

# A.P. Biology

## Philosophy

The study of biology is one of complex relationships within and between organisms. Scientists are continually discovering new ideas about how these complex relationships work. The fact that the world is constantly changing and new discoveries in science are made daily gives ample opportunity to promote biology topics as part of the daily discussions in Advanced Placement Biology. The relevance of the biology themes in terms of making connections to the students' daily lives is made in hopes that they become knowledgeable about the world around them. In an attempt to promote discussions about current issues, the curriculum is supplemented with articles from current popular science magazines and newspapers. It is the hope of this course that this knowledge will allow the students to make informed decisions that will affect not only themselves, but the whole world in the future.

## Course Overview

The course goal is to provide students with the conceptual framework, factual knowledge and analytical skills necessary to deal critically with the rapidly changing science of biology.

Our students meet for 45 minutes each day, five days a week. They also have a lab period every other day for 45 minutes which allows ample time for the 25% lab requirement time.

The course itself covers all of the themes in the *AP Biology Course Description* as per the College Board. The eight overarching themes discussed throughout the course are: science as a process, Evolution, Energy transfer, Continuity and Change, Relationship of structure and function, Regulation, Interdependence in Nature, Science, Technology and Society. Examples of how the themes are woven in throughout the course are as follows:

1. **Science as a Process:** we look at historical experiments such as Hershey-Chase, Watson and Crick, etc. and how the knowledge derived from those milestones help scientists continue the research today.
2. **Evolution:** This topic is discussed throughout the year by using phylogenetic trees to show relationships between organisms and discussions of similarities in DNA uniting all domains.
3. **Energy transfer:** Topics discussed for this include conservation of energy, photosynthesis and cell respiration, ATP as an energy source and food webs in ecosystems.
4. **Continuity and Change:** Topics discussed include natural selection, how global warming affects organisms, meiosis, mutations and genetics
5. **Relationship of Structure to Function:** Topics discussed include enzyme specificity, structure and functions of different cells/organs within organisms

6. **Regulation:** We discuss positive and negative feedback mechanisms and signal transduction pathways and how they relate to an organisms survival.
7. **Interdependence of Nature:** Topics discussed include the relationship between organisms such as predator/prey, symbiotic relationships, nitrogen fixation, and how organisms interact with their environment in order to survive.
8. **Science, Technology, and Society:** Lab activities such as gel electrophoresis, bacterial transformations are performed and discussed as to their relevance in everyday life. Ethical issues such as gene cloning and man's effect on organisms are discussed.

## Course Planner

The following is the syllabus handed out to the students at the beginning of the year. It lists the three major topics: Molecules and Cells, Heredity and Evolution, Organisms and Populations. Each major topic is then broken down into the themes and the 6<sup>th</sup> Edition Campbell and Reece, *Biology*, textbook pages pertaining to that topic are listed as well as any tests, labs, demonstrations, activities and articles.

### A.P. BIOLOGY SYLLABUS

TOPICS	Campbell's 6 <sup>th</sup> Ed. page #'s	Quizzes/ tests	Labs And activities
<b>I. MOLECULES AND CELLS</b>	Units 1 and 2 <b>Ch. 1 &amp; 2</b>	√ Quiz Ch 1&2	Students read Ch. 1 & 2 over summer Summer reading: book of teacher's choice ex. <i>The Double Helix</i> by James Watson
<b>A. CHEMISTRY OF CELLS</b>	<b>Ch. 3-6</b>		
1. WATER characteristics polarity pH	Ch. 3 p. 41-50		String demo Capillary tube demo Penny-surface tension – student activity Study guide Ch. 3
2.ORGANIC MOLECULES Carbon functional groups Carbohydrates Proteins Lipids Nucleic acids	Ch. 4 p. 52-59 Ch. 5 p.62-84	√ Quiz – organic molecules	Lab: McMush- organic compounds  Protein structure: ribbon demo  Lab: organic compound identification Study guide Ch. 4-5
3. FREE ENERGY CHANGES Thermodynamics	Ch. 6 p.87-96		Study guide Ch. 6

