# AP Biology Year at A Glance

<table>
<thead>
<tr>
<th>Title</th>
<th>Content</th>
<th># Days</th>
<th>Chapters</th>
<th>Labs</th>
<th>FRQs</th>
<th>Activities</th>
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<tbody>
<tr>
<td><strong>U n it 1</strong> Origins of Life and Taxonomy (+ Scientific Method)</td>
<td>I. <strong>The History of Life on Earth</strong>&lt;br&gt;A. Experimental Design&lt;br&gt;B. Origin of Life&lt;br&gt;C. Miller Urey&lt;br&gt;D. Protobionts&lt;br&gt;E. Endosymbiotic Theory&lt;br&gt;F. Fossil Record&lt;br&gt;G. RNA Theory</td>
<td>9</td>
<td>CH 25.1-25.3&lt;br&gt;CH 26.1-26.3, 26.6&lt;br&gt;CH 27.1-27.2, 27.4-27.6&lt;br&gt;CH 28.1&lt;br&gt;CH 29.1, 30.1, 32.1&lt;br&gt;CH 32.1, 32.3, 34.1</td>
<td>Origins of Life&lt;br&gt;Prokaryotes in the biosphere</td>
<td>Designing a Controlled Experiment</td>
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<td></td>
<td>II. <strong>Phylogeny and the Tree of Life</strong>&lt;br&gt;A. Classification&lt;br&gt;B. Homology/Analogy&lt;br&gt;C. Cladograms/Phylogenetic Trees&lt;br&gt;D. Main Characteristics of Kingdoms</td>
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<td>III. <strong>Bacteria and Archaea</strong>&lt;br&gt;A. Bacteria Characteristics and Ecological Roles</td>
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<td>2 Evolution</td>
<td>I. <strong>Descent with Modification</strong>&lt;br&gt;A. Common Ancestor&lt;br&gt;B. Darwin&lt;br&gt;C. LaMarck&lt;br&gt;D. Variation&lt;br&gt;E. Mutations&lt;br&gt;F. Artificial Selection&lt;br&gt;G. Natural Selection&lt;br&gt;H. Evidence for Evolution&lt;br&gt;1. Direct Observations&lt;br&gt;2. Homologies (Molecular and Anatomical)&lt;br&gt;3. Convergent Evolution and Analogous Structures&lt;br&gt;4. Fossil Record&lt;br&gt;5. Biogeography</td>
<td>5</td>
<td>Chapter 22&lt;br&gt;Chapter 23&lt;br&gt;Chapter 24</td>
<td>Hardy Weinberg Lab</td>
<td>Rock Pocket Mouse; Evolution Games Project</td>
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### II. The Evolution of Populations

A. Forces of Evolution
   1. Genetic Drift – Founder Effect/Bottleneck
   2. Non-Random Mating (Sexual Selection)
   3. Mutations
   4. Gene Flow
   5. Natural Selection

B. Types of Selection
   1. Disruptive
   2. Stabilizing
   3. Directional

C. Heterozygote Advantage

D. Hardy Weinberg Equilibrium

### III. The Origin of Species

A. Biological Concept of a Species

B. Reproductive Isolation
   1. Temporal
   2. Geographic (allopatric speciation)
   3. Behavioral
   4. Mechanical
   5. Gametic
   6. Reduced hybrid fertility
   7. Hybrid Breakdown

C. Speciation
   1. Gradualism
   2. Punctuated Equilibrium

### I. Water and Life

A. Properties of Water
   1. Polarity and Hydrogen Bonding
      a) Cohesion
      b) Adhesion
      c) High specific heat
      d) Universal solvent

