

AP Biology Course Syllabus

Philosophy:

Biology is the study of living things and is one of the core scientific disciplines. Understanding biology is essential to the understanding of the diversity of life and how all life affects the environment. This course is designed to teach students the vital connection between biological principles and the processes of science, and to provide students with the solid conceptual foundation necessary to understand the expanding role of biology in modern life. It is also designed to aid students in developing their critical thinking skills so that they will be able to make well-informed decisions about their health and the health of the environment. Evolutionary themes are emphasized throughout the course so that students understand that these themes unify all of biological study.

Course Overview:

The class schedule is a block schedule. My AP class meets every day and alternates between 40 and 80 minutes every other day. Labs are scheduled every other day (2 for every 5 days) and the majority of the labs can be completed in one class period unless otherwise stated in this syllabus. If we are working on a lab that requires more than one period, then I will adjust the schedule to fit the need for more time. I cover all of the labs from the *AP Biology Lab Manual* along with other teacher created labs. For many of the labs, the students answer a pre-lab worksheet that allows them to practice writing hypotheses and to focus on what they will be expected to do in the lab. The students then write a lab report that requires them to organize, analyze and explain the results of the lab. The lab reports will be kept in a lab notebook. Students also design several of their own experiments and present their findings. After each chapter, the students take a test that includes teacher generated multiple choice and essay questions and questions taken from previous AP exams. Students are also required to read articles chosen from magazines such as *Scientific American* and *Discover* and write short discussion papers.

Organization:

I have organized this course into the three major themes designated by the *AP Biology Course Description* – Molecules and Cells, Heredity and Evolution, and Organisms and Populations. I attempt to integrate the eight themes (science as a process; evolution; energy transfer; continuity and change; relationship of structure to function; regulation; science, technology, and society; and interdependence in nature) into every unit. I also have attempted to organize the course so that students can observe the connections between structure and function and the similarities and differences between organisms.

Textbooks and other Materials:

Biology (6th ed.) by Neil Campbell and Jane B. Reece. (Benjamin Cummings: 2002) ISBN 0-8053-6624-5

AP Biology Lab Manual for Students (College Board)

Senior Biology 1 and 2 Student Resource and Activity Manuals 2007
(2006 Richard Allen – BIOZONE International Ltd.)

Online Resources from NIH, DNA Interactive, PBS and HHMI

Course Planner:

A. Molecules and Cells (15 weeks)

I. The Ten Themes in the Study of Life (Chapters 1 and 40)

What is Science?

The Processes of Science

Evolution – the unifying element of biology

The Characteristics of Life

Organization of Human Tissues

Functional Anatomy – Form reflects Function

Labs and activities:

The Nature of Science – hands on
Animal Behavior – AP Lab 11
Histology (comparing tissues) – Lab

2. The Chemical Context of Life (Chapter 2)

Atomic Structure
Chemical Bonds
Molecules

Labs and activities:

Building molecular models – hands on

3. Water and the Fitness of the Environment (Chapter 3)

Structure of Water
Properties of Water
Dissociation of Water

Lab and activities:

Water molecule kits – hands on
Dissolved Oxygen – AP Lab 12
Acids and Bases: making a homemade pH scale – Lab

4. Carbon and the Molecular Diversity of Life (Chapter 4)

The Unique Structure and Properties of Carbon
The Structure and Characteristics of Functional Groups

Labs and activities:

Building molecular models – hands on

5. The Structure and Function of Macromolecules (Chapter 5)

Carbohydrates
Proteins

Lipids
Nucleic Acids

Labs and activities:

Identifying Carbohydrates – Lab
Identifying Proteins – Lab
Identifying Lipids – Lab
Protein Folding Activity – hands on
Building a nucleotide – hands on

6. A Tour of the Cell (Chapters 7, 27, 28)

Cell Study Techniques
Comparison of Prokaryotic and Eukaryotic Cells
Evolution of the First Cells
Development of Eukaryotic cells
The Domains of Life
Cell Theory

Labs and activities:

Cell Structure (observing cheek, *Elodea* and onion cells) – Lab
The Cell Amusement Park – cell structures and functions

7. Membrane Structure and Function (Chapter 8)

Fluid Mosaic Model
Structure of the Cell Membrane
Components of the membrane
Membrane Carbohydrates
Membrane Proteins
Passive Transport
Active Transport

Labs and activities:

Diffusion – AP Lab 1
Osmosis – AP Lab 1
Endocytosis – problem solving

8. Regulating the Internal Environment (Chapters 40, 44)

Homeostasis – Regulation and Feedback

Osmoregulators

Water Balance

Waste Disposal

Evolution of the Kidney

The Vertebrate Kidney

The Mammalian Kidney

Labs and activities:

Urinalysis – Lab

9. Cell Communication (Chapter 7, 11)

Cell Surfaces and Junctions

Cell Signaling

Signal Receptors and Initiation of Transduction

Signal Transduction Pathways

Cellular Responses to Signals

Labs and activities:

Cell Signaling – hands on

10. Nervous Systems (Chapter 48)

Overview of Nervous Systems

Nature of Nerve Signals

Evolution and Diversity of Nervous Systems

Vertebrate Peripheral Nervous Systems

Vertebrate Central Nervous Systems

Labs and activities:

Lights, Camera, Actions – Nerve Impulse Simulation

Get the Point – Sensory Perception – Lab

11. Sensory and Motor Mechanisms (Chapter 49)

Sensory Reception
Photoreceptors and Vision
Hearing and Equilibrium
Chemoreceptors – Taste and Smell
Movement and Locomotion

Lab and activities:

Arm Muscle Simulation – Lab

12. Chemical Signals in Animals (Chapter 45)

Evolution of the Regulatory System
Chemical Signals and modes of action
Endocrine glands and their functions
Regulation of Body Functions

Labs and activities:

N/A

13. The Body's Defenses (Chapter 43)

Nonspecific defenses Against Infection
Mechanism of Specific Immunity
Types of Immune Responses
Immunity in Health and Disease
AIDS

Labs and activities:

Articles on HIV and AIDS

14. An Introduction to Metabolism (Chapter 40, 6)

Metabolic Pathways and rates
Laws of Thermodynamics
The Role of ATP
Enzymes and Enzymatic Activity
Control of Metabolism

Labs and activities:

Toothpickase – Lab
Enzyme Catalysis – AP Lab 2
 Q_{10} of *Daphnia magna* – AP Lab 10

15. Cellular Respiration: Harvesting Chemical Energy (Chapter 9)

Redox Reactions
ATP Use
Electron Transport Chain and Production of ATP
Glycolysis
Krebs Cycle
Fermentation and Anaerobic Respiration
Catabolism of Fats and Proteins
Feedback Mechanisms

Labs and activities:

ATP and metabolic activity – hands on
Cellular Respiration Lab – AP Lab 5
Krebs Cycle Caravan – hands on
Fermentation Lab – Lab

16. Animal Nutrition (Chapter 41)

Nutritional Requirements
Food and Feeding Mechanisms – An evolutionary comparison
Food Processing – A comparison
Mammalian Digestive System
Evolutionary Adaptations of Vertebrate Digestive Systems

Labs and activities:

Salivary Amylase Lab – Lab

17. Circulation and Gas Exchange (Chapter 42)

Comparison of Circulatory Systems

Evolution of the Vertebrate System

Anatomy of the Mammalian Heart

Blood Flow and Blood Pressure

Capillary Exchange

Components of Blood

Cardiovascular disease

Gas exchange in gills

Gas Exchange in Vertebrate Lungs

How Do We Breathe?

Blood's Role in Gas Exchange

Labs and activities:

Blood Typing – Lab

Dissection of a cow's heart – Lab

Physiology of the Circulatory System – AP Lab 10

18. Plant Form and Function

The Plant Body – Three Basic Organs

Plant Tissues

The Three Plant Cell Types

Meristems

Primary Growth

Secondary Growth

Root Anatomy

Stem Anatomy

Leaf Anatomy

Labs and activities:

Comparison of Cell Types – hands on

Microscopic Look at Root Tissue – Lab
Microscopic Look at Stem Tissue – Lab

19. Transport in Plants (Chapter 36)

Water Potential
Absorption of Water and Minerals
Transport in Xylem
The Role of Transpiration
The Structure and Function of Stomata
Translocation in Phloem

Labs and activities:

Transpiration Lab – AP Lab 9 (1 week)
Water Potential Lab – AP Lab 1 (2 periods)

20. Plant Nutrition (Chapter 37)

Nutritional Requirements
Mineral Deficiencies
The Role of Soil
Soil Conservation
Nitrogen is Special
Symbiotic Relationships
Parasitic Relationships

Labs and activities:

The Nitrogen Cycle – hands on
Does Nutrition Really Matter – Lab (1 – 2 weeks)

21. Photosynthesis

The Chloroplast – The Site of Photosynthesis
Light Reactions Convert Solar Energy to Chemical Energy

