**AP Biology Syllabus**
**Department of Defense Education Activity**
**This syllabus was modeled after the CollegeBoard AP Biology Sample Syllabus #3.**

**Course Title:** Advanced Placement Biology

**Meeting Times:** The class meets for 80 minutes every other day for 36 weeks.
**Lab Times:** Laboratory experiences comprise 30% of the class time throughout the school year.

**Course Description:**

AP Biology provides an understanding of the unifying themes and fundamental concepts and principles of biology with an emphasis on inquiry and critical thinking skills including: problem solving, mathematical reasoning, and experimental investigations. Topics of study include: molecules and cells, heredity and evolution, and organisms and populations. Laboratory work is an integral component of this course. Technology including graphing calculators, probe ware, graphing and data analysis software, and biological apparatus is used throughout this course.

Though our system has an open enrollment policy, students should understand that this course is designed to be a second year biology course, and the equivalent of a two-semester long introductory, college level biology course. The course requires a working knowledge of biology, and chemistry. The breadth, pace and depth of material covered exceeds the standard high school Biology course, as does the college-level textbook, laboratory work, and time and effort required of students. This course provides the biology foundations for college majors in biology. Students are expected to take the AP Biology Exam at the end of this course.

**Course Purpose and Goals:**

<u>Philosophy</u>

Scientific inquiry is the basis of this course. Scientific inquiry is defined as the diverse ways in which scientists study the natural world and propose explanations based on the evidence derived from their work. Scientific inquiry also refers to the activities through which students develop knowledge and understanding of scientific ideas, as well as an understanding of how scientists study the natural world (NSTA, 2004). This includes active use of the well-designed investigation in which students: 1) form testable questions and hypotheses, 2) design and conduct appropriate investigative procedures, including the identification and control of appropriate variables, 3) organize, display and critically analyze results, 4) draw inferences, summarize results and develop conclusions, and 5) communicate their results for critique by others. Based on the philosophy that scientific knowledge is best acquired through inquiry, the course uses a variety of techniques to promote inquiry in the classroom (ex. multiple revisions, high quality questioning, synthesis, making conclusions based on evidence, etc).

Instruction is designed and sequenced to provide students with learning opportunities in the appropriate settings. They include laboratories, classrooms, forms of technology, and field studies. Teaching strategies include in depth laboratory investigations, demonstrations, collaborative peer-to-peer discussions, and student hands-on experiences. Inquiry requires adequate and timely access to the technology of scientific investigations including computers, internet and online resources, probe ware, graphing calculators, databases, spreadsheets, word processes and presentation software, as well as the experimental apparatus of biology.

The units in this course are designed to integrate and emphasize the eight major themes from the *AP® Biology Course Description* ( Science as a process; Evolution; Energy Transfer; Continuity and Change; Relationship of structure to function; Regulation; Interdependence in nature; and Science, Technology, and society. Also, lectures for all units stress unifying evolutionary themes, such as the universal nature of the genetic codes evidence for evolution,

because students must be aware of the importance of evolution as the foundation of modern biological models and thought. In each unit students read and discuss articles from Eurekalert! the online global news service operated by the American Association for the Advancement of Science in order to develop critical thinking and to relate biological knowledge to environmental and social concerns.

**Goals**

1. To develop a conceptual understanding of the major themes of modern biology (evolution, energy transfer, continuity and change, structure and function, regulation, and interdependence) as a vehicle to investigate the concepts, principles, and topics of biology.
2. To develop and apply scientific inquiry and critical thinking skills, through active hands-on participation in the asking and answering of testable questions, and employing the components of a well-designed experimental investigation.
3. To foster scientific habits of mind including curiosity, creativity, and objectivity; and appreciate science as a process rather than an accumulation of knowledge.
4. To apply an understanding of biological knowledge and scientific methodology to environmental and social issues.

