AP BIOLOGY COURSE OUTLINE
2009-2010

Introduction:

AP Biology is an intensive course designed to be the equivalent of an introductory biology course taken in college. The emphasis is on developing an understanding of biological concepts rather than an accumulation of facts. The student should understand and appreciate the science of biology as a process and a personal experience in scientific inquiry that develops their problem solving and critical thinking skills.

This course also prepares the high school student to take the AP exam given in May. In order to pass the exam (usually this is with a score of 3 or higher), students must be highly motivated and driven to excel in this challenging course. The format for this class will be primarily lecture and lab, supported by interactive labs, hands on activities, and quia review

Prerequisites:

There are few prerequisites for this course. However, in order to be successful on the AP exam, it is recommended that students have had success in both Biology & Chemistry. Junior or Senior status is preferred, sophomores may be considered for this course with special permission.

Materials required:

1) Textbook -

Campbell, Neil A., and Jane B. Reece., Mitchell, Lawrence G. Biology. 5th ed. San Francisco: Benjamin Cummings, 1999.

2) Lab Manual -

Biology Lab Manual. The College Board, 2001.

3) Three ring binder: (3-4") – with 20 tabs with the following headings:

Topics for Binder Index Tabs:

1. Themes in Biology (Chpt 1)
2. The Chemistry of Life (Chpt 2)
3. Water, Carbon, Macromolecules (Chpt 3,4,5)
4. Cell Physiology (Chpt 7,8)
5. Cell Processes (Chpt 11,12)
6. Genetics (Chpts 13-21)
7. Evolution (Chpts 22-25)
8. Prokaryotes (Chpt 27)
9. Eukaryote Diversity (Chpt 28)
10. Plants & Plant Physiology (Chpts 29-30,35 -39)
11. Fungi (Chpt 31)
12. Invertebrates (Chpt 33)
13. Vertebrates (Chpt 34)
14. Animal structure & function (Chpt 40)

15. Animal Anatomy & Physiology (Chpts 41-45, 48,49)
16. Embryology & Development (Chpts 46,47)
17. Ecology (Chpts 50-55)

Optional sections:
18. Terminology – Root Word Quizzes & Key Term Lists
19. Free Response Questions & Sample Questions
20. Labs

Grading Guideline for AP Biology

This course is graded using the total point system. Total points earned divided by total points possible. The more demanding the project, lab or test, the more points possible. Each assignment should indicate the point value. Key terms placed in the vocabulary composition book will be valued at ½ point per definition. The district grading scale will also be used for figuring grades.

AP BIOLOGY CONCEPT OUTLINE

The following guideline from College Board gives the topics that should be covered in this course and the approximate percentage of time that should be devoted to them.

I. Molecules and Cells (25%)

A. Chemistry of Life (7%)

1. Water
2. Organic molecules in organisms
3. Free energy changes
4. Enzymes

B. Cells (10%)

1. Prokaryotic and eukaryotic cells
2. Membranes
3. Subcellular organization
4. Cell cycle and its regulation

C. Cellular Energetics (8%)

1. Coupled reactions
2. Fermentation and cellular respiration
3. Photosynthesis

II. Heredity and Evolution (25%)

A. Heredity (8%)

1. Meiosis and gametogenesis
2. Eukaryotic chromosomes
3. Inheritance patterns

B. Molecular Genetics (9%)

1. RNA and DNA structure and function
2. Gene regulation
3. Mutation
4. Viral structure and replication
5. Nucleic acid technology and application

C. Evolutionary Biology (8%)

1. Early evolution of life
2. Evidence for evolution
3. Mechanisms of evolution

III. Organisms and Population (50%)

A. Diversity of Organisms (8%)

1. Evolutionary patterns
2. Survey of the diversity of life
3. Phylogenetic classification
4. Evolutionary relationships

B. Structure and Function of Plants and Animals (32%)

1. Reproduction, growth, and development
2. Structural, physiological, and behavioral adaptations
3. Response to the environment

C. Ecology (10%)

1. Population dynamics
2. Communities and ecosystems
3. Global issues

LABS

AP students will be required to do a minimum of 12 predetermined AP labs. Several of these will be written up as formal lab reports. Additional labs will be completed in a composition book. Due to the nature of lab work and the significance of the labs to the final AP Exam, labs will typically be valued at 100 points or more. We complete these labs in 1-2 class periods (3 hours), with most of the lab write up and evaluation and conclusion completed outside of the classroom. *The fruit fly lab is an exception – as it takes several weeks to complete.*