Free energy			
4. ENZYMES structure function	Ch. 6 p. 96-103	√ Test Ch. 3-6	Lab: Amylase Lab: glucose oxidase Lab: Tiny Bubbles (labs replace Lab#2 in A.P. manual)
<b>B. CELLS</b>	<b>Ch. 7,8,11,12</b>		
1. PROKARYOTES AND EUKARYOTES structure differences surface/volume ratio	Ch.7 p. 108-118		Lab: surface to volume ratio Study guide Ch. 7
2. MEMBRANES structure function signal transduction pathways	Ch.7 p. 118-123 Ch.8 p. 138-152 Ch.11p.197-212	√Ch.8 activities online quiz **	Lab: AP #1 Diffusion/Osmosis Study guide Ch. 8, 11
3. SUBCELLULAR ORGANIZATION cell organelles	Ch. 7 p.123-135		
4. CELL CYCLE	Ch.12p.215-229	√Test Ch.7,8,11, 12	Lab:AP#3A.1 and 3A.2 onion root tip Video: <i>Cell Division</i>  Study guide Ch. 12
<b>C. CELLULAR ENERGETICS</b>			
1. COUPLED REACTIONS ATP Cellular respiration	Ch. 6 p. 94-96 Ch. 9 p.155-170		Study guide Ch. 9
2. FERMENTATION AND CELLULAR RESPIRATION Fermentation	Ch 9 p. 170-173	√Ch. 9 Activities online quiz	Lab:AP #5 Cell Respiration Demo: yeast fermentation
3. PHOTOSYNTHESIS chlorophyll pathways C <sub>3</sub> , C <sub>4</sub> , CAM plants	Ch. 10 p. 176-194	√Ch. 10 Activities online quiz  √Test Ch. 9 &10	Lab:AP #4 Plant Pigment and Photosynthesis Lab: Spect 20 use Demo-fluorescing chlorophyll Lab: Starch production on geraniums Study guide Ch. 10

<b>II. HEREDITY AND EVOLUTION</b>			
<b>A. HEREDITY</b>			
1. MEIOSIS AND GAMETOGENESIS meiosis Alt. of generations First land plants Seed plants Spermatogenesis oogenesis	Ch.13p.234-245 Ch.29p.576-594 Ch.30p.597-612 Ch.46p.984-989	√Ch.13 Activities online quiz	Lab:AP3B Chromosome simulation (crossing over with beads) Lab: <i>Sordaria</i> (Virtual Lab) Similar to AP Lab 3B.2 Study guides Ch. 13, 29, 30
2.EUKARYOTIC CHROMOSOMES	Ch.15p.269-284		Study guide Ch. 15
3.INHERITANCE PATTERNS Mendel Punnett Squares	Ch.14p.247-266 Ch.15p.276-284	√Test Ch. 13-15	Ch. 14 Study guide Punnett Square practice set
<b>B.MOLECULAR GENETICS</b>			
1.RNA/DNA STRUCTURE AND FUNCTION	Ch.16p.287-301 Ch.17p.303-322 Ch.18p.340-346 Ch.19p.354-356	√Ch.16 Activities online quiz	Lab: AP #6B Restriction enzyme cleavage of DNA and electrophoresis (Lambda DNA) Article “DNA is not Destiny”, <i>Discover 2006</i> Study guides Ch. 16,17,18 Discussion of <i>Double Helix</i> by James Watson
2.GENE REGULATION operons gene amplification control of gene expression	Ch.18p.346-351 Ch.19p.362-372		Lab: AP #6A Bacterial transformation Study guide Ch. 19
3. MUTATION errors on inheritance mutations genome evolution	Ch.15p.279-282 Ch.17p.322-325 Ch.18p.340-346 Ch.19p.368-372, p. 378-381 (7 <sup>th</sup> ed.)		Lab: AP. #7 Genetics of Organisms
4.VIRAL STRUCTURE AND REPLICATION	Ch.18p.328-340		
5.NUCLEIC ACID TECHNOLOGY AND APPLICATIONS DNA technology	Ch.20p.375-399	√Test Ch. 16-20	Study guide Ch. 20 Research and discussion of cloning

