# AP Biology Syllabus

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**Room: A234**

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**Course Overview**

In AP Biology, an emphasis is on students making connections between the big ideas within the AP Biology Curriculum Framework. I teach the equivalent of an introductory college--level biology course, and it is designed to prepare students for the AP Biology Exam.

Lab techniques are learned through researching journal papers, hands-on labs which make up at least 25% of instructional time. **[CR7]** Labs emphasize development and testing of the hypothesis, collection, analysis and presentation of data, as well as discussion of results to discover unanswered questions about the particular topics addressed. A minimum of two labs in each big idea will be conducted. **[CR6]** Students are required to report on all laboratory investigations. **[CR8]**The student-directed and inquiry-based laboratory investigations used throughout the course enable students to apply the seven science practices as defined in the Curriculum Framework.

**Materials**

Campbell, Neil and Reece, Jane B. 2004. *Biology,* Seventh Edition, San Francisco, CA: Pearson Benjamin Cummings. **[CR1]**(newer edition will be used for future classes)

Campbell, Neil. *Student AP Edition Biology Student Study Guide,* Seventh Edition

*AP Biology Investigative Labs: An Inquiry-Based Approach*, The College Board, 2012

College ruled Spiral Notebook

Review book

**Course Components**

READINGS: Include textbook/ journal articles. Students are provided with guided reading questions and are required to take notes and definitions which they keep in a journal.

FLIPPED CLASSROOM: Students are provided with a verity of online media resources from the class website in which they read or view online. For an assessment students take notes on what they have learned and become part of a discussion or debate the next day. Often this media becomes part of the writing topic.

ACTIVITY/LABS: Some activities are expected to be performed outside of class time & students are expected to hand in lab reports for evidence of completion.

DISSCUSSIONS and DEBATES: Often students are engaged in a discussion in which they are given time to prepare with another student. Student discuss thought provoking questions in which the work to tie in concept to the AP Biology big ideas or other learning objectives.

ASSESSMENT: A variety of assessments are used throughout the course. Some assessments will be a representation of the actual AP Exam. There will also be a great deal of writing assignments to assess the student's ability to interpret information, come up with examples, synthesize information in their own words and tie information back to the AP Biology big ideas and learning objectives.

- Quizzes/ Written Responses 30%
- Labs: Lab Work 15%
- Class work / Journal Writing 20%
  Class participation
- Homework: Journal Articles 10%
  Chapter Questions
- Projects 25%

**AP BIOLOGY 4 Big Ideas**

**Big Idea 1: Evolution**
The process of evolution drives the diversity and unity of life.

**Big Idea 2: Cellular Processes: Energy and Communication**
Biological systems utilize free energy and molecular building blocks to grow, to reproduce, and to maintain dynamic homeostasis.

**Big Idea 3: Genetics and Information Transfer**
Living systems store, retrieve, transmit, and respond to information essential to life processes.

**Big Idea 4: Interactions**
Biological systems interact, and these systems and their interactions possess complex properties.

| Curricular Requirements |
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| **CR1** Students and teachers use a recently published (within the last 10 years) college-level biology textbook. |
| **CR2** The course is structured around the enduring understandings within the big ideas as described in the AP® Biology Curriculum Framework. |
| **CR3a** Students connect the enduring understandings within Big Idea 1 (the process of evolution drives the diversity and unity of life) to at least one other big idea. |
| **CR3b** Students connect the enduring understandings within Big Idea 2 (biological systems utilize free energy and molecular building blocks to grow, to reproduce, and to maintain dynamic homeostasis) to at least one other big idea. |
| **CR3c** Students connect the enduring understandings within Big Idea 3 (living systems store, retrieve, transmit, and respond to information essential to life processes) to at least one other big idea. |
| **CR3d** Students connect the enduring understandings within Big Idea 4 (biological systems interact and these systems and their interactions possess complex properties) to at least one other big idea. |
| **CR4a** The course provides students with opportunities outside of the laboratory investigations to meet the learning objectives within Big Idea |
| **CR4b** The course provides students with opportunities outside of the laboratory investigations to meet the learning objectives within Big Idea |
| **CR4c** The course provides students with opportunities outside of the laboratory investigations to meet the learning objectives within Big Idea |
| **CR4d** The course provides students with opportunities outside of the laboratory investigations to meet the learning objectives within Big Idea |
| **CR5** The course provides students with opportunities to connect their biological and scientific knowledge to major social issues (e.g., concerns, technological advances, innovations) to help them become scientifically literate citizens. |
| **CR6** The student-directed laboratory investigations used throughout the course allow students to apply the seven science practices defined in the AP Biology Curriculum Framework and include at least two lab experiences in each of the four big ideas. |
| **CR7** Students are provided the opportunity to engage in investigative laboratory work integrated throughout the course for a minimum of 25 percent of instructional time. |
| **CR8** The course provides opportunities for students to develop and record evidence of their verbal, written and graphic communication skills through laboratory reports, summaries of literature or scientific investigations, and oral, written, or graphic presentations. |