12 Recommended AP Biology Laboratories

1.) Diffusion & Osmosis
2.) Enzyme Catalysis
3.) Mitosis & Meiosis
4.) Plant Pigmentation & Photosynthesis
5.) Cell Respiration
6.) Molecular Biology
7.) Genetics & Organisms
8.) Population Genetics & Evolution
9.) Transpiration
10.) Physiology of the Circulatory System
11.) Animal Behavior
12.) Dissolved Oxygen & Aquatic Primary Productivity

AP Biology lab objectives are outlined with additional documentation.

AP Lab Reports

Lab reports (formal) must be typed. Lab reports should follow the following format. Use the explanation for each section as a guideline. Labs (demo labs) should be legibly written in student composition books following the same general format.

1. TITLE / TOPIC

2. ABSTRACT: Background information that could prove relevant to the lab. Include pertinent information about the topic. The abstract can also be a type of introduction or a compilation of information about the topic that could provide insight or information relevant to the topic.

3. PROBLEM / QUESTION: Identify a focused problem or research question.

4. HYPOTHESIS: Formulate a hypothesis or prediction that is directly related to the research question and is explained (quantitatively where appropriate).

5. VARIABLES: Select appropriate independent, dependent, and controlled variables (this includes control group and constants).

6. MATERIALS: Select appropriate apparatus or materials.

7. PROCEDURE: Describe a method that allows for the control of the variables and the collection of sufficient relevant data. This should be written in numbered steps; avoid words such as then, next, finally, first (they are redundant when using numbered steps).

8. DATA COLLECTION / RESULTS: Record appropriate raw data (qualitative and/or quantitative), including units and uncertainties where necessary. Present data clearly, allowing for easy interpretation. Process the data correctly and present the data appropriately. This should include some version of a graphic organizer (graph, chart, or table). Any lab questions given should be answered here.

9. EVALUATION / CONCLUSION: This should include your judgment of the processes used to plan, perform and investigate your lab. Give a valid conclusion based on the results of the experiment, with an explanation. You may need to compare results with other results. Relate this conclusion to your original hypothesis. Evaluate the strengths and weaknesses of you procedure and results, and state realistic suggestions to improve the investigation. To do this, you might use the following suggested sentences:

"The experimental design is judged to be adequate/inadequate because…"
"The procedure is judged to be adequate/inadequate because…"
"Based upon my evaluation of the experiment, I am not/moderately/very certain of my experimental results. The major sources of uncertainty are…."

AP BIOLOGY

AP Biology is a ***college*** course taught in the high school. Colleges expect a student to have had an "equivalent" experience to their freshman course, including laboratories, and to have mastered its content. If your main goal for taking this course is to obtain credit for an introductory college biology course, you should make contact with the colleges you are likely to attend (talk to the counselor for more information as well). Find out if they accept AP scores for credit (not all of them do).

The AP Exam

The exam is three hours long and consists of two sections:

Section I (80 minutes; 60% of student's total grade):
100 multiple-choice questions that examine the student's understanding of representative content and concepts drawn from across the entire course. To be broad enough in scope to give every student who has covered an adequate amount of material an opportunity to perform well, this section must be so comprehensive that no student should be expected to attain a perfect or near-perfect score. Thought-provoking problems and questions based on fundamental ideas from biology are included along with questions based on the recall of basic facts and major concepts. As a correction for haphazard guessing, *one-fourth of the number of questions answered incorrectly will be subtracted from the number of questions answered correctly*. As a general rule, if you can narrow the multiple choice responses down to two likely answers, I would use my best guess, otherwise you should avoid pure guessing as an option for answering AP test questions.

Section II (10 minute reading time / 90 minutes for essays; 40% of student's total grade):
Four mandatory, equally weighted free-response questions that encompass broader topics. One essay question is usually taken from Area I of the outline (Molecules and Cells) and another question focuses on Area II (Heredity and Evolution). Two questions generally focus on Area III of the outline (Organisms and Populations). Any of these four questions may require the student to analyze and interpret data or information drawn from lab as well as from lecture material, and may require students to integrate material from different areas of the course.

