Course Overview

The course is designed around the AP Biology Curriculum Framework that focuses on the major concepts in biology and their connections. Additionally, the Curriculum Framework provides a basis for students to develop a deep conceptual understanding as well as opportunities to integrate biological knowledge and the science practices through inquiry-based activities and laboratory investigations without having to teach a textbook from cover to cover.

Textbooks/Resources

Students will be using Concepts and Connections 7E by Reece, Taylor, Simon, and Dicke copyright 2012. [CR1] Students will be using the hardback book as well as the electronic access of the textbook. Each student has access to the investigations contained in *AP Biology Investigative Labs: an Inquiry Based Approach*, as well as other laboratory investigations as deemed necessary.

CR1: Students and teachers use a recently published (within the last 10 years) college-level biology textbook.

Teaching Strategies

AP Biology is structured around four Big ideas (Evolution, Energy Processes, Information, and Interactions) described in the Curriculum Framework, which encompass the core scientific principles, theories, and processes governing living organisms and biological systems. At least one of the Big ideas will be incorporated in every lesson throughout the course. **[CR2]** Because evolution is the foundation upon which the entire course is based, it will be referenced throughout the entire course, and science as a process will be woven throughout both the investigations and the class activities outside of the investigations.

CR2: The course is structured around the enduring understandings within the big ideas as described in the AP Biology Curriculum Framework.

Students begin each unit with a list of enduring understandings and big ideas to guide them throughout the main points of the unit and to frame students' class notes. Students are encouraged to add to these notes during class discussions, listing all of their questions that arise as the class discusses each topic. Class discussions may be based on animations from various sources (textbook, CDs, Internet, etc.) to help the students visualize what they have read. Quizzes are interspersed throughout the unit and inform how instruction may need to be adjusted to improve student learning.

To help students apply biological, scientific knowledge and critical thinking skills to major issues of social concern, they will read and report on (both orally and written) one novel that includes biology content in the story-line. Students will need to be prepared to engage in monthly current event discussions informed by readings from recent scientific journals. Through these activities, students are given the opportunity to see that biology is in their everyday lives and is not just a chapter in a textbook.

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.

Investigative Component

Laboratory investigations make up a minimum of 25% of instructional time. Students will conduct a minimum of eight inquiry-based investigations (two per Big idea). Supplemental labs and activities are also used to widen the range of topics covered in a hands-on, discovery mode. By undertaking a variety of investigations throughout the course, all seven science practice skills will be used by students on a regular basis with a goal of leading students toward open inquiry investigations. The science practice skills need to be honed over the entire course and reinforced through opportunities to make observations, ask questions based on those observations, and investigate their own questions both in and out of the designated lab times. It is critical for me, as an instructor, to help students discover how the biological world works as we know it--and to learn how to investigate the biological world that is still unknown. That is why the investigations are a key to this entire course.

Students will maintain a written record (lab notebook) of investigations conducted. In addition, they will be asked for the following throughout the course:

- Ø Formal lab report that emphasizes the development and testing of a hypothesis, the ability to organize collected data, and the ability to analyze and clearly discuss the results.
- Ø Poster presentations (create poster with main investigation components; present to small groups or whole class; field questions).
- Ø Self-assessments of their ability to work in group investigations that will often be conducted in teams of 2 or 3 in order for students to develop group skills and learn the importance of collaboration among scientists.

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.

CR6: The student-directed laboratory investigations used throughout the course allow students to apply the seven science practices defined in the AP Biology Curriculum Frame work and include at least two lab experiences in each of the four big ideas.

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.

Course Schedule

The following table describes how the enduring understandings/essential knowledge statements, learning objectives and seven science practices are the focus of each unit within the course. Due to the reduction in required content for AP Biology, all sections of each chapter will not be covered and/or may be used for reference as needed. The outlined timeline is approximate. Assignments include many ways to meet the objectives (worksheets, readings, dry labs, wet labs, Free Response writing, projects, etc.), and a few of these activities have been elaborated upon in order to fully demonstrate the incorporation of curricular requirements. These assignments connect biological content across big ideas.

UNITS and ACTIVITIES Big Ideas/Science Practices Matrix	1. use representations and models	2. use mathematics	3. engage in scientific questioning	4. plan & implement data collection strategies	5. perform data analysis & evaluation of evidence	6. work with scientific explanations/theories	7. connect & relate knowledge	Big Idea 1:Evolution	Big Idea 2: Energy Processes	Big Idea 3: Information	Big Idea 4: Interactions
Unit 1: INTRODUCTION/NATURE OF SCIENCE											
Safety Lecture											
Nature of Science: checks activity			x	x	x						
Science as a Process: intro to LabQuest Lab [CR6]		x		x	x						
Nature of Science: design experiment Lab [CR6]	x	x	x	x	x						
Science as a Process: measurement Lab [CR6]		x		x	x						
Chemistry of Life Activity or Lab [CR6]	x		x	x	x						x
Organic Nomenclature Worksheet											x
Activity of Enzyme Lab [CR6]	x	x	x	x	x	x	x		x		
Enzyme Catalysis Models	x								x		
Toothpickase and/or Paperase Activity	x	x		x	x				x		
Enzyme Optimization Activity	x	x	x	x	x	x			x		
Unit 2: EVOLUTIONARY BIOLOGY & BIODIVERSITY											
Hardy-Weinberg Lab (Transitioned) [CR6]	x	x	x	x	x	x	x	x			
Evolutionary Agents Activity	x	x		x	x			x			
Genetic Drift w/ Random Numbers Activity	x			x	x	x	x	x			
Interpretation of Fossils Activity	x			x	x	x		x			
Dichotomous Key Activity	x			x				x			
Cladograms Activity	x		x	x	x	x	x	x			
Archaelogical Interpretation Activity	x		x	x	x	x	x	x			
Geologic Time Activity	x	x			x		x				