| MOLCEULES, CELLS & ENERGY Big ideas 1, 2, 3 & 4 [CR2] | | | |
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| TOPICS | READINGS | ACTIVITY/LABS | ASSESSMENT |
| **A. MOLECULES** Big idea 4<br><br>Polarity of water & its importance to biological systems<br><br>Carbon's role in the molecular diversity of life<br><br>Monomers, polymers & reactions involved in building & breaking them down considering polar/nonpolar interactions<br><br>Various levels of structures in protein & carbohydrates<br><br>Enzyme structure as a special protein<br><br>Cohesion, adhesion, specific heat of water & its importance to biological systems<br><br>Acids, bases, and buffers | Chemistry of Life<br><br>Chapters 2--5 from textbook | Using kits to build macro–molecule models**[CR4a]** (SP 1)<br><br>Exercises: protein folding Lab **[CR4b]**<br><br>Acid/base/buffer lab activity **[CR6]** (SP 2)<br><br>Students do variations by adding different macro-molecules to solution to see effects adhesion etc. (EU4.A connects to BI 1) **[CR3d]** (SP 4)<br><br>Given specific heat equation, in groups students try to come up with a way to determine specific heat of water– 15min (EU 4.C connects to BI 1) **[CR3d], [CR4a] & [CR4b]** (SP 3) | Student generated concept maps<br><br>Unit test with free response practice<br><br>Written lab reports **[CR8]** |

| MOLCEULES, CELLS & ENERGY Big ideas 1, 2, 3 & 4 [CR2] | | | |
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| TOPICS | READINGS | ACTIVITY/LABS | ASSESSMENT |
| Identifying macro-molecules in our foods<br><br>Supplements & Add--ons:<br><br>Cohesion/ adhesion in nature<br><br>Various macro-molecules in our foods<br><br>Cycling of chemical elements in ecosystem | Portion of Chapter 55 | LAB: Using and under-standing how different indicators are used to identify proteins, lipids, carbohydrates (incl. reducing sugars analysis) using Biuret, Benedict's, Sudan etc. **[CR6]** (SP 6)<br><br>Research exploring how animals use water's properties for survival (comparing specific heat) (EU 4.C connects to BI 1)**[CR3d]**<br><br>Students make posters of different element cycles including relative amts. of transfer **[CR4b], [CR4d] & [CR8]** | Students compose chart comparing structural differences & how indicators physically work<br><br>Students use chart to predict contents of unknown samples<br><br>Students share one example they have found how animals use water's properties for survival. |
| **B. HISTORY OF LIFE**<br><br>Big idea 1<br><br>Theories of how macro-molecules joined to support origin of life<br><br>Was RNA 1st genetic material?<br><br>Age of earth | Text chapter 25<br><br>outline notes<br><br>guided reading | Clay catalyzed RNA polymerization activity with role playing focus on theories, redevelopment of theories over time (EU 1.B connects to BI 3) **[CR3a] & [CR4c]** (SP 6, 7)<br><br>Discussion of journal article | Concept maps<br><br>Reflection on the development and reformulation of scientific theories<br><br>(extra) model or cartoon explaining the theories of origin of life **[CR4a]** |