Students are asked to organize answers to broad questions, thereby demonstrating reasoning and analytical skills, as well as an ability to synthesize material from several sources into a cogent and coherent essay. **To prepare, students should practice writing free-response answers whenever appropriate during the course**. Answers to the free-response questions must be in **essay form**; outlines alone or unlabeled and unexplained diagrams alone are not acceptable.

The AP exams are intended to have average scores of about 50 percent of the maximum possible score for the multiple-choice section and for the free-response section. Thus, students may find them more difficult than most classroom examinations. However, it is possible for students who have studied most but not all of the topics in the outline to obtain satisfactory grades.

AP GRADES:

The scores on the essay and problem solving questions are combined with the results of the computer scored multiple choice questions, and the total raw scores are converted to a composite score on AP's 5-point scale:

5 = Extremely well qualified
4 = Well qualified
3 = Qualified
2 = Possibly qualified
1 = No recommendation

The AP Biology exam is Monday, May 10, 2010

AP Biology Syllabus

We have block scheduling that allows students a class period of 1 ½ hours every other day. Prior to actual "unit by unit" or "chapter by chapter" instruction, students are given the following:

- Root word lists – these will be studied for 10 consecutive class periods; comprehensive quizzes will follow the brief overview of the latin and greek word origins.
- Vocabulary lists – "Key Terms" – this is a representation of the vocabulary that is critical for the unit by unit information. Students will be expected to provide meanings for each set of "Key Terms" that are provided for them throughout the year. These will be kept in a comprehensive composition book.
- Quia Reviews, Quizzes & Activities – throughout the course of the year, we will use the Quia website to review and complete on line quizzes and activities that prove valuable to the students. Examples of created resources:

Mitosis, Meiosis, & the Cell Cycle - http://www.quia.com/jg/771337.html
Invertebrate/Vertebrate Dissection Battleship http://www.quia.com/ba/107926.html
Plant Review - http://www.quia.com/rr/231355.html
Tough Genetics - http://www.quia.com/rr/139729.html

Unit	Chapter(s)	Activities, Labs, Assessments
"Themes" in Biology	**1**	**Pretest** **Overview** **Scientific lab write up – demo lab (varied)**
Chemistry of Life	**2**	****AP lab – Enzyme Catalysis**** **Labbench Activity** http://www.phschool.com/science/biology_place/labbench/lab2/intro.html **Unit Test**
Water, Carbon & Macromolecules	**3 - 5**	**pH Lab** **Adhesion/Cohesion Lab** ****AP lab – Diffusion & Osmosis**** **Unit Test**
Cell Physiology & Cell Processes	**7, 8** **11,12**	**Cell Tour Project** ****AP lab – Mitosis**** **The Biology Project Activity** http://www.biology.arizona.edu/cell_bio/activities/cell_cycle/cell_cycle.html **Labbench Activity** http://www.phschool.com/science/biology_place/labbench/lab3/intro.html ****AP lab – Cell Respiration**** **Unit Test**
Genetics	**13-21**	****AP lab – Genetics of Organisms**** ***Drosophila* Lab** **Biocoach Activity** http://www.phschool.com/science/biology_place/biocoach/dnarep/intro.html **LabBench Activities** http://www.phschool.com/science/biology_place/labbench/lab7/intro.html http://www.phschool.com/science/biology_place/labbench/lab6/intro.html ****AP lab – Molecular Biology**** **Unit Test**

