Lab
- AP Lab 7- Genetics of Organisms

**Tests and Other Assessments**

- Meiosis quiz
- Mitosis, meiosis, and genetics thinking critically activity
- Genetics test
- Essay on genetics

**Dates**

- 11/1- 11/22

**Unit- 5- Molecular Genetics****Chapters in Text**

- Ch 16- The Molecular Basis of Inheritance
- Ch 17- From Gene to Protein
- Ch 18- Microbial Models: The Genetics of Viruses and Bacteria
- Ch 19- The Organization and Control of Eukaryotic Genomes
- Ch 20- DNA Technology and Genomics
- Ch 21- The Genetic Basis of Development

**Reading Assignments**

- pp. 287-421

**Topics/Content**

- History of the discovery of structure of DNA
- DNA replication and repair

- Role of enzymes and proteins
- The processes of transcription and translation
- Synthesis of proteins
- Structure and reproductive strategies of viruses
- Effects of viruses on other organisms
- Genetics of bacteria
- Genetic recombination
- Bacterial gene expression
- Lac operon and trp operon
- Genome organization at the DNA level
- Control of gene expression
- Molecular biology of cancer
- DNA cloning
- DNA analysis
- Restriction fragment analysis
- Polymerase chain reaction

**Labs and Activities**

- AP Lab 6- Molecular Biology
- PCR Lab

**Tests and Other Assessments**

- Essays on AP Labs 6, 7, DNA technology, and viruses

- DNA Quiz
- Biotechnology Presentations
- Molecular genetics test

**Dates**

- 11/28- 12/21

**Unit- Evolutionary Biology****Chapters in Text**

- Ch 22- Descent with Modification: A Darwinian View of Life
- Ch 23- The Evolution of Populations
- Ch 24- The Origins of Species
- Ch 25- Phylogeny and Systemics
- Ch 26- Early Earth and the Origin of Life

**Reading Assignments**

- pp. 426- 523

**Topics/Content**

- Historical background for evolutionary theory
- Darwinian revolution
- Natural selection
- Population genetics

- Microevolution
- Genetic variation
- Natural selection as the mechanism of adaptive evolution
- Biological species concept
- Prezygotic and postzygotic barriers
- Modes of speciation
- Macroevolution
- Phylogeny
- Fossil record
- Modern systemics
- History of life

**Labs and Activities**

- AP Lab 8- Population Genetics and Evolution

**Tests and Other Assessments**

- Evidence of evolution summaries
- Evolution essays
- Evolution test

**Dates**

- 12/22-1/16

### **III. Organisms and Populations**

#### **Unit- 7- Structure and Function Of Animals**

##### **Chapters in Text**

- Ch 40- An Introduction to Animal Structure and Function
- Ch 41- Animal Nutrition
- Ch 42- Circulation
- Ch 43- The Body's Defenses
- Ch 44- Regulating the Internal Environment
- Ch 45- Chemical Signals in Animals
- Ch 46- Animal Reproduction
- Ch 47- Animal Development
- Ch 48- Nervous System
- Ch 49- Sensory and Motor Mechanisms

##### **Reading Assignments**

- pp. 832-1084

##### **Topics/Content**

- Histology
- Structures and functions of the following: digestive, circulatory, respiratory, immune, endocrine, reproductive, special senses, nervous, and muscular systems

##### **Labs and Activities**

- Histology Lab

- AP Lab 10- Physiology of the Circulatory System
- Create neuron models
- Action potential lab
- Special senses activities

**Tests and Other Assessments**

- Histology Quiz
- Circulatory and respiratory systems quiz
- Anatomy and physiology essays
- Anatomy and physiology test

**Dates**

- 1/17- 2/20

**Unit- 8 - Diversity of Organisms****Chapters in Text**

- Ch 32- Introduction to Animal Evolution
- Ch 33- Invertebrates
- Ch 34- Vertebrate Evolution and Diversity
- Ch 27- Prokaryotes and the Origins of Metabolic Diversity
- Ch 28- The Origins of Eukaryotic Diversity
- Ch 31- Fungi
- Ch 29- Plant Diversity I: How Plants Colonized Land



