

AP Biology Syllabus

Course Description & Philosophy

AP Biology is designed to be a rigorous course that is equivalent to a first year college biology course. It aims to provide students with the conceptual background, analytical skills, and critical thinking skills to deal with the rapidly changing field of biology, and to foster an appreciation for this subject. The topics covered are those that are outlined by the College Board, and include units on Biochemistry, Cell Biology, Cellular Energetics, Molecular & Classical Genetics, Evolution, Plant & Animal Physiology, Ecology, and Biotechnology. The course is a combination of lecture, hands-on learning including an extensive lab component, class discussions, and cooperative learning. In addition, the rigorous nature of the course attempts to promote discipline, self-motivation and a responsible attitude in an effort to prepare students for college, and for productive careers beyond college.

The textbook for the course is the 6th edition of Neil A. Campbell & Jane B. Reece's *Biology*, which emphasizes major themes in biology similar to those outlined by the College Board in the AP Biology curriculum. In addition, the compatible website provides review activities, practice tests, and virtual labs. All of the labs from the AP Biology Lab Manual for Students are also integrated into the course.

Student Evaluation/Assessment

Students are evaluated through a combination of tests, formal and informal lab reports, cooperative learning projects, homework, participation in class discussions, notebook/portfolio, and other class work.

Summer Assignment

In June, students enrolled in AP Biology for the following September must attend a mandatory meeting in which they are informed of course expectations, and are given their summer assignment. During the summer, students are expected to complete readings on animal behavior, and are also expected to complete required lab 11, "Animal Behavior". In addition, students are informed that there will be a review test on the third day of school that covers all material from their first year biology course. This is to make sure this foundational information is fresh in their minds as they enter the AP course.

Unit 1- The Scientific Method & Unifying Themes in Biology

Readings

- Chapter 1

Lecture Topics

- Examples of the eight unifying themes in biology
- Real-life applications of the scientific method

Class Activities/Labs

- Blank table of unifying themes
 - Students are provided with a blank chart of the unifying themes in biology. **As we go through the course**, they are encouraged to fill in this chart with examples of each theme as they are encountered in the material
- Analyzing experimental design using the scientific method
- Use the scientific method to design a lab which proves or disproves a well known cliché (i.e. an apple a day keeps the doctor away)

Unit 2- Chemistry of Life

Readings

- Chapters 2-5, selected parts of 6

Lecture Topics

- Review of basic chemistry
- Principles of water & pH
- Organic chemistry & importance of carbon
- Structure & function of lipids, proteins, carbohydrates, & nucleic acids
- Enzyme structure & function

Class Activities/Labs

- Lab –“Acids, Bases, & pH”
 - Students test natural & synthetic buffers for their ability to withstand pH changes
- Molecule building using molecular modeling kits
- Demonstrations of special properties of water
- Applicable activities from compatible website
- Required AP lab 2-“Enzyme Catalysis”

Test on units 1 & 2

Unit 3-Cell Biology

Readings

- Chapters 7 & 8

Lecture Topics

- Cell structure & function
- Comparison of prokaryotic & eukaryotic cells, plant & animal cells
- Principles of diffusion & osmosis
- Transport in & out of cells

Class Activities/Labs

- Building a 3-D cell & class presentation (cooperative learning project)
- Required AP Lab 1-“Diffusion & Osmosis”
- Lab-“Plasmolysis of Onion Cells”
 - Students use light microscopes to compare onion cells in solutions of varying NaCl concentrations

Test on Unit 3

Unit 4-Cell Reproduction & Meiosis

Reading

- Chapters 12 & 13

Lecture Topics

- Mitosis & the cell cycle
- Control of the cell cycle/mitosis
- Meiosis
- Chromosomal abnormalities, Non-disjunction, polyploidy, and their relationship to disease

Class Activities/Labs

- Required AP lab 3-“Mitosis & Meiosis”

Test on unit 4

Unit 5-Classical genetics

Reading

- Chapters 14 & 15

Lecture topics

- Mendel’s contributions to genetics
- Predicting Probabilities of genetic crosses using statistical formulas & punnett squares
- Relationships between genes & alleles, including dominant/recessive, codominance, incomplete dominance, multiple alleles, epistasis, pleiotropy, & polygenic inheritance
- Gene linkage, including sex-linked genes
- Pedigree analysis
- Human Genetic diseases

Class Activities/Labs

- Required AP lab 7-“Genetics of Organisms”
 - Done on-line as a virtual lab using The Biology Place website (biocoach)
- Extensive practice solving a variety of genetics problems
- Chi Square analysis using Teddy Grahams & M&Ms

Test on unit 5

Unit 6-Molecular Genetics

Reading

- Chapters 16-19

Lecture Topics

- Scientists involved in the discovery of DNA
- Structure of DNA
- DNA replication
- Mutations
- Transcription
- Translation
- Operons
- Eukaryotic gene control