Evolution & Evolutionary Biology	**22-25**	**Natural Selection Lab** ****AP lab – Population Genetics & Evolution**** **Unit Test**
SEMESTER TEST		**COMPREHENSIVE SEMESTER TEST**
Prokaryotes	**27**	**Self paced Unit** **Bacteria pamphlet** **Biocoach Activity** http://www.phschool.com/science/biology_place/biocoach/cells/intro.html
Eukaryote Diversity	**28**	**Self paced Unit** **Cell sample activity** ***Protista* Comparison Activity** **Taxonomic Key Identification project** **Unit quiz**
Plants & Plant Physiology	**29-30, 35-39**	****AP lab – Plant Pigments & Photosynthesis**** **Botany Leaf project** **Stomata Lab** ****AP lab – Transpiration**** **Labbench Activity** http://www.phschool.com/science/biology_place/labbench/lab4/intro.html **Unit Test**
Fungi	**31**	**Self paced Unit** **Fungi power point presentation**
Invertebrates & Vertebrates	**33 – 34**	**Classification lab** **Specimen quiz** **Various Dissections** **(ascaris, clam, squid, cat)** **Unit Test**
Animal Structure & Function	**40**	****AP lab – Animal Behavior**** **Form = Function free response draw**
Animal Anatomy & Physiology	**41-45, 48, 49**	**Varied organ dissections** **(eye, kidney, heart)** **Biocoach Activities** http://www.phschool.com/science/biology_place/biocoach/cardio1/intro.html http://www.phschool.com/science/biology_place/biocoach/cardio2/intro.html ****AP lab – Physiology of the Circulatory System**** **Urinalysis Lab** **Unit Test**
Embryology & Development	**46, 47**	**Microscopic Embryology lab (chick & frog)** **Unit Test**
Ecology	**50 - 55**	****AP lab – Dissolved Oxygen & Primary Productivity**** **Biome Overview & Evaluation** **Aquatic & Terrestrial Biomes** **Dandelion Lab** **Unit Test**

AP Biology Lab Objectives:

LABORATORY #1- DIFFUSION AND OSMOSIS

OVERVIEW

In this laboratory you will investigate the process of diffusion and osmosis in a model of a membrane system. You also will investigate the effect of solute concentration on water potential as it relates to living plant tissues.

OBJECTIVES

Section A: Before doing this laboratory you should understand:

- the mechanisms of diffusion and osmosis and their importance to cells
- the effects of solute size and concentration gradients on diffusion across selectively permeable membranes
- the effects of a selectively permeable membrane on diffusion and osmosis between two solutions separated by the membrane
- the concept of water potential
- the relationship between solute concentration and pressure and the water potential of a solution
- the concept of molarity and its relationship to osmotic concentration

Section B: After doing this laboratory you should be able to:

- measure the water potential of a solution in a controlled experiment
- determine the osmotic concentration of living tissue or an unknown solution from experimental data
- describe the effects of water gain or loss in animal and plant cells
- relate osmotic potential to solute concentration and water potential

LABORATORY #2- ENZYME CATALYSIS

OVERVIEW

In this laboratory you will measure the amount of product generated and then calculate the rate of conversion of hydrogen peroxide (H_2O_2) to water and oxygen gas by the enzyme catalase.

OBJECTIVES

Section A: Before doing this laboratory you should understand:

- the general functions and activities of enzymes
- the relationship between the structure and function of enzymes
- the concepts of initial reaction rates of enzymes
- how the concept of free energy relates to enzyme activity

- how pH relates to enzyme activity
- that changes in temperature, pH, enzyme concentration, and substrate concentration can affect the initial reaction rates of enzyme-catalyzed reactions

Section B: After doing this laboratory you should be able to:

- measure the effects of changes of temperature, pH, enzyme concentration, and substrate concentration on reaction rates of an enzyme-catalyzed reaction in a controlled experiment
- explain how environmental factors affect the rate of enzyme-catalyzed reactions

LABORATORY #3- MITOSIS AND MEIOSIS

OVERVIEW

Exercise 3A is a study of mitosis. You will use prepared slides of onion root tips to study plant mitosis and to calculate the relative duration of the phases of mitosis in the meristem of root tissue. Prepared slides of the whitefish blastula will be used to study mitosis in animal cells and to compare animal mitosis and plant mitosis

Exercise 3B is a study of meiosis. You will simulate the stages of meiosis by using chromosome models. You will study the crossing over and recombination that occurs during meiosis. You will observe the arrangements of ascospores in the asci from a cross between wild type and mutants for tan spore coat color in the fungus *Sordaria fimicola*. These arrangements will be used to estimate the percentage of crossing over that occurs between the centromere and the gene that controls that tan spore color.