BLAST Lab, part 1 [CR6]	x	x	x	x	x	x	x	x		x	
Bacterial Transformation Lab [CR6]	x	x	x	x	x	x	x	x			
Artificial Selection Lab [CR6]		x	x	x	x	x	x	x			
Origin of Life Activity	x			x	x			x			
Unit 3: ECOLOGY/BEHAVIOR											
Fruit Fly Behavior Lab [CR6]	x	x	x	x	x	x	x				x
Aquatic Primary Productivity	x	x	x	x	x	x	x	x	x		x
Ecology: survivorship curves	x	x		x	x	x	x		x		x
Behavior: Competition/Cooperation Lab [CR6]	x			x	x	x					x
A Lesson in Conditioning	x			x	x	x					x
Trial and Error Learning	x			x	x	x					x
Unit 4: INTRODUCTION TO HOMEOSTASIS & RESPONSE TO THE ENVIRONMENT											
Diffusion and Osmosis Lab [CR6]	x	x	x	x	x	x	x		x		x
Microscopy		x		x			x		x		
Exploring Rate of Diffusion Activity									x		
UNIT 5: CELL PROCESSES/CONNECTIONS: RESPIRATION & ANIMAL HOMEOSTASIS											
Cellular Respiration Lab [CR6]	x	x	x	x	x	x	x		x		x
Exercise and Pulse Rate	x	x	x	x	x	x	x		x		x
The Kidney and Homeostasis	x			x	x		x	x	x		x
Antibody Diversity	x			x	x		x	x		x	x
Unit 6: CELL PROCESSES/CONNECTIONS: PHOTOSYNTHESIS & PLANT HOMEOSTASIS											
Photosynthesis Lab [CR6]	x	x	x	x	x	x	x	x	x		
Tropisms	x			x	x	x			x		
Water Movement in Plants Activity	x	x		x	x		x	x	x		x
Transpiration Lab [CR6]	x	x	x	x	x	x	x		x		x
Unit 7: MAKING NEW CELLS & ORGANISMS											
Cell Division Lab [CR6]	x	x	x	x	x	x	x	x		x	
Genetics of Organisms Lab [CR6]										x	
Genetics Activity										x	
BLAST Lab (open inquiry) [CR6]	x	x	x	x	x	x	x	x		x	
Chi Square Problem practice problems		x								x	
Genetics Practice problems	x	x			x	x				x	

Unit 8: ALL ABOUT PROTEINS											
Biotechnology Lab I: Bacterial Transformation [CR6]	x	x	x	x	x	x	x	x		x	
Biotechnology Lab II: Restriction Enzyme Analysis of DNA [CR6]	x	x	x	x	x	x	x			x	
Protein Synthesis Activity	x			x	x		x			x	
Molecular Evolution in a Test Tube Activity	x		x	x	x	x	x			x	
Sequencing and Paper Plasmid Activities											

Big ideas and enduring understandings as well as science practice skills; thus all assignments will help students meet the learning objectives identified throughout the AP Biology Curriculum Framework.

Many of the Free Response questions used for practice also cross several big ideas and apply various science practices (e.g., read/create graphs; calculate rate; apply mathematical formulas; analyze data to draw conclusions, etc.).

CR6: The student-directed laboratory investigations used throughout the course allow students to apply the seven science practices defined in the AP Biology Curriculum Frame work and include at least two lab experiences in each of the four big ideas.

The Foundation

Unit 1. Nature of Science; Chemistry of Life (10 - 15 days) [CR2]

Reading: Chapters 1-3, 6

Enduring understandings to be addressed: 2A; 3A; 4A-B

Discussion Topics and Skills:

Introduction to the four big ideas and enduring understandings; connecting the two together using posters.

Essential questions are presented here to demonstrate how the big ideas cross the entire curriculum:

- How have scientists worked together to investigate the science behind the concepts of biology?
- How have scientists built upon the discoveries of other scientists to develop a more complete picture of the world around us?
- How are scientists able to test the validity of their ideas?
- What is the significance of structural and chemical adaptations to the resilience of living organisms?
- How do individual species, populations, and biomes impact evolutionary change?
- How does energy transfer occur at the molecular level within cells?
- What are some examples of the relationship between evolution of organisms and energy transfer?
- How can continuity within a species be controlled while still allowing for gradual change over time?
- How does structure control function at the molecular/cellular level?
- How does structure control function at the organism level?
- How is the movement of molecules into and out of cells regulated?
- How is homeostasis maintained by an organism?
- How can interdependence in nature be seen at the molecular level?
- How do cells of one organ/tissue rely on the existence of cells in other organs/ tissues?