The Nature of Chlorophyll
The Calvin Cycle
Photorespiration and Alternative Mechanisms

Labs and activities:

Plant Pigment Chromatography – AP Lab 4
Photosynthesis – AP Lab 4
Light Reactions and the Calvin Cycle – Role Playing Simulations

22. Plant Reproduction (Chapter 38)

Alternation of Generations
The Role of Flowers
Pollination vs. Fertilization
Double Fertilization
The Role of Fruit in Seed Dispersal
Evolutionary Adaptations for Seed Dispersal
Asexual Reproduction
Plant Biotechnology

Labs and activities:

Flower Dissection – Lab

23. Plant Responses to Internal and External Signals (Chapter 39)

Signal Transduction and Plant Responses
Responses to Hormones
Responses to Light
Responses to Other External Stimuli
Plant Defenses: Responses to Herbivores and Pathogens

Labs and activities:

Plant Response to Light – Lab (1week)

B. Heredity and Evolution (13 weeks)

1. The Cell Cycle (Chapter 12)

The Role of Cell Division

Chromosome Structure

Stages of Mitosis

Cytokinesis

Regulation of the Cell Cycle – Cancer

Labs and activities:

Mitosis – AP Lab 3

2. Meiosis and Sexual Life Cycles (Chapters 13, 46)

Sexual vs Asexual Reproduction

Autosomes vs Sex Chromosomes

Haploid vs Diploid

Alternation of Generations

Oogenesis and Spermatogenesis

Labs and activities:

Meiosis – AP Lab 3

Crossing over in *Sordaria* – AP Lab 3

3. The Genetic Basis of Development (Chapter 21)

Embryonic Development

Differential Gene Expression

Transcriptional Regulation

Pattern Formation
Homeotic Genes

Labs and activities:

none

4. **Animal Reproduction** (Chapter 46)
Evolution of Animal Reproductive Systems
Mechanisms of Sexual Reproduction
Mammalian Reproduction
Male Anatomy
Female Anatomy
Hormonal Role
Embryonic and Fetal Development
Technological Solutions for Infertility

Labs and activities:

none

5. **Animal Development** (Chapter 47)
Fertilization Activation
Cleavage and Blastula Formation
Formation of the Organs
Morphogenesis
Differential Determinants
Pattern Formation

Labs and activities:

Virtual Animal Development –

[http://worms.zoology.wisc.edu/embryology_
main.html](http://worms.zoology.wisc.edu/embryology_main.html)

6. **Mendel and the Gene Idea** (Chapter 14)

Mendel's Laws
Genotype and Phenotype
Pedigree Analysis
Human Disorders
Technological Processes for Genetic Testing and Counseling

Labs and activities:

Chi-square Analysis – Lab
Pedigree Analysis – hands on
Virtual Fly Lab – <http://www.biologylab.awlonline.com/>
Genetics of *Drosophila* – AP Lab 7 (2-3 weeks)

7. Chromosomal Basis of Inheritance (Chapter 15)

Linkage
Crossing Over
Mapping Chromosomal Loci
Sex Chromosomes
Sex Linkage and Human Disorders
Genetic Errors Cause Disorders
Imprinting

Labs and activities:

Recovering the Romanovs – Sex-linked online activity
<http://www.dnai.org/d/index.html>

8. The Molecular Basis of Inheritance (Chapter 16)

The Evidence that DNA is the Genetic Material
The Structure of DNA
DNA Replication
Damage Repair
Telomeres and Aging

Labs and activities:

Building a Nucleotide – hands on

Leading and Lagging Strands – hands on

9. From Gene to Protein (Chapter 17)

The Central Dogma

The Genetic Code

Evolution of the Genetic Code

Transcription

Eukaryotic Modification of RNA

The Evolutionary Importance of Introns

Translation

Comparison of Protein Synthesis in Prokaryotes and Eukaryotes

Mutations affect Protein Structure and Function

Types of Point Mutations

Labs and activities:

James Bond Cellular Spy – hands on Protein Synthesis

(created by Cheryl Hollinger)

Transcription – hands on

10. Microbial Models: Genetics of Viruses and Bacteria (Chapter 18)

Viral Structure

Lysogenic vs Lytic Cycles

Types of Animal Viruses

Causes and Prevention of Viral Diseases in Animals

Viruses and Cancer

Viroids and Prions

Evolution of Viruses

Bacterial Reproduction

Genetic Recombination

Transformation and Transduction

Conjugation and Plasmids

Transposons

Operons

Labs and activities:

Bacterial Colony Transformation (pGLO) – AP Lab 6 (2-3 days)
Operon Structure and Function Activity – hands on

11. Organization and Control of Eukaryotic Genomes (Chapter 19)

Chromatin Structure Based on DNA Packing
Repetitive DNA and Non-coding Sequences
Gene Families
Gene Amplification, Loss and Rearrangement
Expression of Genes
Transcription Initiation
Post-transcription Mechanisms
Cancer and Genetic Changes in the Cell Cycle
Oncogene Proteins

Labs and activities:

Cancer – online activity
http://mama.uchsc.edu/vc/cancer/ca_properties/p1.cfm

12. DNA Technology and Genomics (Chapter 20)

Restriction Enzymes and Recombinant DNA
Genetic Engineering
The Cloning Procedure
DNA Libraries
Restriction Fragment Analysis
Gel Electrophoresis
Mapping Genomes
Applications
Ethical Questions

Labs and activities:

RFLP Cleavage Patterns of *Lambda* DNA – AP Lab 6 (2 days)
Virtual DNA Murder Mystery (CD-Rom)

13. Descent with Modification: A Darwinian View of Life (Chapter 22)

Historical Context for Evolutionary Theory

Descent with Modification

Natural Selection and Evolution

Homology

Labs and activities:

none

C. Organisms and Populations (10 weeks)

1. The Evolution of Populations (Chapter 23)

Population Genetics

Allele Frequencies

Hardy-Weinberg Principle

Microevolution

Genetic Drift

Natural Selection

Genetic Variation Between Populations

Natural Selection as the Mechanism of Adaptive Evolution

Labs and activities:

Population Genetics and Evolution – AP Lab 8

Random Genetic Drift Lab – Lab

2. Phylogeny and Systematics (Chapters 24 and 25)

What is a Species?

Barriers that Isolate Gene Pools

Allopatric Speciation

Sympatric Speciation

“Evo-devo” Genes

Fossil Records

Continental Drift

Systematics
Cladograms
Phylogenetic Trees

Labs and activities:

Building a Cladogram – hands on

3. Early Earth and the Origin of Life (Chapter 26)

History of the Earth

The Origin of Life

The Major Lineages of Life

Labs and activities:

none

4. The Origins of Eukaryotic Diversity (Chapter 28)

Protists

Origin and Early Diversification

Endosymbiosis

Euglenozoa

Alveolata

Algae

Labs and activities:

none

5. Plant Diversity (Chapters 29 – 30)

Evolution of Land Plants

Origin of Land Plants

Bryophytes
Origin of Vascular Plants
Seedless Vascular Plants
Evolution of Seed Plants
Gymnosperms
Angiosperms
Plants and Human Welfare

Labs and activities:

Dissection of Various Fruits – Lab

6. **Fungi** (Chapter 31)
Overview of Fungi
Evolution of Fungi
The Phyla of Fungi
Ecological Impacts of Fungi

Labs and activities:

Dissection of Various Fungal Types – Lab

7. **Animal Diversity** (Chapters 32 – 34)
What is an animal?
Origins of Animal Diversity
Noncoelomate Invertebrates
Coelomate Invertebrates
Vertebrates

Labs and activities:

none

8. **Introduction to Ecology and the Biosphere** (Chapter 50)
What is Ecology?
Factors Affecting the Distribution of Organisms
Aquatic and Terrestrial Biomes

Labs and activities:

Study of Biomes – Research Project

9. Behavioral Biology

What is Behavior?

Learning

Animal Cognition

Social Behavior and Sociology

Labs and activities:

Field Study of Animal Behavior (1 week)

10. Population and Communal Ecology (Chapters 52 – 53)

Characteristics of Populations

Life Histories

Population Growth

Population-Limiting Factors

Human Population Growth

What is Community?

Control in Community Structure

Disturbance and Community Structure

Factors that Affect the Biodiversity of Communities

Labs and activities:

Population Growth and Balance Interactive Activity – hands on

<http://www.arcytech.org/java/population/introduction.html>

Predator-Prey Populations Biokit – Lab

11. Ecosystems (Chapter 54)

Trophic Relationships

Primary Production

Secondary Production

Element Cycling

Human Impact on Ecosystems

Labs and activities;

Creating an Ecosystem – hands on

12. Conservation Biology (Chapter 55)

The Importance of and Threats to Biodiversity

Conservation of Populations and Species

Conservation of Communities and Ecosystems

Labs and activities:

Readings from Newspapers – hands on