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| **C. CELLS** (structure & function) Big idea 1 & 2<br><br>Explain similari ties, differences & evolutionary relationships between prokaryotic & eukaryotic cells<br><br>Cell membrane structure & function<br><br>Cell communication (signals, receptors, responses hormones)<br><br>Methods of transport across membranes | Text chapters 6,7,11<br><br>Outline notes<br><br>Guided reading questions<br><br>Journal articles on organelle based health issues **[CR5]** | Mini poster/ models comparing structures of cells from 3 different cell types from 3 differ-ent kingdoms (EU 1.A connects to BI 3) **[CR3a], [CR4a], [CR4c] & [CR8]**<br><br>LAB: Normal vs Plasmolyzed Cells using Plant cells (teacher generated) **[CR6]**<br><br>Osmosis & diffusion **[CR4b], [CR4c] & [CR6]**<br><br>Cell size lab teacher generated<br><br>Mini Poster Presentations comparing 3 feedback mechanisms **[CR8]**<br><br>Inquiry lab # 4 Diffusion and Osmosis **[CR6]** (SP 3, 4)<br><br>LAB: Microscope techniques for observing & measuring different types of cells. | Student generated concept maps<br><br>Reading quizzes<br><br>Mini poster comparing structures of cells from 3 different kingdoms<br><br>Unit test with Free Response practice<br><br>Written lab reports **[CR8]**<br><br>graph & calculations<br><br>Cell Size lab calculations<br><br>Formal Lab Writeup for Inquiry lab Diffusion & Osmosis **[CR8]**<br><br>Microscope drawings & calculation<br><br>Analyze & Discuss chart comparing different types of cells & their functions in the human body<br><br>Discussion of the endosymbiont hypotheses of the evolution of eukaryotic cells **[CR3b]** |
| **D. IMMUNITY** Big idea 2 & 3<br><br>Innate vs Acquired Response<br><br>Humoral responses B cells vs T cells<br><br>Self vs non--self<br><br>Speaker from Pharmaceutical Company | Text chpt. 43<br><br>.<br><br>Video Humoral Immune system | Students takes notes | Student generated concept maps<br><br>Video discussion and quiz |

MOLCEULES, CELLS & ENERGY Big ideas 1, 2, 3 & 4 [CR2]

| TOPICS | READINGS | ACTIVITY/LABS | ASSESSMENT |
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| **E. CELL ENERGY**<br><br>ATP structure & function<br><br>Redox reactions in relation to cellular respiration<br><br>Enzyme catalysis<br><br>Activation energy & specificity<br><br>Cellular respiration glycolysis, citric acid cycle, electron transport chain & chemiosmosis<br><br>Mitochondria form & function<br><br>Photosynthesis mechanisms; light/dark<br><br>Compare/contrast to respiration<br><br>Alternative mechanisms<br><br>Understanding light energy & the nano scale (the size of small things inside cells) | Text chpts 8, 9, 10<br><br>Outline notes<br><br>Guided reading questions | Eduweblabs: Prelab "Enzyme Catalysis"<br><br>Investigative lab #13: Enzyme Activity (EU 4.A connects to BI 2) **[CR3d] & [CR6]**<br><br>Investigative Lab: Enzymes: Factors affecting the rate of activity **[CR6]** (SP 2, 5)<br><br>Investigative Lab #6 Cellular Respiration **[CR6]** (SP 2)<br><br>Fermentation in Yeast Lab (Flynn kit) student generated variations required<br><br>Investigative Lab #5 Photosynthesis **[CR6]**<br><br>Internet activity comparing different wavelengths of light in relation to photosynthesis (teacher generated)<br><br>Discussion on nanotechnology & implications of our smaller world **[CR5]** | Student generated concept maps<br><br>Reading quizzes<br><br>Unit test with free response practice<br><br>graphs<br><br>Enzyme graphs & questions<br><br>Presentation of students group lab results to class **[CR8]**<br><br>Presentations of lab data and results **[CR8]**<br><br>Graphs & discussion on Yeast Lab with variations **[CR8]**<br><br>Presentations on lab results<br><br>Lab writeup and analysis **[CR8]**<br><br>Students make a chart comparing sizes of cellular parts & larger items to evaluate range of metric distance measurements down to the nano scale **[CR4b]** |