CR2: The course is structured around the enduring understandings within the big ideas as described in the AP Biology Curriculum Framework.

- How are all organisms interdependent on each other; how does this relate to evolution?
- What advances have been made in laboratory technology to allow scientists to simulate the natural world?
- What is the affect of scientific research and technological innovations on society?

Process of science reviewed: [CR4a]

- Scientific method, with emphasis on the fact that there is not ONE way to do science
- Explain what is meant by scientific theory
- Practice with data collection, analysis, and presentation

Evolution established as foundational theme: [CR3a]

- Lamarck vs. Darwin; students will illustrate the difference using several examples
- Define mechanism of natural selection and briefly describe what is occurring when a population is said to evolve
- Compare/contrast natural and artificial selection; students will identify what these process have in common

Chemistry of Life: [CR4a]

- Identify basic elements of living organisms
- Distinguish between inorganic and organic compounds
- List and describe water's unique properties; relate properties to structure; describe importance of these properties to living organisms
- Describe characteristics, structure, and function of organic compounds (carbohydrates, proteins, lipids, nucleic acids)
- Contrast condensation reactions (dehydration synthesis) and hydrolysis

Ground Rules for Metabolism: [CR4a]

- Apply the first and second laws of thermodynamics to biological systems and how evolution conforms to, and does not violate, these laws
- Explain how the world of life maintains a high degree of organization (continuity and change)
- Investigate enzyme structure and function, and the relationship between enzymes and energy use, through analysis of data and graphs
- Model the role of the participants (substrates, intermediates, enzymes, cofactors, energy carriers, and products) in a variety of metabolic pathways

Activities:

1. Nature of Science: Analyze data, create and revise hypotheses, draw conclusions; understand that conclusions are often tentative and may be changed with the discovery of new data.
2. Nature of Science: design an experiment: Emphasis on development of testable hypothesis, identification of independent, dependent and controlled variables, procedure development, and data analysis using mathematics and graphing.

CR4a: The course provides students with opportunities outside of the laboratory investigations to meet the learning objectives within Big Idea 1.

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.

3. Enzyme Catalysis Model: Objective: create models to illustrate an enzyme/ substrate complex, the interaction of a competitive inhibitor, and the interaction of a noncompetitive inhibitor. **[CR4d]**
4. Enzyme Optimization: Students will analyze background information, develop a hypothesis, and design and carry out an experiment to determine optimum pH or temperature for an enzyme. **[CR4d]**

CR4d: The course provides students with opportunities outside of the laboratory investigations to meet the learning objectives within Big Idea 4.

Free Response questions from previous AP Exams:
2010-2
2002-2
2005-1
2003B-3
2000-1

Unit 2. Evolutionary Biology & Biodiversity (15 - 25 days) [CR2]
Enduring understandings to be addressed: 1; 2A-B, 2D-E; 3A, C; 4B, C **Discussion Topics and Skills:** Chapters 13, 14, 15

1. Evidence of Evolution
   - Describe and justify the evidence Darwin used to develop the theory of natural selection
2. Microevolutionary Processes
   - Distinguish between microevolution and macroevolution
   - Relate differences that occur in gene pools, alleles, and allele frequency to each other
   - Calculate allele frequencies in populations in Hardy-Weinberg equilibrium selection
   -Distinguish the founder effect from a bottleneck
   -Distinguish between an adaptation and an evolutionary adaptation
3. Evolutionary Patterns, Rates, and Trends
   - Discuss the biological species concept; and how pre/post-zygotic mechanisms; allopatric and sympatric speciation contribute to this concept
   - Explain the relationship between gene flow and genetic divergence
   - Evaluate phylogenetic trees to see how taxonomy reflects evolutionary history
   - Create a model illustrating mass extinctions
4. Life's Origin and Early Evolution
   - Summarize and compare current hypotheses for how and where life began
   - Explain how we know that DNA is the hereditary material, as opposed to other molecules
   - Describe how the endosymbiosis theory may help explain the origin of eukaryotic cells; describe the modern evidence supporting this theory
   - Understand the basic timeline of the evolution of life and the key events along the timeline
5. Discuss and compare the kingdoms in relation to evolution of structures, metabolism, and cellular organization; classification (systematics, phylogeny, cladograms); role in the biosphere (niche); life cycles **[CR3a], [CR3b] & [CR3d]**

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.

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.

Assignments:

1. Cladograms: students will understand the nature of cladograms based on various types of data; learn how to read and analyze cladograms; construct cladograms and Venn diagrams from provided data. **[CR3d]**
2. Evolutionary Agents: determine allele frequencies for a gene in a model population; calculate expected ratios of phenotypes based on Hardy-Weinberg proportions; describe factors that influence Hardy-Weinberg equilibrium of a population; describe the effects of different selection pressures on identical model populations; identify the level at which selection operates in a population; describe the impact of the founder effect on the genetic structure of populations.
3. BLAST (used here and in unit 8) (Big idea 1 connected to Big idea 4)

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.

