

Course Name: AP Biology

Course Overview

My Biology II and AP Biology courses conform to the standards set forth by the College Board. All topics are covered that are listed in the *AP Biology Course Description*. These topics include biochemistry, cell structure and function, cellular energetics, animal physiology, evolution, classification, animals, ecology, genetics molecular basis of inheritance, DNA technology and plants. Each of the aforementioned topics is integrated using the eight major themes from the AP Biology Curriculum Requirements.

Students perform the twelve recommended labs in the *AP Lab Manual for Students*. Additional labs have been implemented as well. Students are expected to collect data to solve biological problems. Labs take up about 25 percent of instructional time. [C8]

Classes meet everyday for 90 minutes. In order to take AP Biology students are required to take Biology II as a prerequisite (also a 90 minute class). In Biology II half of the AP material is covered with the remainder of the material covered in AP Biology. The following syllabus includes what is taught in Biology II and AP Biology. Students are required to read the chapters listed on the syllabus and at the end of each unit there is a unit test.

The objectives of the course are that each student shall

- Demonstrate skills using various types of biological instruments and scientific methodologies.
- Use the scientific method to solve scientific problems.
- Exhibit mastery of the major principles of biology.
- Apply biological knowledge and higher order thinking to environmental and social concerns.

I try to provide my students with a variety of teaching strategies that encourage both independent work and collaborative work.

- The eight major themes from the AP biology Course Description are stressed throughout the course. [C6] Evidence of evolution is a unifying theme that employed across all topics. [C5] The following is an example of how these themes are tied in.
 - Theme 1 – Science as Process – Students engage in a project (seed germination) to demonstrate the use of scientific reasoning to solve a problem.
 - Theme 2 – Evolution – Students are constantly evaluating the origins of behaviors, genomes, organelles, etc. This theme is a unifying theme and is discussed in each unit.
 - Theme 3 – Energy Transfer – Students are asked to describe the movement of energy within an ecosystem, originating with the sun and

- proceeding through the autotrophs where it is chemically converted and stored and then passed on to the heterotrophs or dissipated as heat.
- Theme 4 – Continuity and Change – Students are asked to consider how specific changes to an ecosystem can affect the organisms that live within it.
 - Theme 5 – Relationship of Structure to Function – Students consider how organisms are physically adapted to survive and reproduce in their environment. Students also consider how the structure of cellular organelles, individual cells, and tissues is related to its function.
 - Theme 6 – Regulation – Students are to understand the regulatory mechanisms of organisms and how these mechanisms aid or hinder its survival in particular environments. We discuss many types of feedback mechanisms when we do our unit on the systems.
 - Theme 7 - Interdependence in Nature – Students investigate how organisms interact with their environment and how survival would not be possible without these interactions.
 - Theme 8 – Science, Technology and Society – Students are asked to consider how the population growth of human beings has influenced local ecosystems throughout history, and how it continues to do so, even to the extent of affecting the biosphere.
- I am a very hands-on teacher and hands on activities are a large component of the course. My philosophy is that when students see it or do it they are able to make better connections with the topic. These activities often involve role playing or student simulations. For example, when we study photosynthesis, students are involved in a “photosynthesis dance”. Where the music symbolizes the light energy and students are assigned a role of electrons, ATP Synthase, etc.
 - Students are required to find journal articles and newspaper clippings and write summaries on the article’s content. These often times lead to discussions on ethical concerns. A recent issue that has been discussed is the requirement by some states of the cervical cancer vaccine. [C7]
 - Our school has laptop carts that classes are able to utilize and this has enabled me to use computer simulations. Students have performed simulations on blood typing, genetic engineering, populations, the cell cycle, immunology, and genetics. Sites that I use often are <http://nobelprize.org/> and <http://www.pbs.org/wgbh/nova/>. Students are provided with question sheets that guide them through the activity. I also use the activities that are on the CD-ROM for the Campbell’s book.