PCR Gel electrophoresis			
<b>C. EVOLUTIONARY BIOLOGY</b>			
1.EARLY EVOLUTION early Earth origin of life	Ch.26p.510-523 (see also Ch. 26 in 7 <sup>th</sup> Ed.)		Study guide Ch. 26
2.EVIDENCE FOR EVOLUTION Darwin Phylogeny	Ch.22p.432-442 Ch25p. 484-505		Study guide Ch. 22, 25
3. MECHANISMS OF EVOLUTION population genetics origin of species reproductive barriers genome evolution	Ch.22p.428-442 Ch.23p.445-461 Ch.24p.464-481 Ch.25p.502-505, p.504-506 in 7 <sup>th</sup> Ed of Campbell and Reese	√Quiz- genetic problems  √Ch. 24 Activities online Quiz  √Test Ch 22-24 √Ch. 25 Quiz	Hardy-Weinberg problem sets Lab:AP#8 Population Genetic & Evolution Project: Reproductive Barriers poster Study guides Ch. 23,24
<b>III.ORGANISMS AND POPULATIONS</b>			MidTerm – practice AP test
<b>A. DIVERSITY OF ORGANISMS</b>			
1.EVOLUTIONARY PATTERNS	Ch.29p.575-582 Ch.31p.616-618 Ch.32p.633-639		Study guides Ch. 29
2.SURVEY OF DIVERSITY OF LIFE major lineages	Ch26p. 522-523 Ch.27p.526-539 Ch.28p.545-572 Ch.29p.582-594 Ch.30p.600-613 Ch.31p.619-628 Ch.32p.642-644 Ch.33p.646-675 Ch.34p.678-713	√Ch. 27 Quiz	Lab: protists – microscope work Lab: bacteria – microscope work

<p>3.PHYLOGENIC CLASSIFICATION</p> <ul style="list-style-type: none"> <li>bacteria</li> <li>protists</li> <li>algae</li> <li>plants</li> <li>fungi</li> <li>invertebrates</li> <li>vertebrates</li> </ul>	<p>Ch.25p.492-494  Ch.26p.523-524  Ch.27p.526-528  Ch.27p.535-539  Ch.28p.545-572  Ch.29p.575-596  Ch.30p.597-613  Ch.31p.616-628  Ch.32p.633-635  Ch.32p.639-644  Ch.33p.646-675  Ch.34p.678-713</p>	<p>√Ch 32 &amp; 33 Quiz</p>	<p>Parade through the kingdoms packet (Study guides for Ch. 27, 28, 31, 32, 33, 34)</p> <p>Project: Classification (students assigned a phylum and develop a handout for other students)</p> <p>Lab practical on invertebrates</p>
<p>4. EVOLUTIONARY RELATIONSHIPS</p> <ul style="list-style-type: none"> <li>homologies</li> </ul>	<p>Ch.25p.432-442</p>		<p>2nd practice exam</p>
<p><b>B.STRUCTURE AND FUNCTION OF PLANTS AND ANIMALS</b></p>			
<p>1.PLANT REPRODUCTION, GROWTH AND DEVEL.</p>	<p>Ch.21p.406-412  Ch.29p.578-596  Ch.30p.597-612  Ch.35p.729-745  Ch.38p.783-797</p>	<p>√Ch. 21 Activities online quiz</p>	<p>Lab: AP #9 Transpiration  Lab: Whole Plant Transpiration (marigolds)  Study guides Ch. 29,30, 35, 38  Video: <i>First Flowers</i> by Discovery Channel</p>
<p>2. ANIMAL REPRO, GROWTH AND DEVEL</p> <ul style="list-style-type: none"> <li>animal reproduction</li> <li>animal development</li> </ul>	<p>Ch.21p.402-412  Ch.46p.975-984  Ch.47p.998-1019</p>	<p>√2nd practice AP exam</p> <p>√Ch. 46 Activities online quiz</p> <p>√Ch 47 Activities online quiz</p>	<p>Study guides Ch. 46,47</p>
<p>3.PLANT ADAPTATIONS</p> <ul style="list-style-type: none"> <li>vascular plants</li> <li>seed plants</li> <li>plant structure and growth</li> <li>transport</li> <li>nutrition</li> </ul>	<p>Ch.29p.575-596  Ch.30p.597-613  Ch.35p.720-728  Ch.36p.748-764  Ch.37p.767-780  Ch.38p.783-797  Ch.39p.802-829</p>	<p>√Ch. 37 Activities online quiz</p> <p>√Ch. 35-37 Quiz</p> <p>√Ch. 38 &amp; 39 Quiz</p>	<p>Lab: Angiosperm flower structure  Lab: looking at stomata  Lab: celery with dye  Study guide Ch. 36-38</p>