   B. pH

   C. Solution – Solvent, Solute

   D. Hydrophobic/Hydrophilic

   E. Polar/Non-polar

### II. Carbon and the Molecular Diversity of Life

A. Organic compounds

B. Functional Groups – Hydroxyl, Carbonyl, Carboxyl, Amino, Methyl, Sulphhydryl, Phosphate

### III. The Structure and Function of Large Biological Molecules

A. Macromolecules
   1. Carbohydrates
   2. Lipids
|-----------------------------|

### IV. Introduction to Metabolism

|---------------------|

### The Cell and Cell Processes

|------------------------|

| 7 Chapter 6.2 -6.5  Chapter 7  Chapter 11  Chapter 48  Chapter 9.1-9.5  Chapter 10.1-10.3  Diffusion/Osmosis Lab; Cell Respiration Lab  Diffusion/Osmosis Lab; Cell Respiration Lab  Cell Communication  Sweet Beets |
4. Second Messengers – camp, Calcium
   C. Response
      1. Cellular response
      2. Nuclear Response

IV. Neuron Signaling
   A. Neuron Structure
   B. Action Potentials - Resting Potential, Threshold Potential, Depolarization, Repolarization
   C. Voltage Gated Channels - Sodium and Potassium
   D. Sodium-Potassium Pump
   E. Synapse
   F. Neurotransmitters

V. Cellular Respiration and Fermentation
   A. Cellular Respiration (follow the flow of electrons) - Equation
      1. General Process and Locations
         a) Glycolysis
         b) Kreb's Cycle
         c) Electron Transport Chain
      2. Electron Carriers – NADH and FADH2
   B. Substrate Level Phosphorylation compared to Oxidative phosphorylation
   C. Chemiosmosis – Proton gradient that drives ATP production
   D. Fermentation – Alcohol and Lactic Acid Fermentation

VI. Photosynthesis
   A. Photosynthesis (follow the flow of electrons) - Equation
      1. General Process and Locations
         a) Light Reactions
            (1) Electron Transport Chain
         b) Calvin Cycle
      2. Electron Carrier - NADPH
      3. Structure of Leaves and Chloroplasts
   B. Pigments and Light Absorption

5 Homeostasis

I. Resource Acquisition and Transport in Vascular Plants
   A. Transpiration
   B. Xylem and Phloem
   C. Gas Exchange
   D. Stomatal Control (K+ ions)

II. Plant Responses to Internal and External Signals
   A. Plant Hormones - Auxin, Gibberellins, Abscisic acid, Ethylene
### III. Basic Principles of Animal Form and Function

<table>
<thead>
<tr>
<th>A.</th>
<th>Exchange with environment</th>
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<tbody>
<tr>
<td>B.</td>
<td>Tissue Structure and Function - Epithelial, Connective, Muscle, Nervous</td>
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<tr>
<td>C.</td>
<td>Feedback Loops - Positive and Negative</td>
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<tr>
<td>D.</td>
<td>Homeostasis</td>
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<tr>
<td>E.</td>
<td>Thermoregulation - Endotherms, Ectotherms, Metabolic rate</td>
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### IV. Examples of Homeostasis

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<thead>
<tr>
<th>A.</th>
<th>Circulatory System</th>
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<td>B.</td>
<td>Digestive System</td>
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<tr>
<td>C.</td>
<td>ADH – Kidneys</td>
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### V. Endocrine System

<table>
<thead>
<tr>
<th>A.</th>
<th>Hormones</th>
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<tr>
<td>B.</td>
<td>Protein and Lipid Hormones – Signal Transduction</td>
</tr>
<tr>
<td>C.</td>
<td>Blood Sugar Regulation – Insulin/Glucagon</td>
</tr>
<tr>
<td>D.</td>
<td>Metabolism Regulation</td>
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### VI. Immune System and Lymphatic System

<table>
<thead>
<tr>
<th>A.</th>
<th>Types of Blood Cells</th>
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<tr>
<td>B.</td>
<td>Lines of Defense (Nonspecific) - Inflammatory Response, Macrophages, Natural Killer Cells, Perforin</td>
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<tr>
<td>C.</td>
<td>Lines of Defense (Specific) - B Cells, T Cells, Memory Cells, Antibodies, Antigens</td>
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<tr>
<td>D.</td>
<td>Humoral Response</td>
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<td>E.</td>
<td>Cell-mediated Response</td>
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<td>F.</td>
<td>Acquired – Active Immunity</td>
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<td>G.</td>
<td>Passive Immunity</td>
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### Nucleic Acids and Proteins