OBJECTIVES

Section A: Before doing this laboratory you should understand:

- the key mechanical and genetic differences between meiosis and mitosis
- the events of mitosis in animal and plant cells
- the events of meiosis (gametogenesis) in animal and plant cells

Section B: After doing this laboratory you should be able to:

- recognize the stages of mitosis in a plant or animal cell
- calculate the relative duration of the cell cycle stages
- describe how independent assortment and crossing over can generate genetic variation among the products of meiosis
- use chromosome models to demonstrate the activity of chromosomes during Meiosis I and Meiosis II
- relate chromosome activity to Mendelian segregation and independent assortment
- calculate the map distance of a particular gene from a chromosome's center for between two genes using an organism of your choice in a controlled experiment
- demonstrate the role of meiosis in the formation of gametes using an organism of your choice, in a controlled experiment

- compare and contrast the results of meiosis and mitosis in plant cells
- compare and contrast the results of meiosis and mitosis in animal cells

LABORATORY #4- PLANT PIGMENTS AND PHOTOSYNTHESIS

OVERVIEW

In this laboratory you will separate plant pigments using chromatography. You also will measure the rate of photosynthesis in isolated chloroplasts. The measurement technique involves the reduction of the dye, DPIP. The transfer of electrons during the light-dependent reactions of photosynthesis reduces DPIP and changes its color from blue to colorless.

OBJECTIVES

Section A: Before doing this laboratory you should understand:

- how chromatography separates two or more compounds that are initially present in a mixture
- the process of photosynthesis
- the function of plant pigments
- the relationship between light wavelength or light intensity and photosynthetic rate

Section B: After doing this laboratory you should be able to:

- separate pigments and calculate their Rf values
- describe a technique to determine photosynthetic rates
- compare photosynthetic rates at different temperatures, different light intensities, and different wavelengths of light in a controlled experiment
- explain why the rate of photosynthesis vary under different environmental conditions

LABORATORY #5- CELL RESPIRATION

OVERVIEW

Seeds are living but dormant. When conditions necessary to begin growth are achieved, germination occurs, cellular reactions are accelerated, and the rate of respiration greatly increases. In this laboratory you will measure oxygen consumption during respiration as the change in gas volume in respirometers containing either germinating or nongerminating peas. In addition, you will measure the respiration of these peas at two different temperatures.

OBJECTIVES

Section A: Before doing this laboratory you should understand:

- how a respirometer works in terms of the gas laws
- the general process of metabolism in living organisms

Section B: After doing this laboratory you should be able to:

- test the effects of temperature on the rate of cell respiration in ungerminated versus germinated seeds in a controlled experiment
- calculate the rate of cell respiration from experimental data
- relate gas production to respiration rate

LABORATORY #6- MOLECULAR BIOLOGY

OVERVIEW

In this laboratory, you will investigate some basic principles of genetic engineering. Plasmids containing specific fragments of foreign DNA will be used to transform *Escherichia coli* cells, conferring antibiotic (ampicillin) resistance. Restriction enzyme digests of phage lambda DNA also will be used to demonstrate techniques for separating and identifying DNA fragments using gel electrophoresis.

OBJECTIVES

Section A: Before doing this laboratory you should understand:

- how gel electrophoresis separates DNA molecules present in a mixture
- the principles of bacterial transformation
- the conditions under which cells can be transformed
- the process of competent cell preparation
- how a plasmid can be engineered to include a piece of foreign DNA
- how plasmid vectors are used to transfer genes
- how antibiotic resistance is transferred between cells
- how restriction endonucleases function
- the importance of restriction enzymes to genetic engineering experiments

Section B: After doing this laboratory you should be able to:

- use plasmids as vectors to transform bacteria with a gene for antibiotic resistance in a controlled experiment
- demonstrate how restrictions enzymes are used in genetic engineering
- use electrophoresis to separate DNA fragments
- describe the biological process of transformation in bacteria
- calculate transformation efficiency
- be able to use multiple experimental controls
- design a procedure to select positively for antibiotic resistant transformed cells
- determine unknown DNA fragment sizes when given DNA fragments of known size

LABORATORY #7- GENETICS OF ORGANISMS

OVERVIEW

In this laboratory, you will use fruit flies to do genetic crosses. You will learn how to collect and manipulate fruit flies, collect data from F1 and F2 generations, and analyze the results from a monohybrid, dihybrid, or sex-linked cross.