biotechnology responses			
4.ANIMAL ADAPTATIONS body systems animal behavior	Ch.40p.834-847 Ch.41p.850-866 Ch.42p.871-897 Ch.43p.900-916 Ch.44p.925-952 Ch.45p.955-972 Ch.46p.975-995 Ch.48p.1022-1051 Ch.49p.1057-1086 Ch.51p.1122-1148	√Ch. 41 Activities online quiz √CH. 41&42 Quiz	Lab: AP 10C – <i>Daphnia</i> Experiment (virtual lab) Study guides Ch. 41-45, 48,49, 51
5.PLANT RESPONSE	Ch.39p.802-829		Lab: Gravitropism of corn seeds Study guide Ch. 39
6.ANIMAL RESPONSE homeostasis immune system endocrine system nervous system sensory organs	Ch.40p.842-847 Ch.43p.871-908 Ch.44p.925-941 Ch.45p.955-972 Ch.48p.1022-1026 Ch.49p.1057-1074 Ch.51p.1121-1122	√Quiz Ch. 44 &45	Lab: AP #11 Animal behavior Lab: AP #10 Physiology of circulatory system Lab: Respiration- Vital Capacity
<b>C. ECOLOGY</b>			
1.POPULATION DYNAMICS population ecology	Ch.52p.1151-1171		Study guide Ch. 52
2.COMMUNITIES AND ECOSYSTEMS biomes abiotic factors primary production chemical cycling	Ch.50p.1095-1118 Ch.53p.1174-1195 Ch.54p.1198-1221		Lab: AP #12 Dissolved oxygen and aquatic productivity Study guides Ch. 53,54 3 <sup>rd</sup> practice exam
3. GLOBAL ISSUES	Ch.50p.1092-1106 Ch.54p.1214-1221 Ch.55p.1224-1245	√Test Ch 50-55	Video: <i>An Inconvenient Truth</i> by Al Gore followed by class discussion Study guide Ch. 55

## Lab/activities for major topic areas:

### Molecules and Cells

1. demonstration using string to show properties of water – adhesion/cohesion (teacher led)
2. capillary tube demonstration – adhesion/cohesion properties of water (teacher led)
3. Lab: using pennies and drops of water to show surface tension (student- wet lab)
4. McMush lab: take a “Happy Meal”, blend it up and test for organic compounds (proteins, carbohydrates, and lipids) (student wet lab)
5. student activity: using ribbon to show protein structure formation (hand’s on)
6. Lab: Organic compounds -students test for known and unknown organic compounds. (student – wet lab)
7. Lab- Amylase enzyme lab ([www.science-projects.com/Amylase.htm](http://www.science-projects.com/Amylase.htm)) – students use amylase to look at breakdown of starch (student – wet lab)
8. Lab- Glucose Oxidase lab – students investigate the effect of temperature, substrate concentration and specificity on enzymes (student wet-lab)
9. Lab: Tiny Bubbles – students investigate the effect of hydrogen peroxide on yeast and they also design their own experiment to test effect of temperature or substrate (student wet-lab)
10. Lab: Surface volume to ratio – Students use agar blocks and phenolphthalein to find out the relationship of surface area to volume (student wet-lab)
11. Lab: AP Lab #1 Diffusion and Osmosis (student wet-lab)
12. Lab: AP Lab #3A – Mitosis (student – dry lab)
13. Lab: AP Lab #5 Cell respiration (student wet-lab)
14. Lab: Yeast fermentation – Students put yeast and varying amounts of sugar in fermentation tubes and measure the carbon dioxide produced. (student wet-lab)
15. Lab: Introduction to Use of Spec 20 – students get used to using the Spec 20 by measuring colored cellophane at different wavelengths and then generating a graph (student – dry lab)
16. Lab: AP Lab #4 Plant Pigments and Photosynthesis (student wet-lab)
17. Demonstration – Fluorescing of chlorophyll (teacher led)
18. Lab: Starch production on geraniums – students use black construction paper on geranium leaves to look for absence of starch production (student wet-lab)