- Ch 30- Plant Diversity II: The Evolution of Seed Plants

**Reading Assignments**

- pp. 633-709
- pp. 526-612

**Topics/Content**

- Evolution of animals
- Animal diversity
- Phylogenetic classification
- Invertebrate diversity
- Protostomia and Deuterostomia
- Chordates
- Structure and function of fungi
- Land plant evolution
- Alternation of generations
- Bryophytes
- Origin of vascular plants
- Pteridophytes
- Seed plant evolution
- Gymnosperms
- Angiosperms

**Labs and Activities**

- Dissection of earthworm, grasshopper, clam, crayfish, starfish, and perch
- Power point presentations on plant diversity

**Tests and Other Assessments**

- Animal test
- Animal essays
- Plant diversity test
- Plant essay

**Dates**

- 2/21- 3/27

**Unit- 9- Structure and Function of Plants****Chapters in Text**

- Ch 35- Plant Structure and Growth
- Ch 36- Transport in Plants
- Ch 37- Plant Nutrition
- Ch 38- Plant Reproduction and Biotechnology
- Ch 39- Plant Responses to Internal and External Signals

**Reading Assignments**

- pp. 718-828

**Topics/Content**

- Plant structure
- Plant growth
- Transport mechanisms in plants
- Plant nutrition
- Sexual and asexual reproduction in plants
- Plant adaptations
- Plant biotechnology
- Plant responses

**Labs and Activities**

- Plant microscope lab
- Plant structures lab
- AP Lab 9- Transpiration

**Tests and Other Assessments**

- Plant test
- Plant essays

**Dates**

- 3/28- 4/16

**Unit- 10- Ecology****Chapters in Text**

- Ch 50- An Introduction to Ecology and the Biosphere
- Ch 51- Behavioral Biology
- Ch 52- Population Ecology
- Ch 53- Community Ecology
- Ch 54- Ecosystems
- Ch 55- Conservation Biology

**Reading Assignments**

- pp. 1090-1245

**Topics/Content**

- Biomes
- Behavioral biology
- Population ecology
- Population-limiting factors
- Human population
- Community structure
- Flow of energy through an ecosystem
- Conservation biology
- Global warming
- Global issues, societal concerns, and environmental concerns

<b>Labs and Activities</b> <ul style="list-style-type: none"> <li>• AP Lab 11- Animal Behavior</li> <li>• AP Lab 12- Dissolved Oxygen and Aquatic Primary Productivity</li> </ul>
<b>Tests and Other Assessments</b> <ul style="list-style-type: none"> <li>• Ecology test</li> <li>• Ecology essay</li> </ul>
<b>Dates</b> <ul style="list-style-type: none"> <li>• 4/17- 4/30</li> </ul>
<p><b>REVIEW- Students will complete practice exams and essays in preparation for the AP EXAM. Students will complete review activities in class. Dates 4/1- 5/11</b></p> <p><b>AFTER the EXAM- Students will complete forensics activities after the AP Exam.</b></p>

## Major Themes

The eight major themes are integrated in each unit throughout the course. For example, in Unit 4- Heredity the following themes are discussed:

Theme 1- Science as a Process- Students read articles regarding how the structure of DNA was discovered.

Theme 2- Evolution- Students are asked to explain how mutations and genetic recombination generate heritable variations that are subject to natural selection.

Theme 3 -Energy Transfer- Student analyze how energy is used in the processes of DNA synthesis, transcription, and translation.

Theme 4- Continuity and Change- Students examine the natural selection leads to a change in gene pools over time.

Theme 5- Relationship of Structure and Function- Students explain how the structure of DNA is related to the function of DNA.

Theme 6- Regulation- Students analyze how the cell cycle is regulated

Theme 7- Interdependence in Nature- Students explain how an organism's adaptations allow it to survive in certain environments.

Theme 8- Science, Technology and Society- Students present biotechnology topics and debate the issues involved.