Class Activities/Labs

- DNA extraction using calf brains
- Building a 3-D model of DNA
- Using K'nex kits to simulate DNA replication & transcription
- Build a 3-D, movable model of translation

Test on Unit 6

Unit 7-Biotechnology

Reading

- Chapter 20, various internet readings

Lecture Topics

- Review of Basic biotechnology techniques/tools including
 - Restriction enzymes

- o Recombinant DNA
- o Cloning
- o PCR
- o DNA sequencing
- o Bioinformatics
- o Gel electrophoresis
- o Southern blotting
- o Micro array assays
- o cDNA
- o Probing

Class Activities/Labs

- Lab-“Transformation of E.coli Using the pGLO Plasmid”
- Lab –“Using Gel Electrophoresis to Determine Paternity”
 - o Both above labs replace required lab 6-Molecular Biology
- Creating a standard curve using gel electrophoresis data
- Paper simulations of PCR, DNA sequencing, & probing
- Bioinformatics activity
 - o Students must analyze a given DNA sequence using the data found on the NCBI website

Test on unit 7

Unit 8-Cellular Energetics

Reading

- Chapters 9 & 10, selected reading from chapter 6

Lecture Topics

- ATP structure, and function as an energy source
- Cellular respiration & fermentation, including glycolysis, Krebs’ cycle, & Electron transport chain
- Photosynthesis, including the light dependent & light-independent reactions
- C4 and CAM plants

Class Activities/Labs

- Required AP lab 5-“Cellular Respiration”
- Required AP lab 4-“Plant Pigments & Photosynthesis”
 - o This is done as a paper lab, due to lack of spectrophotometers

Test on unit 8

*** At this point, it is a week before Winter Break. We review in class for 2 days, and then students take the mid term exam. This exam is a 2-day exam, consisting of multiple choice on day 1, and essays on day 2.**

Unit 9-Evolution

Reading

- Selected parts of chapters 22-25

Lecture Topics

- Comparison of Darwin's theory with creationism, catastrophism, Lamarckism
- Evidence for Darwin's theory of descent with modification
- Population genetics, including the Hardy-Weinberg theory & equation
- Macroevolution versus microevolution, and cause of each
- Types of natural selection
- Speciation

Class Activities/Labs

- Extensive problem solving using the Hardy-Weinberg equation
- Required AP lab 8-“Population Genetics & Evolution”

Test on Unit 9

Unit 10-Taxonomy

Reading

- Selected parts of chapters 25, 27-28, 31-34

Lecture Topics

- Phylogeny, classification criteria
- Dichotomous keys
- 3 domain system of classification
- Basic characteristics of prokaryotes, protists, fungi
- Major evolutionary branchpoints in the development of animals
- Survey of major animal invertebrate phyla
- Comparison of vertebrate subphyla

Class activities/Labs

- Use of dichotomous keys to classify organisms
- Creation of a dichotomous key for students in the class
- Comparative anatomy dissection of earthworm, squid, clam, grasshopper, perch

Test on unit 10

Unit 11-Plant Physiology

Reading

- Chapters 29, 30, 35-39

Lecture Topics

- Evolution of land plants, including adaptations to terrestrial life
- Comparison of bryophytes, pteridophytes, & gymnosperms
- Structure of major cells, tissues & organs of angiosperms
- Angiosperm transport & the importance of transpiration
- Angiosperm reproduction & development
- Plant behavior & hormones

Class Activities/Labs

- Required AP lab 9-“Transpiration”
- Lab-“Effect of Auxin & Giberellin on Plant Growth”
 - Students use bean plants to observe the effects of these plant hormones on growth & development
- Observation of plants cells/tissues/organs using the light microscope

Test on unit 11

Unit 12-Animal Physiology –animal tissues & metabolism

Reading

- Chapters 40

Lecture topics

- Structure & function of the four types of animal tissues
- Comparison of metabolism in endotherms & ectotherms
- Biological feedback, comparison of positive & negative feedback

Class Activities/labs

- Use of light microscopes to observe various animal tissues

Test on Unit 12

Unit 13-Animal Physiology-the nervous system, senses, muscle structure & function

Reading

- Chapters 49 & 50

Lecture Topics

- Organization of mammalian nervous systems
- Structure of neurons
- Generation & propagation of an action potential
- Structure & function of synapses
- Structure & function of the vertebrate brain
- Structure & function of vertebrate eyes, ears, olfactory epithelium, & taste buds, including evolution of the above organs
- Microscopic & gross structure of muscles
- Muscle contraction

Class Activities/Labs

- Dissection of cow eye, sheep brain
- Lab-“Reflex Testing”
 - Students test such reflexes as knee-jerk reaction, pupil dilation, blinking reflex, plantar reflex

Test on Unit 13

Unit 14-Animal Physiology-excretory & endocrine systems

Reading

- Chapters 44 & 45, selected parts of chapter 11

Lecture Topics

- Relationship between the nervous & endocrine systems
- Chemical signals (hormones) & signal transduction pathways
- Structure of the vertebrate endocrine system
- Effects of major vertebrate hormones
- Thermoregulation