### Heredity and Evolution

1. Lab: AP Lab #3 B.1 – simulation of meiosis (student dry lab)
2. Lab: Internet Lab based on AP Lab #3B.2 *Sordaria* lab found at [www.biology.com](http://www.biology.com)
3. Genetics problem sets

4. Lab: AP Lab #6B Restriction Enzyme Cleavage of DNA and Electrophoresis (Lambda DNA) (student wet-lab)
5. Lab: AP Lab #6A Bacterial Transformation (student wet-lab)
6. Lab: AP Lab #7 Genetics of Organisms (student wet-lab)
7. Hardy-Weinberg problem sets
8. Lab: AP Lab: #8 Population Genetics and Evolution (student dry lab)
9. Project: reproductive barriers poster – students design a poster to show different types of reproductive barriers

### **Organisms and Populations**

1. Lab: Protists – students investigate different protists using the microscope (student dry lab)
2. Lab: Bacteria – students investigate different bacteria using the microscope (Student dry lab)
3. Virtual lab: Heart rate of *Daphnia* [www.biology.com](http://www.biology.com) choose 6<sup>th</sup> Ed. Of Campbell and Reece, choose chapter 42
4. Classification Project – students research on of the invertebrate phyla and create a handout on major characteristics, representative organisms, methods of locomotion, evolutionary history, methods of feeding, reproduction, location, circulation, adaptations, etc.
5. Lab: Lab #9 Transpiration (student wet-lab)
6. Lab: Whole plant transpiration with marigolds – Students use same variable for the whole plant that are used in AP Lab #9 (student wet-lab)
7. Lab: Flower structure – Students dissect a flower to look at the structures and relate functions (student dry lab)
8. Lab: celery in dye – to show how dye is carried in plant (student wet-lab)
9. Lab: Stomata – Students look at stomata using a variety of techniques (leaves, Nail polish technique) (student wet-lab)
10. Lab: Corn gravitropism – Students investigate gravitropism using corn seeds (student wet-lab)
11. Lab: AP Lab #11 Animal Behavior (student dry lab)
12. Lab: AP Lab #10 Physiology of Circulatory System (student dry lab)
13. Lab: Vital Capacity lab using a wet Spirometer (student dry lab)
14. Lab: AP Lab #12 Dissolved Oxygen and Aquatic Primary Productivity (student wet-lab)

## **Teaching Strategies**

The course textbook:

Campbell, Neil A. and Jane B. Reece, Biology 6<sup>th</sup> Edition, Pearson Education, Inc. San Francisco, Ca., 2002

Lab Manual:

*AP Biology Lab Manual for Students*, College Board, 2001

## Lab Component

Due to the extra lab periods, 11 of the suggested AP Biology labs in the *Biology Lab Manual for Students* published by the College Board are completed (AP lab 2 is accomplished using three other labs) and many additional labs are supplemented where appropriate. At least one double period is utilized to complete the labs, a class before to prep for the lab and a class after to discuss data. Labs such as Fruit fly genetics are spread out over a long time period so the students may use several classes each week to gather data and continue procedures. In each of these laboratory experiences, students use the scientific method to solve biological problems. For some of the labs, students are expected to write formal lab reports that include: title, abstract, background, materials and methods, data and data analysis, conclusion and validity. If they do not write labs, they are answering questions in the AP Lab Manual or questions for non AP Lab manual labs.