**Conceptual Organization**

The students are exposed to the equivalent of a college introductory biology course, meaning that the content and level of depth of the material is equivalent to a college level course. As with university courses, it is expected that students will be independent learners. Scientific inquiry is an integral component of this course, the elements of the well-designed investigation and the nature of the scientific methods are taught within the context of the topics, rather than treated as a separate introductory unit. As students investigate phenomena they extend their understanding of forming testable questions and hypotheses. Laboratory techniques are learned in the direct application of their use, rather than as a generic exercise isolated from their setting of application. Methods to collect, organize and display data are learned within the authentic use of real experimental data. This approach of learning uses the investigative skills within and throughout the authentic need of using and applying the skills.

The order of topics within the course, not only provides a logical and systemic study to biology, but also accommodates the frequent transfer of students within the schools of the system, so that transfer students can maintain a consistent flow of learning.

**Course Format and Policies:**
**This school system calculates weighted grades for students who complete the course and take the requisite exam of an Advanced Placement (AP) Course.**

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|---|---|
| Unweighted Scale A=4 | Weighted Scale A=5 |
| Unweighted Scale B=3 | Weighted Scale B=4 |
| Unweighted Scale C=2 | Weighted Scale C=3 |
| Unweighted Scale D=1 | Weighted Scale D=2 |
| Unweighted Scale F=0 | Weighted Scale F=0 |

As in any science class, safety is of paramount importance. The student is expected to follow general lab safety procedures, and is expected to demonstrate knowledge safety issues specific to a given lab before being allowed to begin the lab.

This class is highly organized and if the student misses a class they are expected to meet with me at some time outside of class in order to go over what they missed.

The quarter grade is determined by a weighted average in which the test average makes up 60 % of the grade, the lab report average makes up 30% of the grade and class work/homework makes up 10% of the course grade.

Late work will not be accepted unless the student has an excused absence from school for the entire school day. The missed work must be turned in the morning of the student's return to school prior to classes beginning.

**Textbook, Materials and Other Resources:**

Required Textbook

Campbell, Neil A. and Jane B. Reece. 2012. *Biology*, 9th edition, San Francisco, CA: Benjamin Cummings/Pearson Education.

- Supplemental Textbooks and Readings

  Starr, Cecie and Taggartt, Ralph. 2010. *Biology The Unity and Diversity of Life 10th Edition.* Belmont, CA: Brooks/Cole – Thomson Learning.

  The College Board. 20012. *AP Biology Lab Manual for Students, 2nd Edition.* Princeton, NJ: The College Board.

- Hanna, Kathi E,(2006). CLONING & STEM CELL RESEARCH "Cloning Embyonic Stem Cells",., http://www.genome.gov/10004765, April 2006.
- "Causes of Endangerment," Endangered Specie. Com, available at; http://www.endangeredspecie.com/causes_of_endangerment.htm,tradeAugust 2006, "The Elephants of Africa, the Poaching Problem," PBS.org, November 2006.
- GENETICALLY MODIFIED ORGANISMS (2006). "Food and Environment: Genetic Engineering", Union of Concerned Scientists, www.ucsusa.org, April 2006.
- Gibbs, Nancy, (2006). HUMAN GENETIC ENGINEERING "Dying To Have a Family", Time Magazine, available at http://www.time.com/time/magazine/printout/0,8816,1001976,00.html, March 11, 2002;
- "Polymerase Chain Reaction," National Human Genome Center, http://www.genome.gov/10000207, June 2006.
- "Genetic Mapping," Human Genome Center, http://www.genome.gov/10000715, July 2006.
- Kluger, Jeffery, (2006). GREENHOUSE EFFECT /Global Warming: "Polar Ice Caps, Melting Faster Than Ever," Time Magazine, March 26, 2006.

- Other Resources

  - Laboratory classroom that includes the space, facilities and equipment to conduct hands-on, inquiry-based investigations. This includes: microscopes, stereoscopes, electrophoresis apparatus, prepared slides, a micro centrifuge, Vernier Probware and LabQuest equipment.