<table>
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<tr>
<th>I.</th>
<th>The Molecular Basis of Inheritance</th>
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<tbody>
<tr>
<td>A.</td>
<td>DNA History</td>
</tr>
<tr>
<td>1.</td>
<td>Griffith, Avery, Hershey and Chase, Chargaff, Watson and Crick, Franklin</td>
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<tr>
<td>B.</td>
<td>DNA Structure</td>
</tr>
<tr>
<td>1.</td>
<td>DNA Directionality (5’-3’)</td>
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<tr>
<td>2.</td>
<td>Hydrogen Bonding</td>
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<tr>
<td>3.</td>
<td>Base Pairing (purines and pyrimidines)</td>
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<tr>
<td>C.</td>
<td>DNA Replication</td>
</tr>
<tr>
<td>1.</td>
<td>Semiconservative model</td>
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<tr>
<td>2.</td>
<td>Enzymes involved in the process (DNA polymerase I and III,</td>
</tr>
</tbody>
</table>
topoisomerase, SSB, primase, ligase, helicase)
3. Leading and Lagging Strand, Okazaki Fragments
4. Proofreading and Repair
5. Replicating the end of DNA molecules

D. DNA Packaging

II. Cell Cycle
A. Cellular Organization of the Genetic Material
   1. Sister chromatids, homologous chromosomes
B. Phases of the Cell Cycle
   1. Interphase
   2. Mitotic Phase
C. Cell Cycle Regulation
   1. Checkpoints
   2. Cyclins/cdk5
   3. External signals
   4. Growth factors
D. Cancer

III. From Gene to Protein
A. Central Dogma
B. Basic Principles of Transcription and Translation
   1. Template strand
   2. Coding strand
C. The Genetic Code
   1. Codons
   2. Reading frame
D. RNA – structure, types, differences from DNA
E. Transcription
   1. Steps, enzymes, regulation
   2. Binding and Initiation of Transcription
      a) Promoter Region and TATA Box
   3. Elongation of the RNA Strand
   4. Termination of Transcription
F. RNA Processing in Eukaryotic Cells
   1. Alteration of mRNA Ends
   2. Split Genes and RNA Splicing
   3. Ribozymes
G. Translation
   1. Steps, enzymes, regulation
   2. Structure and Function of Transfer RNA
   3. Ribosomes
   4. Building a Polypeptide
      a) Ribosome Association and Initiation of Translation
b) Elongation of the Polypeptide Chain
c) Termination of Translation
d) Polyribosomes
5. Completing and Targeting the Functional Protein
H. Mutations – point mutations and frameshift mutations
I. Codons, read the codon chart, anticodon
J. Protein synthesis in eukaryotes vs. prokaryotes

IV. Regulation of Gene Expression
   A. Opens: The Basic Concept
   B. Repressible and Inducible Operons (Negative Control)
   C. Positive Gene Regulation
   D. Regulation of Eukaryotic Gene Expression
      1. Differential Gene Expression
      2. Regulation of Chromatin Structure
         a) Histone Modifications (histone acetylation)
         b) DNA Methylation
         c) Epigenetic Inheritance
      3. Regulation of Transcription Initiation
         a) Transcription Factors
         b) Enhancer Regions
      4. Mechanisms of Post-Transcriptional Regulation
         a) RNA Processing
         b) mRNA Degradation
         c) Initiation of Translation
         d) Protein Processing and Degradation
   E. Non-Coding RNAs
      1. microRNAs, RNAi, siRNAs
   F. Cytoplasmic Determinants
   G. Sequential Regulation of Gene Expression During Cellular Differentiation
   H. Genes associated with cancer
      1. Proto-oncogenes
      2. Tumor suppressors genes
      3. Interference with Normal Cell-Signaling Pathways

7 Biotechnology
   I. Viruses
      A. Structure
      B. Replicative Cycles - Lytic Cycle and lysogenic Cycle
      C. Retroviruses
   II. Biotechnology

8 20.1-20.2
19.1-19.2
27.1-27.2-
Review Bacteria
Restriction Enzyme Analysis of DNA; Bacterial Transformation
Biotechnology
Who Will You Stand With?
### A. DNA Cloning: Preview