Free Response questions from previous AP Exams:

2011B-4
2009-3
2008B-4
2008B-3
2005B-2
2004-2

The Big Picture

Unit 3. Ecology and Behavior (15 - 20 days) [CR2]
Enduring understandings to be addressed: 1A; 2A,C-E; 3E; 4
Discussion Topics and Skills: Chapters 34, 35, 36, 37

1. Population Ecology **[CR3d] & [CR4d]**
   - Analyze and interpret logistic and exponential growth curves
   - Convert data tables into different survivorship curves and age structure diagrams
2. Community Structure and Biodiversity **[CR3d] & [CR4d]**
   - Contrast types of symbiosis
   - Relate community interactions to co-evolution
   - Compare succession within different communities
3. Ecosystems **[CR3d] & [CR4d]**
   - Compare biogeochemical cycles in terms of the role of different organisms
   - Analyze trophic levels and calculate flow of energy through food chain/web/pyramid
4. Biosphere **[CR3d] & [CR4d]**
   - Students report on different biomes
   - Discussion topic: Impact of humans on the biosphere. What can we do? What should we do? How do our decisions/actions affect other species?
5. Behavioral Ecology **[CR3d] & [CR4d]**
   - Compare animal behavior in different environments and to different stimuli
   - Compare/contrast the role of the environment and genes on behavior with both animal and plant examples
   - Explain how adaptive behavior, social behavior, selfish behavior, and altruism can all promote an individual's reproductive success (fitness); what are the costs/benefits of each behavior?

CR2: The course is structured around the enduring understandings within the big ideas as described in the AP Biology Curriculum Framework.

CR4d: The course provides students with opportunities outside of the laboratory investigations to meet the learning objectives within Big Idea 4.

Assignments:

1. Ecology: Graphically depict the survivorship curves of three different species and explain the differences between them. **[CR4d]**
2. Competition or Cooperation: determine whether competition or cooperation among team members is more efficient when it comes to completing a task.
3. Make connections to other populations. Discuss how different strategies provide fitness/evolutionary advantages to different organisms.
4. Behavior Lab **[CR6]**

Free Response questions from previous AP Exams:

2011B-2
2011B-3
2010-4
2008
2007-3

The Supporting Details

Unit 4. Introduction to Homeostasis & Response to the Environment (10 - 15 days) [CR2]

Enduring understandings to be addressed: 1B-C; 2A-D; 3B, D-E; 4

Discussion Topics and Skills: Chapters 4, 5, 25, 26.3, 27.1

1. Demonstrate proper microscope techniques
2. Cell Structure and Function
   - Review basic cellular components focusing on structure and function and their evolution
   - Calculate surface-to-volume ratios in comparing cells of different sizes
   - Construct models comparing key differences between prokaryotic vs. eukaryotic cell structure
3. A Closer Look at Cell Membranes
   - Create representations of the fluid mosaic model
   - Explain the concept of selective permeability as it applies to cell membrane function
   - Distinguish between passive and active transport
   - Compare cell communication processes in different types of organisms
4. Plants and Animals—Common Challenges **[CR3a] & [CR3b]**
   - Define homeostasis in relation to the internal environment of an organism
   - Compare negative and positive feedback processes in a plant and an animal
   - Illustrate, with examples, how a cell uses diffusion and active transport to maintain an internal environment
   - Evaluate data that are suggested to indicate circadian rhythms in organisms
   - Explain the process of apoptosis as a normal process

Assignments:

Diffusion and Osmosis Lab **[CR6]**

CR4d: The course provides students with opportunities outside of the laboratory investigations to meet the learning objectives within Big Idea 4.

CR6: The student-directed laboratory investigations used throughout the course allow students to apply the seven science practices defined in the AP Biology Curriculum Frame work and include at least two lab experiences in each of the four big ideas.

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.

Free Response questions from previous AP Exams:
2011-1 (connects to evolution)
2008B-2
2008-3
2006B-2
2005B-4
2004B-3
2002-4

Unit 5. Cell Processes/Connections: Respiration & Animal Homeostasis (15 - 20 days) [CR2]
Enduring understandings to be addressed: 1B-C; 2A; 4
Discussion Topics and Skills: Chapters 6, 7, 20, 24, 25, 26, 28, 29

1. How Cells Release Chemical Energy **[CR4b]**
   - Illustrate differences between anaerobic and aerobic respiration pathways
   - Compare the major stages of aerobic respiration in plants and animals; associate each to a particular cell component
   - List some sources of energy (other than glucose) that can be fed into the respiratory pathways
2. Animal Homeostasis: What roles do the following play in maintaining homeostasis in animals?
   - Neural Control
   - Sensory Perception
   - Endocrine Control
   - Immunity
   - Internal Environment

Discussion: Why is high blood pressure called the "silent killer?" What can you do to avoid high blood pressure (explore societal and environmental concerns) **[CR5]**

Discussion: What role can you play in the fight against childhood obesity? (explore societal and environmental concerns) **[CR5]**

Assignments:
1. Cellular Respiration Lab (Big idea 2 connects with Big idea 4)
2. Antibody Diversity (connects to genetics)

Free Response questions from previous AP Exams:
2011-2
2010B-2
2010-1
2009-2
2009B-4

CR2: The course is structured around the enduring understandings within the big ideas as described in the AP Biology Curriculum Framework.

CR4b: The course provides students with opportunities outside of the laboratory investigations to meet the learning objectives within Big Idea 2.