  - TI 83/84 Graphing calculators

- prepared slides
- chromatographic apparatus
- respirometers
- greenhouse
- water analysis apparatus
- computers with various probes.
- Chromatography paper
- Water test kits
- Soil test kits
- pH paper

- Internet access and online resources include:
  the Campbell Biology Website
  http://www.campbellbiology.com
  Interactive Concepts in Biology CDROM Version 4.0 for:
  - Biology Labs On-Line: http://www.biologylabsonline.com.
  - The Biology Project:
    http://www.biology.arizona.edu/molecular_bio/molecular_bio.html.
  - LabBench:
    http://www.phschool.com/science/biology_place/labbench/lab7/intro.html.

**Big Idea 1—Evolution**
- FB2036 Artificial Selection Advanced Inquiry Lab
- FB2041 Understanding Evolutionary Relationships Advanced Inquiry Activity
- FB2046 Genetics of *Drosophila* Eye Color Advanced Evolution Lab

**Big Idea 2— Energy and Communication**
- FB2030 Diffusion and Osmosis Advanced Inquiry Lab
- FB2032 Water Potential Advanced Inquiry Lab
- FB2034 Photosynthesis in Leaf Disks Advanced Inquiry Lab
- FB2045 Cellular Respiration Advanced Inquiry Lab

**Big Idea 3— Genetics and Information Transfer**
- FB2031 Environmental Effects on Mitosis Advanced Inquiry Lab
- FB2033 Cancer and the Loss of Cell Cycle Control Advanced Inquiry Activity
- FB2001 Caution! Mold Crossing Ahead Advanced Genetics Lab
- FB2042 Bacterial Transformation Lab
- FB2043 Restriction Enzyme Analysis of DNA Lab

**Big Idea 4—Interactions**
- FB2038 Rate of Transpiration Advanced Inquiry Lab
- FB2037 Fruit Fly Behavior Advanced Inquiry Lab
- FB2039 Peroxidase Enzyme Activity Advanced Inquiry Lab (Flinn)

## Course Content Outline:

| **AP Biology Course Outline** | | | | |
|---|---|---|---|---|
| **Week** | **Themes and Content** | **Assignments** | **Readings** | **Assessments** |
| **Area I: Molecules and Cells**<br>**Cells are the structural and functional units of life; cellular processes are based on physical and chemical changes.** | | | | |
| **1-2** | **Unit I - Chemistry of Life**<br>Atomic Structure, Bonding, Water Carbohydrates, Proteins, Lipids, and Nucleic Acids<br>(Major Themes stressed:Continuity | AP Lab Enzyme Catalysis | **CR: Chapters 1 - 5**<br>**Supplement: Selected News Releases from** | Unit I Test and Enzyme Catalysis Lab Report |