OBJECTIVES

Section A: Before doing this laboratory you should understand:

- chi-square analysis of data
- the life cycle of diploid organisms useful in genetics studies

Section B: After doing this laboratory you should be able to:

- investigate the independent assortment of two genes and determine whether the two genes are autosomal or sex-linked using a multi-generation experiment
- analyze the data from your genetic crosses chi-square analysis techniques

LABORATORY #8- POPULATION GENETICS AND EVOLUTION

OVERVIEW

In this activity, you will learn about the Hardy-Weinberg law of genetic equilibrium and study the relationship between evolution and changes in allele frequency by using your class as a sample population.

OBJECTIVES

Section A: Before doing this laboratory you should understand:

- how natural selection can alter allelic frequencies in a population
- the Hardy-Weinberg equation and its use in determining the frequency of alleles in a population
- the effects on the allelic frequencies of selection against the homozygous recessive or other genotypes

Section B: After doing this laboratory you should be able to:

- calculate the frequencies of alleles and genotypes in the gene pool of a population using the Hardy-Weinberg formula
- discuss natural selection and other causes of microevolution as deviations from the conditions required to maintain Hardy-Weinberg equilibrium

LABORATORY #9 -TRANSPIRATION

OVERVIEW

In this laboratory, you will apply what you learned about water potential from Laboratory 1 (Diffusion and Osmosis) to the movement of water within the plant. You will measure transpiration under different laboratory conditions. You also will study the organization of the plant stem and leaf as it relates to these processes by observing sections of tissue.

OBJECTIVES

Section A: Before doing this laboratory you should understand:

- how water moves from roots to leaves in terms of physical/chemical properties of water and the forces provided by differences in water potential
- the role of transpiration in the transport of water within a plant
- the structures used by plants to transport water and regulate water movement

Section B: After doing this laboratory you should be able to:

- test the effects of environmental variables on rates of transpiration using a controlled experiment
- make thin section of stem, identify xylem and phloem cells, and relate the function of these vascular tissues to the structures of their cells.

LABORATORY #10 -PHYSIOLOGY OF THE CIRCULATORY SYSTEM

OVERVIEW

In Exercise 10A, you will learn how to measure blood pressure. In Exercise 10B, you will measure pulse rate under different physiological conditions: standing, reclining, after the baroreceptor reflex, and during and immediately after exercise. The blood pressure and pulse rate will be analyzed and related to a relative fitness index. In Exercise 10C, you will measure the effect of temperature on the heart rate of the water flea, *Daphnia magna*.

OBJECTIVES

Section A: Before doing this laboratory you should understand:

- the relationship between temperature and rates of physiological processes
- basic anatomy of various circulatory systems

Section B: After doing this laboratory you should be able to:

- measure heart rate and blood pressure in a human volunteer
- describe the effect of changing body position on heart rate and blood pressure
- explain how exercise changes heart rate
- determine a human's fitness index
- analyze pooled cardiovascular data
- discuss and explain the relationship between heart rate and temperature

LABORATORY #11- ANIMAL BEHAVIOR

OVERVIEW In this laboratory, you will observe the behavior of an insect and design an experiment to investigate its responses to environmental variables. You also will observe and investigate mating behavior.

OBJECTIVES

Section A: Before doing this laboratory you should understand:

- the concept of distribution of organisms in a resource gradient
- the difference between a kinesis and a taxis

Section B: After doing this laboratory you should be able to:

- measure the effects of environmental variables on habitat selection in a controlled experiment
- describe the different types of insect mating behaviors

LABORATORY #12 - DISSOLVED OXYGEN AND AQUATIC PRIMARY PRODUCTIVITY

OVERVIEW In Exercise 12A, you will measure and analyze the dissolved oxygen concentration in water samples at varying temperatures. In Exercise 12B, you will measure and analyze the primary productivity of natural waters or laboratory cultures as a function of light intensity.

OBJECTIVES

Section A: Before doing this laboratory you should understand:

- the biological importance of carbon and oxygen cycling in ecosystems
- how primary productivity relates to the metabolism of organisms in an ecosystem
- the physical and biological factors that affect the solubility of gasses in aquatic ecosystems
- the relationship between dissolved oxygen and the process of photosynthesis and respiration as they affect primary productivity

Section B: After doing this laboratory you should be able to:

- measure primary productivity based on changes in dissolved oxygen in a controlled experiment
- investigate the effects of changing light intensity and/or inorganic nutrient concentrations on primary productivity in a controlled experiment