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.

Unit 6. Cell Processes/Connections: Photosynthesis & Plant Homeostasis (15 - 20 days) [CR2]
Enduring understandings to be addressed: 1B; 2A, E; 4A, C
Discussion Topics and Skills: Chapters 7, 32. 33

1. Where It Starts—Photosynthesis **[CR3a] & [CR4b]**
   - Create models of plant structures related to process of photosynthesis
   - Analyze data of energy use comparing autotrophs and heterotrophs
   - Describe the major processes that occur in the two stages of photosynthesis; associate each reaction to a particular cell component
   - Compare/contrast noncyclic and cyclic pathways; relate to evolution in plants
   - Describe evolutionary trends for dealing with differing climate conditions (C_3, C_4, and CAM plants)
2. Plant Homeostasis & Transport **[CR3b]**
   - Explain how plant cells regulate the movement of water and organic materials (bulk flow, translocation, and cohesion-tension theory)
   - Model the experiments leading to the understanding of the role of each class of plant hormones
   - Create time-lapse movie of tropisms and explain how each is regulated
   - Interpret data collected about the activity of organisms with circadian cycles and biological clocks and compare to organisms without photoperiodic responses
   - Describe the action of phytochrome and the role it plays in long-day, short-day, and day-neutral plants

Activities:
Transpiration Investigation (Big idea 4 connects to Big idea 2) **[CR3d]**

Free Response questions from previous AP Exams:
2011-4
2010B-1
2006-3
2006B-3
2003B-2
Photosynthesis/Cell Respiration, 1993

Unit 7. Making New Cells & Organisms (15 - 20 days) [CR2]
Enduring understandings to be addressed: 1A, C; 2A, E; 3A, C; 4A, C
Discussion Topics and Skills: Chapters 8, 9, 31 33

1. How Cells Reproduce **[CR3c] & [CR4c]**
   - Compare each stage of the cell cycle in normal versus cancerous cells
   - Explain the difference between mitotic division and cytokinesis; compare differences in the processes between animal and plant cells
   - Discuss the process by which cancers form **[CR5]**
   - Review experimental data about cell differentiation
2. Meiosis and Sexual Reproduction **[CR3c]**
   - Distinguish between the processes of mitosis and meiosis; distinguish between somatic and germ cells

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.

CR4b: The course provides students with opportunities outside of the laboratory investigations to meet the learning objectives within Big Idea 2.

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.

CR4c: The course provides students with opportunities outside of the laboratory investigations to meet the learning objectives within Big Idea 3.

- Explain why meiosis is important for survival of a species and relate to evolutionary processes
- Illustrate the cellular events that occur during each phase of meiosis I and meiosis II and explain the biological implication of each
- Communicate to fellow students the importance and mechanism of crossing over and how one would recognize if crossing over occurred

3. Reproductive Mechanisms **[CR3c]**
   - Discuss mechanisms that increase genetic variation; relationship to evolutionary fitness
   - Revisit alternation of generations in the context of evolution of organisms; sexual vs. asexual; viral replication
   - Describe the double fertilization that occurs uniquely in the flowering plant life cycle
   - Report on modern biotechnological techniques and parthenogenesis, vegetative propagation, and tissue culture propagation **[CR5]**
   - Differentiate between growth and development; discuss regulation mechanisms
4. Observing Patterns in Inherited Traits **[CR3c]**
   - Discuss the significance of the work of Mendel
   - Collect and analyze data related to several different inheritance patterns
   - Construct and interpret Punnett squares; apply product rule
   - Construct and interpret pedigrees
5. Chromosomes and Human Inheritance **[CR5]**
   - List several examples of human inheritance patterns

Discussion: What are some benefits of genetic screening and genetic counseling? Would you want to know if your child had a genetic disease?

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.

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.

Assignments:

1. Cell Division: Mitosis and Meiosis Investigation
2. Genetics of Organisms using Drosophila, C-Ferns, Fast Plants
3. Complete BLAST
4. Apply to enzyme of their choice
5. Blood Group Genetics **[CR5]**
6. Students act as blood geneticists at a medical lab and serve as expert witnesses in a case of disputed inheritance. Several inheritance patterns will be explored.

Free Response questions from previous AP Exams:

2011-3
2011B-1
2008-4
2004 #1
2002B-4
Plant Reproduction, 1987
2005-3
2006B-1

Unit 8. All About Proteins (20 - 25 days) [CR2]
Enduring understandings to be addressed: 1; 2E; 3A-C; 4A,C
Discussion Topics and Skills: Chapters 10, 11, 12

1. DNA Structure and Function **[CR3b] & [CR4d]**
   - Discuss the historical events leading to our current knowledge of DNA
   - Draw a DNA molecule, labeling the parts of a nucleotide
   - Create an illustration how double-stranded DNA replicates from stockpiles of nucleotides
2. From DNA to Protein **[CR3c]**
   - Compare/contrast DNA and RNA
   - Describe the stages of protein synthesis; translate a DNA code into a polypeptide chain
   - Cite an example of a change in one DNA base pair that has a profound effect on the human phenotype (sickle cell anemia); revisit heterozygote advantage of this trait and malaria **[CR5]**
   - Investigate some of the environmental agents that can cause mutations and the type of mutations these agents cause
   - Explain why mutations in germ cells are usually more of a problem than mutations in somatic cells