- Importance of water conservation for terrestrial animals & Disposal of nitrogenous waste
- Evolution & comparison of various animal excretory systems/structures
- Detailed structure & function of mammalian excretory system & kidney

Class Activities/Labs

- “Play the Endocrinologist”-students are given a list of patient symptoms and must diagnose which gland(s) is/are defective
- Dissection of pig kidney
- Lab-“Simulated Urinalysis”

Test on Unit 14

Unit 15-Animal Physiology-digestion

Reading

- Chapter 41

Lecture Topics

- Nutritional requirements of animals
- Comparison of feeding mechanisms in animals
- Comparison of complete & incomplete digestive systems
- Structure & function of the mammalian digestive system

Class Activities/Labs

- Diagram of cheeseburger digestion
 - Students must produce a detailed diagram explaining the digestion of a cheeseburger with lettuce & tomato, using as few words as possible
- Lab-“Gastric Juice”
 - Students examine the effects of pepsin, salivary amylase, & HCl on digestion of various types of foods

Test on Unit 15

Unit 16-Animal Physiology-circulation & respiration

Reading

- Chapter 42

Lecture Topics

- Evolutionary comparison of circulatory systems in animals

- Evolution of the vertebrate heart
- Mammalian heart, including structure, pathway of blood, beating of heart
- Cardiovascular disease & stroke, including bypass surgery
- Comparison of structure & function of blood vessels
- Composition of blood, including hematopoiesis
- Evolutionary comparison of gas exchange in animals
- Structure & function of mammalian respiratory system
- Mechanism of gas exchange within mammalian body
- Structure of respiratory pigments & oxygen-dissociation curves

Class Activities/Labs

- Dissection of calf heart
- Required AP lab 10-“Physiology of the Circulatory System”

Test on Unit 16

Unit 17-Animal Physiology-immune system

Reading

- Chapter 43, various internet sites

Lecture Topics

- Structure & function of the lymphatic system
- Nonspecific mammalian defenses
- Clonal selection & its relation ship to humoral & cell mediated immunity
- Secondary immune response
- Genetics of immunity
- Auto immune diseases, cancer, AIDS, organ transplants

Class Activities/Labs

- Use of internet to research cause, symptoms, prognoses, & epidemiology of specified communicable diseases
- Lab-“Simulated Blood Typing Whoduunit”
 - Students use the antigen antibody reaction to investigate a crime scene
- Lab-“Simulated ELISA for Mononucleosis”

Test on Unit 17

Unit 18-Animal Physiology-reproduction & development

Reading

- Chapters 46 & 47

Lecture Topics

- Comparison of sexual & asexual reproduction
- Comparison of internal & external fertilization, and importance of the amniotic egg
- Comparison of spermatogenesis & oogenesis
- Structure & function of the human male & female reproductive systems
- Female menstrual cycle
- Birth control methods
- Comparison of fertilization in humans & sea urchins
- Major events that occur during cleavage, gastrulation, neurulation, & organogenesis
- Major factors in differentiation, including cytoplasmic determinants, induction, homeobox genes, & organizers

Class Activities/Labs

- Observation of developmental stages of frogs & chickens using stereoscopes
- Infertility Project
 - Students simulate a group of relevant doctors who collaborate to give advice to a fictitious couple who are having trouble conceiving-project includes internet research so that students may recommend appropriate medical tests, infertility treatments, and other options
- Dissection of cat-dome as a culmination of the animal physiology unit

Test on unit 18

Unit 19-Ecology & Environmental Science

Reading

- Selected parts of chapters 50-55

Lecture Topics

- Food webs, trophic pyramids, 10% rule, biomagnification
- Biogeochemical cycles
- Population ecology, demography, histograms, k & r organisms
- Comparison of primary & secondary succession
- Comparison of major terrestrial & aquatic biomes
- Global warming, pollution, depletion of ozone layer, acid rain
- Alternative energy sources
- Biodiversity & sustainability

Class Activities/Labs

- Required AP lab 12-“Dissolved Oxygen & Primary Productivity”
 - Done on-line as a virtual lab using The Biology Place website (biocoach)

Test on this unit is incorporated into final exam

Review Unit

For the remainder of the course (usually 1-2 weeks, depending on the number of closures due to weather), we spend time reviewing for both the final exam and the AP Biology exam. This review consists of a mixture of the following

- Practice multiple choice questions
- Practice essay questions, including some where students evaluate each others essays
- Creating scoring rubrics for essays
- Various review games
- Discussion of completed “Themes of Biology” chart (see unit 1)

The course ends with a 2 day final exam, similar in format to the midterm exam (above).

Additional Review

In addition, since the course ends approximately 1 month prior to the AP exam, there are lunchtime review sessions scheduled twice a week, and 2 evening review sessions that run from approximately 5PM-8PM.