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| | and Change, Evolution) | | **Eurekalert!** | |
| **3-4** | **Unit II – The Cell**<br>Cell Membrane Structure and Function<br>Cell Organelles and Their Functions<br>Membrane Transport<br>(Major Themes stressed: Relationship of Structure to Function, Continuity and Change, Evolution) | AP Lab Diffusion and Osmosis | **CR: Chapters 7 - 8**<br>**Supplement: Selected News Releases from Eurekalert!** | **Unit II Test and** Diffusion and Osmosis Lab Report |
| **5-7** | **Unit III – Metabolism**<br>Control of Metabolism<br>Photosynthesis<br>Respiration<br>(Major Themes stressed: Energy Transfer, Evolution, Continuity and Change) | AP Lab Plant Pigments and Photosynthesis<br>AP Lab Cell Respiration | **CR: Chapters 6, 9, 10**<br>**Supplement: Selected News Releases from Eurekalert!** | **Unit III Test and** Plant Pigments and Photosynthesis<br>Cell Respiration<br>**Lab Reports** |
| **8-9** | **Unit IV – Cell Division**<br>Mitosis<br>Meiosis<br>Genetic Variation<br>(Major Themes stressed: Continuity and Change, Evolution) | AP Lab Mitosis and Meiosis | **CR: Chapters 12 - 13**<br>**Supplement: Selected News Releases from Eurekalert!** | **Unit IV Test and** Mitosis and Meiosis Lab Report |
| **10-12** | **Unit V – Genetics**<br>Mendelian Genetics<br>The Chromosomal Basis of Inheritance<br>(Major Themes stressed: Science as a Process, Continuity and Change) | AP Lab The Genetics of Organisms | **CR: Chapters 14 - 15**<br>**Supplement: Selected News Releases from Eurekalert!** | **Unit V Test Genetics of Organisms Lab Report** |
| **13-15** | **Unit VI – Molecular Genetics**<br>DNA Replication<br>Mutations<br>Protein Synthesis<br>DNA Organization<br>Molecular Genetics of Viruses and Bacteria<br>Gene Regulation<br>Recombinant DNA<br>(Major Themes stressed: Continuity and Change, Relationship of Structure to Function, Regulation, Science, Technology and Society) | AP Lab Molecular Biology | **CR: Chapters 16 - 20**<br>**Supplement: Selected News Releases from Eurekalert!** | **Unit VI Test Molecular Biology Lab Report** |
| **16-18** | **Unit VII – Evolution**<br>Microevolution and Macroevolution<br>Natural Selection<br>Sources of Variation<br>Factors Affecting Allele Frequencies<br>Hardy-Weinberg Theorem<br>Speciation<br>Patterns of Evolution<br>(Major Themes stressed: Evolution, Continuity and Change)<br>Why Biotechnology | AP Lab Population Genetics and Evolution | **CR: Chapters 22 - 24**<br>**Supplement: Selected News Releases from Eurekalert!** | **Unit VII Test Population Genetics and Evolution Lab Report** |
| **19** | **Unit VIII – Tree of Life** | | **CR: Chapters** | **Unit VIII Test** |

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| | Taxonomy<br>Prokaryotes<br>Protists<br>Fungi<br>Plants<br>Animals<br>(Major Themes stressed: Continuity and Change, Evoultion) | | **27 - 34**<br>**Supplement: Selected News Releases from Eurekalert!** | |
| **20-22** | **Unit IX – Plants**<br>Structure and Function<br>Plant Tissues<br>Plant Reproduction<br>Plant Growth<br>Water and Sugar Transport<br>Plant Hormones<br>(Major Themes stressed: Relationship of Structure to Function, Regulation) | AP Lab<br>Transpiration | **CR: Chapters 35 - 39**<br>**Supplement: Selected News Releases from Eurekalert!** | **Unit IX Test**<br>**Transpiration Lab Report** |
| **23-26** | **Unit X – Animal Structure and Function**<br>Homeostasis<br>Respiratory System<br>Circulatory System<br>Digestive System<br>Excretory System<br>Muscular System<br>Nervous System<br>Immune System<br>Endocrine System<br>(Major Themes stressed: Relationship of Structure to Function, Regulation) | AP Biology Lab<br>Physiology of the Circulatory System | **CR: Chapters 40 – 45, 48, 49**<br>**Supplement: Selected News Releases from Eurekalert!** | **Unit X Test**<br>Physiology of the Circulatory System Lab Report |
| **27-28** | **Unit XI – Reproduction and Development**<br>Overview of Animal Reproduction<br>Mechanisms of Sexual Reproduction<br>Mammalian Reproduction<br>Embryonic Development<br>Cellular and Molecular Basis of Morphogenesis and Development in Animals<br>(Major Themes stressed: Relationship of Structure to Function, Regulation) | | **CR: Chapters 46 - 47**<br>**Supplement: Selected News Releases from Eurekalert!** | **Unit XI Test** |
| **29-31** | **Unit XII – Animal Behavior and Ecology**<br>Learning<br>Animal Cognition<br>Social Behavior<br>Population Ecology<br>Community Ecology<br>Ecological Succession<br>Ecosystems<br>(Major Themes stressed: Interdependence in Nature, Relationship of Structure to | AP Lab Animal Behavior<br>AP Lab Dissolved Oxygen and Primary Productivity | **CR: Chapters 50 - 54**<br>**Supplement: Selected News Releases from Eurekalert!** | **Unit XII Test**<br>Animal Behavior and Dissolved Oxygen and Primary Productivity Lab Reports |