   Discussion: Why is the genetic code almost universal? What are the evolutionary implications of this?
3. Controls Over Genes **[CR3d]**
   - List and define the levels of gene control in eukaryotes; contrast this with prokaryotic gene control
4. Studying and Manipulating Genomes **[CR3d] & [CR5]**
   - Debate the value of using modern techniques, such as recombinant DNA, using DNA fragments, in the production and use of transgenic organisms
   - Explain how knowing the composition of genes can help scientists derive counterattacks against rapidly mutating organisms

   Discussion: How does knowing the genetic makeup of Earth's organisms help us reconstruct the evolutionary history of life?

   Discussion: What problems might be involved in trying to clone extinct animals? (explore societal and environmental concerns) **[CR3d] & [CR5]**

Assignments:

1. Biotechnology Investigation 1: Transformation (Big idea 3 connects to Big idea 1) **[CR3c]**
2. Protein Synthesis Activity: Objective: provide students with game format to "see" the relationship between DNA, RNA and proteins.
3. Molecular Evolution in the Test-Tube: In this paper and pencil activity, students explore how evolution can be studied in a test-tube system. The activity is based on research performed by Sol Spiegelman in the mid-1960s.

CR2: The course is structured around the enduring understandings within the big ideas as described in the AP Biology Curriculum Framework.

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.

CR4d: The course provides students with opportunities outside of the laboratory investigations to meet the learning objectives within Big Idea 4.

Free Response questions from previous AP Exams:

2009B-1
2009-4
2005-2
2005B-3
2002-1
2001 #4

Practice Tests; Semester Tests; Review of Course; Individual Student Investigation (15 - 25 days)

- Full-length, released tests used throughout course for diagnostic purposes.
- Review format determined by needs of students.
- Post-AP assignment varies from year to year; determined by interests of students; may include writing review sheets for General Biology class, mammalian dissections, performance of student-generated labs, making video for General Biology class, etc.
- Each student will select a single topic of investigation that is conducted over the last half of the year based on individual observations, interests, and questions generated during the course of the many investigations in the first part of the course. The student will then design, conduct, and collect and analyze data from this investigation and then report on his/her findings to the entire class.

Course Overview

The course is designed around the AP Biology Curriculum Framework that focuses on the major concepts in biology and their connections. Additionally, the Curriculum Framework provides a basis for students to develop a deep conceptual understanding as well as opportunities to integrate biological knowledge and the science practices through inquiry-based activities and laboratory investigations without having to teach a textbook from cover to cover.

Textbooks/Resources

Students will be using Concepts and Connections 7E by Reece, Taylor, Simon, and Dicke copyright 2012. [CR1] Students will be using the hardback book as well as the electronic access of the textbook. Each student has access to the investigations contained in *AP Biology Investigative Labs: an Inquiry Based Approach*, as well as other laboratory investigations as deemed necessary.

CR1: Students and teachers use a recently published (within the last 10 years) college-level biology textbook.

Teaching Strategies

AP Biology is structured around four Big ideas (Evolution, Energy Processes, Information, and Interactions) described in the Curriculum Framework, which encompass the core scientific principles, theories, and processes governing living organisms and biological systems. At least one of the Big ideas will be incorporated in every lesson throughout the course. **[CR2]** Because evolution is the foundation upon which the entire course is based, it will be referenced throughout the entire course, and science as a process will be woven throughout both the investigations and the class activities outside of the investigations.

CR2: The course is structured around the enduring understandings within the big ideas as described in the AP Biology Curriculum Framework.

Students begin each unit with a list of enduring understandings and big ideas to guide them throughout the main points of the unit and to frame students' class notes. Students are encouraged to add to these notes during class discussions, listing all of their questions that arise as the class discusses each topic. Class discussions may be based on animations from various sources (textbook, CDs, Internet, etc.) to help the students visualize what they have read. Quizzes are interspersed throughout the unit and inform how instruction may need to be adjusted to improve student learning.

To help students apply biological, scientific knowledge and critical thinking skills to major issues of social concern, they will read and report on (both orally and written) one novel that includes biology content in the story-line. Students will need to be prepared to engage in monthly current event discussions informed by readings from recent scientific journals. Through these activities, students are given the opportunity to see that biology is in their everyday lives and is not just a chapter in a textbook.

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.

Investigative Component

Laboratory investigations make up a minimum of 25% of instructional time. Students will conduct a minimum of eight inquiry-based investigations (two per Big idea). Supplemental labs and activities are also used to widen the range of topics covered in a hands-on, discovery mode. By undertaking a variety of investigations throughout the course, all seven science practice skills will be used by students on a regular basis with a goal of leading students toward open inquiry investigations. The science practice skills need to be honed over the entire course and reinforced through opportunities to make observations, ask questions based on those observations, and investigate their own questions both in and out of the designated lab times. It is critical for me, as an instructor, to help students discover how the biological world works as we know it--and to learn how to investigate the biological world that is still unknown. That is why the investigations are a key to this entire course.