| MOLCEULES, CELLS & ENERGY Big ideas 1, 2, 3 & 4 [CR2] | | | |
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| TOPICS | READINGS | ACTIVITY/LABS | ASSESSMENT |
| **A. MOLECULAR BASIS OF INHERITANCE**<br><br>DNA structure & replication<br><br>RNA structure<br><br>Protein Synthesis transcription & translation<br><br>Mutations - basis for natural selection | Text chapters 16, 17<br><br>Journal Article Reading<br><br>Watson and Crick's original Nature paper from 1953 | DNA extraction<br><br>Comparing DNA & protein sequences from an internet based computer database in discussing evolutionary implications of mutations (SP 7) | Student generated concept maps<br><br>Reading quizzes<br><br>Journal article discussions<br><br>Unit test with Free Response practice<br><br>Bioinformatics results |
| **B. MITOSIS & MEOSIS**<br>Cell Cycle mechanism & control<br><br>Chromosomes<br><br>Sexual vs asexual reproduction & evolutionary advantages<br><br>Stages of meiosis<br><br>Genetic variation in offspring, mecha-nisms & impact on evolution<br><br>Investigating genetics: environ-mental influences | Text chapters 12, 13 | Investigative Lab #7: Mitosis and Meiosis (EU 3.A connects to BI1) **[CR3c] & [CR6]**<br><br>Karyotyping exercise (teacher generated--students will have to do this on their own time) **[CR4c]** | Student generated concept maps<br><br>Reading quizzes<br><br>Unit test with Free Response practice<br><br>Investigative LAB Analyses<br><br>Karyotyping results<br><br>Students choose & research controversial topics and the arguments supporting their genetic and/or environmental basis. Ex. Obesity, alcoholism, etc. **[CR5]** |

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| **C. MENDELIAN GENETICS MENDEL'S LAWS**<br><br>Patterns of inheritance<br><br>Predicting genetic outcomes genetic counseling<br><br>Gene linkage & mapping<br><br>Mutations revisited | Text chapters 14, 15<br><br>Scientific American Article Reading | activity: Looking at corn crosses & analyzing results | Student generated concept maps<br><br>Reading quizzes<br><br>Journal article discussions<br><br>Unit test with free response practice |
| **D. MOLECULAR GENETICS**<br><br>Regulation of gene expression<br><br>Viruses<br><br>Gene expression in bacteria<br><br>Biotechnology DNA Technology, Recombinant DNA, PCR, Gel electrophoresis<br><br>Applications of DNA technology<br><br>Use of bioinformatics to analyze genomes<br><br>Comparing & discussing genomic sequences in relation to evolution | Text chapters 18--21<br><br>Journal Article Reading<br><br>Article by Kary Mullis on PCR. | DNA Electrophoresis Investigative lab #9: Biotechnology I and Biotechnology II. Bacterial Transformation and Restriction Enzyme Analysis of DNA **[CR6]**<br><br>Watch a lecture of this technique used at U of R | Student generated concept maps<br><br>Reading quizzes<br><br>Journal article discussions<br><br>Unit test with free response practice<br><br>Results for both transformation & electrophoresis labs<br><br>Analysis and group presentation of Investigative lab<br><br>Post video discussion and writ-up |

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| **E. EVOLUTIONARY BIOLOGY**<br><br>Darwin's explorations and theory of descent with modification & natural selection<br><br>Galapagos Islands Overview<br><br>Evidence for evolution (molecular analyses & morphological analyses<br><br>Phylogeny & systematics<br><br>Evolution of populations<br><br>Hardy-Weinberg Law | Text chapters 22–25<br><br>Journal Article Reading<br><br>*Beak of the Finch* by Jonathan Weiner | Activity: Genetics Survey Project analyzing traits of those around us<br><br>Lab Investigation "2 Mathematical Modeling: Hardy-Weinberg **[CR6]** (SP2, 4, 5, 7)<br><br>Activity: Students create Geologic timeline<br><br>Activity: Hands on fossil analysis (at local science museum) **[CR4a]** (SP 6, 7) | Student generated concept maps<br><br>Reading quizzes<br><br>Article discussions<br><br>Unit test with Free Response practice |