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| | Function, Energy Transfer, Science, Technology and Society) | | | |
| **32** | **AP Exam Review** | | | |
| **33-36** | **Field Investigation (Major Themes stressed: Science as a Process)** | **Quadrat Analysis** | | **Quadrat Analysis Lab Report** |

## Laboratory Experience

Laboratory investigations are an integral component of this course. These investigations are equivalent to those in a college level laboratory course. The lab work in this course supports, enhances and extends the concepts and principles presented in the classroom. They also provide students with the opportunity to learn and apply new laboratory skills, foster collaborative relationships with others, and improve problem-solving skills.

The hands on laboratory investigations are inquiry based, student-centered and are a primary vehicle for learning the fundamental concepts and principles of biology. This includes active use of the well-designed investigation in which students 1) form testable questions and hypotheses, 2) design and conduct appropriate investigative procedures, including the identification and control of appropriate variables, 3) organize, display and critically analyze results, and conduct error analysis, 4) draw inferences, summarize results and develop conclusions, and 5) communicate their results for critique by others. Laboratory investigations reflect a balance of structured, guided and open-ended inquiry.

Students are required to maintain and keep a laboratory journal. Because colleges often require students to present their laboratory materials from AP courses before granting college credit for laboratory, students are expected to retain their laboratory notebooks, reports, and other materials.

The laboratory component of the course has a strong emphasis on science as a process as one of the four big ideas.

**1. Lab 1 – Diffusion and Osmosis**

*a.* Big Idea 2

*b.* See new Sample Investigation 4

i. Dialysis tubing diffusion and osmosis

ii. Tubers

ii. Unknown sucrose solutions

iv. Keep water potential calculations

*c.* Opportunities for inquiry

i. Various tubers

ii. Aquatic plants (marine vs. fresh)

ii. Vary the solute

**2. Lab 2 – Enzyme Catalysis (Catalase)**

*a.* Big Idea 4 or 1

*b.* See new Sample Investigation 13

i. Spectrophotometer lab

ii. New investigation uses turnip peroxidase

*c.* Opportunities for inquiry using catalase

i. Vary the enzyme or substrate concentration

ii. Vary the pH or temperature

iii. Vary the catalase source among the yeasts, liver, wheat germ, or bacterial sources

(1) If varying among kingdoms this could be Big Idea 1

**3. Lab 3A – Mitosis**

*a.* Big Idea 3

*b.* See new Sample Investigation 7

i. Chi squared calculation

ii. Mitotic promoters and inhibitors

iii. Karyotypes of cancer cells

*c.* Phase names are out

*d.* Opportunities for inquiry

i. Mitotic promoters and inhibitors

(1) Auxins, Phytohemagglutinin, Caffeine

ii. Vary the type of meristem

iii. Vary the slide preparation techniques

iv. Vary the times for harvest

**4. Lab 3B – Meiosis**

*a.* Big Idea 3

*b.* See new Sample Investigation 7

*c.* Sordaria section (3B.2) remains unchanged

*d.* Opportunities for inquiry

i. Lily anther harvesting

**5. Lab 4A – Plant Pigments**

*a.* Big Idea 2 or 1

*b.* If using monocots, dicots, various algae, cyanobacteria or other pigmented bacteria this could be Big Idea 1

*c.* Opportunities for inquiry

i. Vary the plant parts or species

ii. Vary the chromatography solvents

iii. Vary the stationary phase media

(1) Paper, TLC plates, Column chromatography

iv. *Drosophila* mutant eye color

**6. Lab 4B – Photosynthesis with DPIP**

*a.* Big Idea 2

*b.* See new Sample Investigation 5

i. Floating leaf disk assay

*c.* Opportunities for inquiry

i. Vary the plant parts or species

ii. Vary the light sources or wavelengths

iii. Leaves grown in the dark vs. light

**7. Lab 5 – Cell Respiration with Peas**

*a.* Big Idea 2

*b.* See new Sample Investigation 6

*c.* Opportunities for inquiry

i. Vary the types of seeds

ii. Small animals

iii. Vary the temperatures

iv. What about facilitative anaerobes?