Students will maintain a written record (lab notebook) of investigations conducted. In addition, they will be asked for the following throughout the course:

- Ø Formal lab report that emphasizes the development and testing of a hypothesis, the ability to organize collected data, and the ability to analyze and clearly discuss the results.
- Ø Poster presentations (create poster with main investigation components; present to small groups or whole class; field questions).
- Ø Self-assessments of their ability to work in group investigations that will often be conducted in teams of 2 or 3 in order for students to develop group skills and learn the importance of collaboration among scientists.

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.

CR6: The student-directed laboratory investigations used throughout the course allow students to apply the seven science practices defined in the AP Biology Curriculum Frame work and include at least two lab experiences in each of the four big ideas.

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.

Course Schedule

The following table describes how the enduring understandings/essential knowledge statements, learning objectives and seven science practices are the focus of each unit within the course. Due to the reduction in required content for AP Biology, all sections of each chapter will not be covered and/or may be used for reference as needed. The outlined timeline is approximate. Assignments include many ways to meet the objectives (worksheets, readings, dry labs, wet labs, Free Response writing, projects, etc.), and a few of these activities have been elaborated upon in order to fully demonstrate the incorporation of curricular requirements. These assignments connect biological content across big ideas.

UNITS and ACTIVITIES Big Ideas/Science Practices Matrix	1. use representations and models	2. use mathematics	3. engage in scientific questioning	4. plan & implement data collection strategies	5. perform data analysis & evaluation of evidence	6. work with scientific explanations/theories	7. connect & relate knowledge	Big Idea 1:Evolution	Big Idea 2: Energy Processes	Big Idea 3: Information	Big Idea 4: Interactions
Unit 1: INTRODUCTION/NATURE OF SCIENCE											
Safety Lecture											
Nature of Science: checks activity			x	x	x						
Science as a Process: intro to LabQuest Lab [CR6]		x		x	x						
Nature of Science: design experiment Lab [CR6]	x	x	x	x	x						
Science as a Process: measurement Lab [CR6]		x		x	x						
Chemistry of Life Activity or Lab [CR6]	x		x	x	x						x
Organic Nomenclature Worksheet											x
Activity of Enzyme Lab [CR6]	x	x	x	x	x	x	x		x		
Enzyme Catalysis Models	x								x		
Toothpickase and/or Paperase Activity	x	x		x	x				x		
Enzyme Optimization Activity	x	x	x	x	x	x			x		
Unit 2: EVOLUTIONARY BIOLOGY & BIODIVERSITY											
Hardy-Weinberg Lab (Transitioned) [CR6]	x	x	x	x	x	x	x	x			
Evolutionary Agents Activity	x	x		x	x			x			
Genetic Drift w/ Random Numbers Activity	x			x	x	x	x	x			
Interpretation of Fossils Activity	x			x	x	x		x			
Dichotomous Key Activity	x			x				x			
Cladograms Activity	x		x	x	x	x	x	x			
Archaelogical Interpretation Activity	x		x	x	x	x	x	x			
Geologic Time Activity	x	x			x		x				

BLAST Lab, part 1 [CR6]	x	x	x	x	x	x	x	x		x	
Bacterial Transformation Lab [CR6]	x	x	x	x	x	x	x	x			
Artificial Selection Lab [CR6]		x	x	x	x	x	x	x			
Origin of Life Activity	x			x	x			x			
Unit 3: ECOLOGY/BEHAVIOR											
Fruit Fly Behavior Lab [CR6]	x	x	x	x	x	x	x				x
Aquatic Primary Productivity	x	x	x	x	x	x	x	x	x		x
Ecology: survivorship curves	x	x		x	x	x	x		x		x
Behavior: Competition/Cooperation Lab [CR6]	x			x	x	x					x
A Lesson in Conditioning	x			x	x	x					x
Trial and Error Learning	x			x	x	x					x
Unit 4: INTRODUCTION TO HOMEOSTASIS & RESPONSE TO THE ENVIRONMENT											
Diffusion and Osmosis Lab [CR6]	x	x	x	x	x	x	x		x		x
Microscopy		x		x			x		x		
Exploring Rate of Diffusion Activity									x		
UNIT 5: CELL PROCESSES/CONNECTIONS: RESPIRATION & ANIMAL HOMEOSTASIS											
Cellular Respiration Lab [CR6]	x	x	x	x	x	x	x		x		x
Exercise and Pulse Rate	x	x	x	x	x	x	x		x		x
The Kidney and Homeostasis	x			x	x		x	x	x		x
Antibody Diversity	x			x	x		x	x		x	x
Unit 6: CELL PROCESSES/CONNECTIONS: PHOTOSYNTHESIS & PLANT HOMEOSTASIS											
Photosynthesis Lab [CR6]	x	x	x	x	x	x	x	x	x		
Tropisms	x			x	x	x			x		
Water Movement in Plants Activity	x	x		x	x		x	x	x		x
Transpiration Lab [CR6]	x	x	x	x	x	x	x		x		x
Unit 7: MAKING NEW CELLS & ORGANISMS											
Cell Division Lab [CR6]	x	x	x	x	x	x	x	x		x	
Genetics of Organisms Lab [CR6]										x	
Genetics Activity										x	
BLAST Lab (open inquiry) [CR6]	x	x	x	x	x	x	x	x		x	
Chi Square Problem practice problems		x								x	
Genetics Practice problems	x	x			x	x				x	

Unit 8: ALL ABOUT PROTEINS											
Biotechnology Lab I: Bacterial Transformation [CR6]	x	x	x	x	x	x	x	x		x	
Biotechnology Lab II: Restriction Enzyme Analysis of DNA [CR6]	x	x	x	x	x	x	x			x	
Protein Synthesis Activity	x			x	x		x			x	
Molecular Evolution in a Test Tube Activity	x		x	x	x	x	x			x	
Sequencing and Paper Plasmid Activities											

Big ideas and enduring understandings as well as science practice skills; thus all assignments will help students meet the learning objectives identified throughout the AP Biology Curriculum Framework.