Text for Biology II and AP Biology

Campbell, Neil A. and J. Reece. *Biology*, 6th edition (2002)

Course Planner – Biology II

Unit 1. Molecular Biology (3 weeks) [C1]

Readings

- Themes of Biology, Chapter 1
- The Chemistry of Life Chapters 2,3,4, and 5

Lecture Topics

- Principles of Chemistry (atoms, molecules, bonds)
- Role of water and Carbon and the functional groups
- Organic Molecules – Carbohydrates, lipids, proteins, nucleic acids
- Enzymes: general properties of enzyme Activity

Lab

- Review of food tests that are used to identify different organic compounds (completed in previous biology course)
- Pineapple Enzymes & JELL-O Molds - Another in the series of Kitchen Chemistry labs to teach about the properties of proteins & enzymes.
- Toothpickase Lab – A brief activity that illustrates the effect of substrate concentration & temperature on enzyme function.
- AP Lab 2: Enzyme Catalysis [C8]
- Properties of Proteins: Kitchen Chemistry - Brief real-life exercise in effects of pH & temperature on protein structure.
- Seed Germination Lab –Scientific Method and formal lab write up [C6]
A simple lab teaching the process of scientific inquiry by studying factors affecting germination of lentil seeds.

Unit Test

Unit 2. Cell Biology (2 weeks) [C1]

Readings

- Chapters 7,8, and 11

Lecture Topics

- Design of prokaryotic and Eukaryotic cells; Comparing structure and function of individual cells
- Cell organelles - Structure and function
- Membrane structure and function , transport across the membrane
- Cell Signaling

Lab

- AP Lab 1: Diffusion and Osmosis [C8]
- Microscope Techniques – as found in most general lab books [C8]

- Cell Membranes - This lab is a kinesthetic activity that allows students to be creative in building their own models of cell membranes.
- Examination of Different Cell Types (Prokaryotes, eukaryotes (plant, animal)) [C8]

Unit Test

Unit 3. Cell Reproduction (1.5 weeks) [C2]

Readings

- The Cell Cycle and Meiosis, Chapters 12 and 13
-

Lecture Topics

- Significance of Mitosis and Meiosis
- Cell Cycle and regulation
- Compare and contrast mitosis in various eukaryotic organisms.
- Compare and contrast meiosis in eukaryotic organisms.
- Chromosomal abnormalities due to nondisjunction
- Alternation of Generations

Lab

- AP Lab 3 – Mitosis and Meiosis [C8]
- Mitosis Internet Tutorial from the University of Arizona biology project

Unit Test

Unit 4. Animal Form and Function (8 Weeks) [C3]

This unit is covered very thoroughly as the systems make a large component of our State's Biology II curriculum.

Readings

Chapters 40-49

Lecture Topics

- Digestive System Structure and Function
- Heart and circulatory system
- Respiratory system
- Immune System
- Osmoregulation and the excretory system
- Endocrine system
- Nervous system and sensory system
- Muscular System. Voluntary and involuntary muscles, muscular contraction
- Reproductive System
- Homeostasis
- Feedback Mechanisms

Lab

- AP Lab 10 –Physiology of the Circulatory System [C8]
- How are respiration rates of goldfish affected by temperature lab [C8]. Adapted from a lab that was provided at an AP Workshop
- Cow and pig kidney Dissection [C8]
- Fetal Pig Dissection [C8]

Project

Students trace outlines of their body on a large sheet of paper, and then place several pieces of plastic over top and staple to a dowel rod. As we cover each of the systems, students are to diagram to scale) each of the organs in each system. While they do this they are reflecting with one another on how structure and function of the organs are related and they get into discussions of the feedback mechanisms that are involved with each system. Students end up with a wonderful overlay of the human body that is personalized to them and a wealth of knowledge about each system. To top it off we do a brain cap activity as well. With this activity students use a swim cap to label the parts of the brain while they are learning about the different lobes and their functions.