**8. Lab 6A – Bacterial Transformation**

*a.* Big Idea 3

*b.* See new Sample Investigation 8

**9. Lab 6B – Restriction Enzymes**

*a.* Big Idea 3

*b.* See new Sample Investigation 9

**10. Lab 7 – Genetics of Organisms (Drosophila)**

*a.* Big Idea 3

*b.* Opportunities for inquiry

i. Vary the types of model organisms

ii. Vary the temperature, food, egg laying area

**11. Lab 8 – Population Genetics and Evolution (PTC)**

*a.* Big Idea 1

*b.* See new Sample Investigations 1 and 2

i. Artificial selection using a model organism

ii. Computer simulation/spreadsheet

*c.* Keep the Hardy Weinberg Equation

*d.* Opportunities for inquiry

i. Food preference questionnaire correlation to PTC vs. non-taster?

ii. Annual demographic record

**12. Lab 9 – Transpiration**

*a.* Big Idea 4

*b.* See new Sample Investigation 11

*c.* Potometer

*d.* Keep surface area calculation

| No. | Laboratory Title and Overview | Goals: Before and After Lab | Time (days) |
|---|---|---|---|
| I | INQUIRY and the NATURE of SCIENCE Laboratory: In this laboratory students will explore concepts via inquiry and hypothesis development. Students will also cover skills for viewing scientific work through a critical lens. | After the lab you should be able to:<br>• conduct inquiry investigations<br>• be a critical reader of scientific information<br>• form multiple hypotheses given a scientific topic<br>• understand the nature of science, inquiry, fraud and theory building | 3 |

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| 1 | DIFFUSION AND OSMOSIS: 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. | Before the Lab you should understand:<br><br>• the mechanisms of diffusion and osmosis and their importance to cells<br>• the effects of solute size and concentration gradients on diffusion across selectively permeable membranes<br>• the effects of a selectively permeable membrane on diffusion and osmosis between two solutions separated by the membrane<br>• the concept of water potential<br>• the relationship between solute concentration and pressure and the water potential of a solution<br>• the concept of molarity and its relationship to osmotic concentration<br><br>After the Lab you should be able to:<br><br>• measure the water potential of a solution in a controlled experiment<br>• determine the osmotic concentration of living tissue or an unknown solution from experimental data<br>• describe the effects of water gain or loss in animal and plant cells<br>• relate osmotic potential to solute concentration and water potential | 4 |
| 2 | ENZYME CATALYSIS: In this laboratory you will measure the amount of product generated and then calculate the rate of conversion of hydrogen peroxide (H2O2) to water and oxygen gas by the enzyme catalase. | Before the Lab you should understand:<br><br>• the general functions and activities of enzymes<br>• the relationship between the structure and function of enzymes<br>• the concepts of initial reaction rates of enzymes<br>• how the concept of free energy relates to enzyme activity<br>• how pH relates to enzyme activity<br>• that changes in temperature, pH, enzyme concentration, and substrate concentration can affect the initial reaction rates of enzyme-catalyzed reactions<br><br>After the Lab you should be able to:<br><br>• 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<br>• explain how environmental factors affect the rate of enzyme-catalyzed reactions | 3 |
| 3 | MITOSIS AND MEIOSIS: 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 | Before the Lab you should understand:<br><br>• the key mechanical and genetic differences between meiosis and mitosis<br>• the events of mitosis in animal and plant cells<br>• the events of meiosis (gametogenesis) in animal | 3 |