1. Restriction Enzymes to Make Recombinant DNA
2. Cloning Eukaryotic Genes in a Bacterial Plasmid
   a) Producing Clones
   b) Storing Clones
   c) Screening Library for Clones
3. Expressing Clones Genes
   a) Bacterial Expression
   b) Eukaryotic Expression
4. Amplification of DNA - PCR

### B. Studying the Sequence, Expression, and Functions of Genes

1. Gel Electrophoresis and Southern Blot
2. DNA Sequencing
3. Analyzing Expression
   a) Single Gene
   b) Interacting Genes
4. Determining Gene Function

### C. Cloning and Applications

1. Cloning
   a) Plants
   b) Animals
   c) Stem Cells
2. Applications
   a) Medical
   b) Forensics
   c) Environmental Cleanup
   d) Agricultural

### III. Genomes

A. Linkage map
B. Transposable elements
C. Transposons
D. Retrotransposons
E. STRs

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### I. Meiosis and Sexual Life Cycles

A. Meiosis Comparison with Mitosis
B. Genetic Variation in Meiosis – Crossing over and Independent assortment
C. Oogenesis, Spermatogenesis

### II. Animal Development

A. Fertilization
B. Cleavage
C. Gastrulation
D. Cytoplasmic Determinants
E. Cell Differentiation

### III. Angiosperm Reproduction

Chapter 13
Chapter 47
Chapter 38.1
Chapter 14
Chapter 15

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### Reproduction and Genetics

8

Chapter 21.2, 21.4-21.5

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Fruit Fly Cross

Genes and Consequences;
Fruit Fly Dissections
A. Flower Structure
B. Fertilization
C. Fruit Formation

IV. Mendel and the Gene Idea
   A. Mendel
   B. Law of Segregation
   C. Law of Independent Assortment
   D. Probability
   E. Monohybrid and Dihybrid Crosses
   F. Pedigree Analysis
   G. Genetic Diseases
   H. Inheritance Patterns - Recessive, Dominant, Codominance, Incomplete Dominance, Polygenic Traits, Pleiotropy, Epistasis

V. The Chromosomal Basis of Inheritance
   A. Sex Linkage
   B. X-inactivation
   C. Linkage and Genetic Recombination
   D. Polyploidy, Trisomy, Monosomy, Nondisjunction
   E. Chromosomal Mutations and Disorders
   F. Genomic Imprinting

I. Animal Behavior
   A. Innate vs. Learned Behavior
   B. Fixed Action Pattern
   C. Operant Conditioning
   D. Classical Conditioning
   E. Habituation
   F. Altruism

II. Introduction to Ecology and the Biosphere
    A. Levels of Organization
    B. Biomes

III. Population Ecology
    A. Abiotic Factors and Biotic Factors
    B. Survivorship Curves - K-selected and R-selected species
    C. Growth Rate, Exponential and Logistic Growth Patterns
    D. Carrying Capacity – Limiting Factors, Density Dependent, Density Independent
    E. Invasive Species

IV. Community Ecology
    A. Niche
    B. Competitive Exclusion
    C. Symbiotic Relationships
    D. Predation, Defense Mechanisms – Batesian Mimicry, Mullerian Mimicry
    E. Coevolution
    F. Keystone Species

Chapter 51
Chapter 52.4
Chapter 53
Chapter 54
Chapter 55
Chapter 56.1

Animal Behavior; Energy Dynamics

Crazy About Cryptids; The Field Guide to Fantastic Beasts
V. **Ecosystems and Restoration Ecology**
   A. Nutrient Cycling – Carbon, Nitrogen, Phosphorous, Water
   B. Energy Flow, Food Chains/Webs
   C. Trophic Levels and Structure
   D. Ecological Pyramid
   E. Production Efficiency - 10% Rule

VI. **Conservation Biology and Global Change**
   A. Biodiversity and Human Impacts

Textbook: Campbell Biology, 9th edition
Mastering Biology online textbook link: [http://www.k12pearson.com/PH/rqstAccess/default.cfm](http://www.k12pearson.com/PH/rqstAccess/default.cfm)