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| TOPICS | READINGS | ACTIVITY/LABS | ASSESSMENT |
| **A. BIOLOGICAL DIVERSITY & MICROBIOLOGY**<br><br>Early life on earth<br><br>Evolution of prokaryotes & eukaryotes | Text chapters 25, 26, 27<br><br>Text 29, 30 | Students are to find an article involving genetic recombination using prokaryotes and present to class **[CR5]**<br><br>Investigative LAB # 3: Analyzing Genes with BLAST (EU 1.B connects to BI 4) **[CR3a] & [CR6]** | Article presentation to class<br><br>Student generated concept map<br><br>Section test |
| **B. PLANTS & THEIR DIVERSITY**<br><br>How plants colonized land<br><br>Evolution of seed plants<br><br>Structure, growth & development<br><br>Plants responses to internal & external stimuli<br><br>Plant nutrition<br><br>Angiosperm Reproduction | Text 35, 36<br><br>Text 37, 38, 39 | Eduweblabs: Prelab Transpiration<br><br>Investigative LAB # 11: Transpiration (EU 1.B connects to BI 4) **[CR3a] & [CR6]** (SP 2, 3, 5)<br><br>LAB: Flower dissection<br><br>LAB: Students conduct a long term (exp't) lab investigation plant growth from seeds under various conditions in our greenhouse. **[CR6]** (SP 3.5, 6, 7) | Practical Test specimen identification & placing on phylogenetic tree<br><br>Student generated concept map<br><br>Section test<br><br>Eduweblab transpiration results<br><br>Investigative labs analysis<br><br>Flower dissection practical<br><br>Formal writeup for students' own plant lab **[CR8]** |
| | Text chapters 32–34 and 40–49 | Survey of animal phyla in concept map/chart form generated by students (Practical with actual animal specimens)<br><br>Daphnea heart rate Lab<br><br>Human Biology: Circula-tion and Blood Pressure Lab: Examining circulation of the goldfish **[CR6]** (SP 7)<br><br>Lab: Dissection -Rat | |

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| **C. ANIMAL DIVERSITY**<br><br>Characteristics (body plans & systems) of invertebrates as you go up the phylogenetic tree<br><br>Basic anatomy principles<br><br>Analysis of structure & function of body systems<br><br>Digestive, Circulatory, Respiratory, Excretory, Endocrine, Nervous, Muscular Systems | | | Student generated concept maps (one for each system & animal diversity examination)<br><br>Reading quizzes<br><br>Unit test with Free Response practice<br><br>Practical quiz observing various specimens and classifying them using students' own made chart of animal phyla<br>Practical test with<br><br>dissection specimen |

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| TOPICS | READINGS | ACTIVITY/LABS | ASSESSMENT |
| **D. ECOLOGY**<br><br>Ecological interactions- biotic vs abiotic<br><br>Behavioral ecology- natural selection involve-ment<br><br>Population dynamics- growth & its regulations<br><br>Communities & Ecosystems energy levels & flows, cycles, symbiosis & impact on evolution<br><br>Human influences positive & negative | Text chapters 50–55 | Investigative LAB #12: Fruit fly behavior **[CR6]** (SP 3, 4)<br><br>Animal Behavior: Taxis, Kinesis, and Agonistic Behavior **[CR6]** (SP 3, 4, 6)<br><br>LAB: 11 Animal Behavior lab Pilbugs<br><br>LAB: Dissolved Oxygen & Aquatic Primary Productivity (EU 4.A connects to BI 1) **[CR3d], [CR5] & [CR6]** (SP 2, 3, 4, 5, 6, 7)<br><br>Activity – “My footprint” (EU 4.A connects to BI 1)**[CR3d] & [CR4d]** | Student generated concept maps<br><br>Reading quizzes<br><br>Unit test with Free Responses<br><br>Investigative Lab #11 report **[CR8]**<br><br>report on primary productivity Presentation: Students present lab results to class with ways to improve water quality of their local river **[CR5]**<br><br>Students complete “My Footprint” online and write a paper discussing their individual impact on Earth **[CR5]** |