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| | blastula will be used to study mitosis in animal cells and to compare animal mitosis and plant mitosis<br><br>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. | and plant cells<br><br>After the Lab you should be able to:<br><br>• recognize the stages of mitosis in a plant or animal cell<br>• calculate the relative duration of the cell cycle stages<br>• describe how independent assortment and crossing over can generate genetic variation among the products of meiosis<br>• use chromosome models to demonstrate the activity of chromosomes during Meiosis I and Meiosis II<br>• relate chromosome activity to Mendelian segregation and independent assortment<br>• 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<br>• demonstrate the role of meiosis in the formation of gametes using an organism of your choice, in a controlled experiment<br>• compare and contrast the results of meiosis and mitosis in plant cells<br>• compare and contrast the results of meiosis and mitosis in animal cells | |
| 4 | PLANT PIGMENTS AND PHOTOSYNTHESIS: 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. | Before the Lab you should understand:<br><br>• how chromatography separates two or more compounds that are initially present in a mixture<br>• the process of photosynthesis<br>• the function of plant pigments<br>• the relationship between light wavelength or light intensity and photosynthetic rate<br><br>After the Lab you should be able to:<br><br>• separate pigments and calculate their Rf values<br>• describe a technique to determine photosynthetic rates<br>• compare photosynthetic rates at different temperatures, different light intensities, and different wavelengths of light in a controlled experiment<br>• explain why the rate of photosynthesis vary under different environmental conditions | 3 |
| 5 | CELL RESPIRATION: 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 | Before the Lab you should understand:<br><br>• how a respirometer works in terms of the gas laws<br>• the general process of metabolism in living organisms<br><br>After the Lab you should be able to:<br><br>• test the effects of temperature on the rate of cell | 4 |

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| | either germinating or nongerminating peas. In addition, you will measure the respiration of these peas at two different temperatures. | respiration in ungerminated versus germinated seeds in a controlled experiment<br>• calculate the rate of cell respiration from experimental data<br>• relate gas production to respiration rate | |
| 6 | MOLECULAR BIOLOGY: 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. | Before the Lab you should understand:<br>• how gel electrophoresis separates DNA molecules present in a mixture<br>• the principles of bacterial transformation<br>• the conditions under which cells can be transformed<br>• the process of competent cell preparation<br>• how a plasmid can be engineered to include a piece of foreign DNA<br>• how plasmid vectors are used to transfer genes<br>• how antibiotic resistance is transferred between cells<br>• how restriction endonucleases function<br>• the importance of restriction enzymes to genetic engineering experiments<br>After the Lab you should be able to:<br>• use plasmids as vectors to transform bacteria with a gene for antibiotic resistance in a controlled experiment<br>• demonstrate how restrictions enzymes are used in genetic engineering<br>• use electrophoresis to separate DNA fragments<br>• describe the biological process of transformation in bacteria<br>• calculate transformation efficiency<br>• be able to use multiple experimental controls<br>• design a procedure to select positively for antibiotic resistant transformed cells<br>• determine unknown DNA fragment sizes when given DNA fragments of known size | 5 |
| 7 | GENETICS OF ORGANISMS: 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. | Before the Lab you should understand:<br>• chi-square analysis of data<br>• the life cycle of diploid organisms useful in genetics studies<br>After the Lab you should be able to:<br>• investigate the independent assortment of two genes and determine whether the two genes are autosomal or sex-linked using a multi-generation experiment<br>• analyze the data from your genetic crosses chi-square analysis techniques | 5 |
| 8 | POPULATION GENETICS AND EVOLUTION: In this activity, you will learn about the Hardy-Weinberg law | Before the Lab you should understand: | 3 |