Unit Tests are broken up within this unit

Unit 5. Animal Behavior (1 week) [C3] and [C5]

Readings

- Chapter 51
- Videos on Behavior

Lecture Topics

- Concepts of Behavior
- Learning
- Animal Cognition
- Social Behavior and Sociobiology

Lab

- AP Lab 11 General Observation of Behaviors [C8]

Unit 6. Mechanisms of Evolution and Diversity (2 weeks) [C2 and C5]

Readings

- Chapters 22-26

Lecture Topics

- History of Darwin and the voyage of the *Beagle*
- Evidence for Evolution
- Evolution in action today

- Modern synthesis, population genetics, Hardy-Weinberg law of equilibrium problems
- Natural Selection, microevolution events, types of selection, preservation of variation
- Speciation, prezygotic and postzygotic mechanisms, allopatric and sympatric speciation
- Gradualism. Punctuated equilibrium

Lab

- AP Lab 8 – Population Genetics and Evolution [C8]
- Hardy Weinberg Problems
- Natural Selection - A simulation of natural selection through a game of predator and prey in camouflaged butterfly populations.

Unit Test

Final Exam Review for Biology II

AP Biology Vacation Assignment – Survey of Animal Phyla Chapters 33-34.

Guided Reading on the Evolution of the Animal Phyla characteristics and diversity.

Course Planner - AP Biology

Unit 7. Diversity of Life (2 weeks) [C2,C3, and C5]

Readings

Chapters 27-32

Lecture Topics

- Three Domains
- Phylogenetic Trees
- Prokaryotes Characteristics and Diversity
- Eukaryotic Diversity
- Endosymbiosis
- Evolution of plants
- Animal Development

Unit 8 . Energy Transformation (3 weeks)

Readings

Photosynthesis and Respiration, Chapters 9-10

Lecture Topics

- Chloroplast Structure and Function
- Light reactions and Dark Reactions (Calvin Cycle)

- Comparison of C₃, C₄ and CAM pathways
- Overview of aerobic and anaerobic respiration
- Structure of Mitochondria and how related to function
- Glycolysis
- Krebs Cycle
- Electron Transport Chain and Chemiosmosis in Photosynthesis and respiration
- Substrate level and oxidative phosphorylation
- The role of Photosynthesis and respiration global warming [C6 and C7]

Lab

- AP Lab 4 Plant Pigments and Photosynthesis [C8]
- AP Lab 5 Cell Respiration [C8]
- Leaf-disk assays [C8]
- Examination of Stomata (*Zebrina* Plants) and Xylem in celery [C8]

Unit Test

Unit 9. Genetics (2 weeks) [C2]

Readings

Genetics Chapters 14-15

Lecture Topics

- Mendelian genetics, Laws of probability, segregation, and independent assortment
- Beyond Mendel – codominance, pleiotropy, epistasis, polygenic inheritance
- Human genetics
- Pedigree analysis
- Sex linkage, autosomal linkage, linkage maps

Lab

- M & M Chi Square Lab [C8]
- AP Lab 7 *Drosophila* [C8]
 - Students perform the actual lab and we also perform the lab virtually. Students are required to do a formal lab write up in which they analyze crosses that were assigned to them. Each student has been provided with a cross that involves a dominant trait, recessive trait, sex0linked trait, lethal, and a dihybrid. They must form hypotheses and perform a Chi-square analysis
- Students work problems and we go over the problems in class
- Research assignment on a genetic disorder. [C2 AND C7]
- Human Karyotype Lab – can be found in most lab manuals [C8]

Unit test

Unit 10. DNA Replication and Protein Synthesis (1.5 weeks)

Readings

Chapters 16 and 17

Lecture Topics

- Review characteristics of DNA
- DNA structure with structure of pyrimidines and purines
- Anti-parallelism in DNA
- DNA Replication with associated enzymes (Helicase, Topoisomeres, Primase, DNA Polymerase, Ligase, etc.)
- Three types of RNA

Lab

- DNA Extraction from Strawberries and Bananas[C8]

Unit 11. Genetics of Viruses and Bacteria, Eukaryotic Genomes and DNA Technology (2.5 weeks)