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| | of genetic equilibrium and study the relationship between evolution and changes in allele frequency by using your class as a sample population. | • how natural selection can alter allelic frequencies in a population<br>• the Hardy-Weinberg equation and its use in determining the frequency of alleles in a population<br>• the effects on the allelic frequencies of selection against the homozygous recessive or other genotypes<br><br>After the Lab you should be able to:<br><br>• calculate the frequencies of alleles and genotypes in the gene pool of a population using the Hardy-Weinberg formula<br>• discuss natural selection and other causes of microevolution as deviations from the conditions required to maintain Hardy-Weinberg equilibrium | |
| 9 | TRANSPIRATION: 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. | Before the Lab you should understand:<br><br>• how water moves from roots to leaves in terms of physical/chemical properties of water and the forces provided by differences in water potential<br>• the role of transpiration in the transport of water within a plant<br>• the structures used by plants to transport water and regulate water movement<br><br>After the Lab you should be able to:<br><br>• test the effects of environmental variables on rates of transpiration using a controlled experiment<br>• make thin section of stem, identify xylem and phloem cells, and relate the function of these vascular tissues to the structures of their cells | 5 |
| 10 | PHYSIOLOGY OF THE CIRCULATORY SYSTEM: 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. | Before the Lab you should understand:<br><br>• the relationship between temperature and rates of physiological processes<br>• basic anatomy of various circulatory systems<br><br>After the Lab you should be able to:<br><br>• measure heart rate and blood pressure in a human volunteer<br>• describe the effect of changing body position on heart rate and blood pressure<br>• explain how exercise changes heart rate<br>• determine a human's fitness index<br>• analyze pooled cardiovascular data<br>• discuss and explain the relationship between heart rate and temperature | 4 |
| 11 | ANIMAL BEHAVIOR: In this laboratory, you will observe the behavior of an insect and design an | Before the Lab you should understand: | 4 |

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| | experiment to investigate its responses to environmental variables. You also will observe and investigate mating behavior. | • the concept of distribution of organisms in a resource gradient<br>• the difference between a kinesis and a taxis<br><br>After the Lab you should be able to:<br><br>• measure the effects of environmental variables on habitat selection in a controlled experiment<br>• describe the different types of insect mating behaviors | |
| 12 | DISSOLVED OXYGEN AND AQUATIC PRIMARY PRODUCTIVITY: 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. | Before the Lab you should understand:<br><br>• the biological importance of carbon and oxygen cycling in ecosystems<br>• how primary productivity relates to the metabolism of organisms in an ecosystem<br>• the physical and biological factors that affect the solubility of gasses in aquatic ecosystems<br>• the relationship between dissolved oxygen and the process of photosynthesis and respiration as they affect primary productivity<br><br>After the Lab you should be able to:<br><br>• measure primary productivity based on changes in dissolved oxygen in a controlled experiment<br>• investigate the effects of changing light intensity and/or inorganic nutrient concentrations on primary productivity in a controlled experiment | 4 |
| 13 | Woodland Quadrat Analysis | Before the Lab you should understand:<br><br>• a forest community is an assemblage of plant and animal populations coexisting and interacting in a particular area<br><br>• analyze the composition and structure of the community **After the Lab you should be able to:** perform a quadrat analysis on a community<br>• analyze the composition and structure of the community | 7 |
| TOTAL Laboratory Days (Greater than 25% Instructional Time) | | | 57 |

**Assessment:**

Student understanding is evaluated using formative assessments and summative assessments. Formative assessments are used to check student understanding while learning is occurring. Unit tests are designed to emulate the AP Exam in order to prepare the students for taking that type of test. They consist of multiple choice questions and free response questions designed to test the student's knowledge of topics as they relate to the eight major themes of AP Biology. Lab Reports require the students to analyze data collected during the lab, to draw conclusions based on that analysis, and to demonstrate knowledge of concepts that were investigated during the lab.

| Assessment Type | Goal | Description |
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| Laboratory Journals | To assess understanding of concepts, principles, and application of skills and processes of the laboratory. | Students maintain laboratory journals of all lab work. It includes lab notes, data, graphs, and responses to questions, lab write-ups, error analysis, and further questions. Students are encouraged to keep their lab journals to demonstrate lab activity in a college AP review. |
| Unit Tests | To assess understanding of major concepts, principles, and application of problem solving skills. | 60 minute tests that contain multiple choice questions and free response questions similar to those found on the AP Biology Exam. |
| Semester Exams | To assess understanding of major concepts, principles, and application of problem solving skills | 90 minute exams that contain multiple choice questions and free response questions similar to those found on the AP Biology Exam. |

**In support of the AP Biology class:**

Special afterschool Study Sessions are set up throughout the school year to allow for preparation and review for the assessments given. Students are also encouraged to come in during seminar to complete laboratory assignments and to receive extra help. Students are able to see me prior to school, after school and during lunch to receive additional help and to complete laboratory assignments.