Readings

Chapters 18-20

Lecture Topics

- Bacteria Reproduction and Nutritional Modes
- Bacteria: classification and their roles, both harmful and beneficial
- Viruses: basic virus structure, reproduction
- AIDS and other important viruses
- Viroids, prions, emerging viruses
- Discussion of characteristics of cells that provides evidence of a common origin
- Biotechnology techniques: cloning, PCR, principles of electrophoresis, RFLP analysis
- Discussion of ethical issues with DNA Technology; for example insurance rights to screen based upon ones genes. [C6 AND C7]
- Control of gene Expression, Lac Operon

Lab

- Paper Labs – DNA scissors and DNA goes to the races from Carolina Biological Supply
- AP Lab 6:Transformation and Electrophoresis [C8]

Unit Test

Spring Break

Unit 12. Plant Diversity (2.5 Weeks)

Readings

Chapters 29-30, 35-39

Lecture Topics

- Alternation of Generations
- Angiosperm Structure and Growth
- Angiosperm Reproduction and growth
- Plant Control Systems

Lab

- Flower Dissection lab - can be found in most lab manuals [C8]
- Fruit Lab – can be found in most lab manuals [C8]
- AP Lab 9 Transpiration. [C8]

Unit 13. Ecology (2 weeks) [C3]

Readings

Chapters 50 and 52-55

Lecture Topics

- Biomes: aquatic and terrestrial biomes and the factors that influence them
- Community Ecology
- Ecological Succession, soil and its role in succession
- Ecosystem ecology, trophic structure, and productivity
- Population Ecology

Lab

- AP Lab 12 Dissolved Oxygen and Temperature

Independent Research

- Students use the Internet and other resources to determine the latitude, temperature range, rainfall, flora, fauna, and anything that is unique to their assigned biome. They provide their classmates with a brochure about their biome and give a presentation about their biome.
- Students are asked to find an example of the introduction of a non-native species to an environment. The student getting on closest to our own biome wins a prize. Students lead discussions about their non-native species and the affects on the local ecosystem. [C6 and C7]

Lab

- AP Lab 12 – Dissolved Oxygen and Temperature [C8]

Unit Test on Ecology

Unit14. Review (1-2 weeks)

Lab Component

Students complete all labs in the AP Biology Lab Manual for Students. These labs are completed exactly as stated in the manual or with small modifications to fulfill my course objectives. Students also complete labs that I have modified from other AP Biology teachers and textbooks. On average, students spend one to two days in lab a week, depending upon the topic. Students turn in some kind of lab write-up for each one. Students are encouraged to develop group and individual work skills, and these are part of the lab evaluation.

To stress biology as process, lab activities emphasize the development and testing of hypotheses, collection and analysis of data and a discussion of results [C4]. Each six weeks students complete a formal lab report on one of the labs that is being performed. In many cases I do use simulations in order to support student understanding. Before each lab I require students to complete a page of background information on that lab that is being performed. They are also required to complete the activities on Lab Bench (http://www.phschool.com/science/biology_place/labbench/) and answer pre-lab questions.

Student Evaluation

Students are evaluated in a number of ways that reflect the nature of the course. Tests are multiple choice questions and often include essay question from previous AP Exams. Student evaluation also includes quizzes, student projects, lab write-ups (formal and informal), research papers, presentations, homework assignments, lab practicals, and Science in the News articles.

Resources

Text

Campbell, Neil A. and J. Reece. *Biology*, 6th edition (2002)

Morgan, Judith Giles and M. Eloise Brown Carter. *Investigating Biology*, 4th Edition (2002)

Miller, Kenneth R. and Joseph Levine . *Biology*, (2002)
And accompanying Lab Manual that comes with the text

Internet Resources

<http://www.biology87.org/>

http://www.bio.kimunity.com/ap_biology/

<http://nobelprize.org/>

<http://www.pbs.org/wgbh/nova/>

Other

Communication with other AP Teachers through the AP Discussion Board. This has been a very valuable resource. Many of my labs have been adapted from teachers that have been willing to share a wealth of knowledge.