Many of the Free Response questions used for practice also cross several big ideas and apply various science practices (e.g., read/create graphs; calculate rate; apply mathematical formulas; analyze data to draw conclusions, etc.).

CR6: The student-directed laboratory investigations used throughout the course allow students to apply the seven science practices defined in the AP Biology Curriculum Frame work and include at least two lab experiences in each of the four big ideas.

The Foundation

Unit 1. Nature of Science; Chemistry of Life (10 - 15 days) [CR2]

Reading: Chapters 1-3, 6

Enduring understandings to be addressed: 2A; 3A; 4A-B

Discussion Topics and Skills:

Introduction to the four big ideas and enduring understandings; connecting the two together using posters.

Essential questions are presented here to demonstrate how the big ideas cross the entire curriculum:

- How have scientists worked together to investigate the science behind the concepts of biology?
- How have scientists built upon the discoveries of other scientists to develop a more complete picture of the world around us?
- How are scientists able to test the validity of their ideas?
- What is the significance of structural and chemical adaptations to the resilience of living organisms?
- How do individual species, populations, and biomes impact evolutionary change?
- How does energy transfer occur at the molecular level within cells?
- What are some examples of the relationship between evolution of organisms and energy transfer?
- How can continuity within a species be controlled while still allowing for gradual change over time?
- How does structure control function at the molecular/cellular level?
- How does structure control function at the organism level?
- How is the movement of molecules into and out of cells regulated?
- How is homeostasis maintained by an organism?
- How can interdependence in nature be seen at the molecular level?
- How do cells of one organ/tissue rely on the existence of cells in other organs/ tissues?

CR2: The course is structured around the enduring understandings within the big ideas as described in the AP Biology Curriculum Framework.

- How are all organisms interdependent on each other; how does this relate to evolution?
- What advances have been made in laboratory technology to allow scientists to simulate the natural world?
- What is the affect of scientific research and technological innovations on society?

Process of science reviewed: [CR4a]

- Scientific method, with emphasis on the fact that there is not ONE way to do science
- Explain what is meant by scientific theory
- Practice with data collection, analysis, and presentation

Evolution established as foundational theme: [CR3a]

- Lamarck vs. Darwin; students will illustrate the difference using several examples
- Define mechanism of natural selection and briefly describe what is occurring when a population is said to evolve
- Compare/contrast natural and artificial selection; students will identify what these process have in common

Chemistry of Life: [CR4a]

- Identify basic elements of living organisms
- Distinguish between inorganic and organic compounds
- List and describe water's unique properties; relate properties to structure; describe importance of these properties to living organisms
- Describe characteristics, structure, and function of organic compounds (carbohydrates, proteins, lipids, nucleic acids)
- Contrast condensation reactions (dehydration synthesis) and hydrolysis

Ground Rules for Metabolism: [CR4a]

- Apply the first and second laws of thermodynamics to biological systems and how evolution conforms to, and does not violate, these laws
- Explain how the world of life maintains a high degree of organization (continuity and change)
- Investigate enzyme structure and function, and the relationship between enzymes and energy use, through analysis of data and graphs
- Model the role of the participants (substrates, intermediates, enzymes, cofactors, energy carriers, and products) in a variety of metabolic pathways

Activities:

1. Nature of Science: Analyze data, create and revise hypotheses, draw conclusions; understand that conclusions are often tentative and may be changed with the discovery of new data.
2. Nature of Science: design an experiment: Emphasis on development of testable hypothesis, identification of independent, dependent and controlled variables, procedure development, and data analysis using mathematics and graphing.

CR4a: The course provides students with opportunities outside of the laboratory investigations to meet the learning objectives within Big Idea 1.

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.

3. Enzyme Catalysis Model: Objective: create models to illustrate an enzyme/ substrate complex, the interaction of a competitive inhibitor, and the interaction of a noncompetitive inhibitor. **[CR4d]**
4. Enzyme Optimization: Students will analyze background information, develop a hypothesis, and design and carry out an experiment to determine optimum pH or temperature for an enzyme. **[CR4d]**

CR4d: The course provides students with opportunities outside of the laboratory investigations to meet the learning objectives within Big Idea 4.

Free Response questions from previous AP Exams:
2010-2
2002-2
2005-1
2003B-3
2000-1

Unit 2. Evolutionary Biology & Biodiversity (15 - 25 days) [CR2]
Enduring understandings to be addressed: 1; 2A-B, 2D-E; 3A, C; 4B, C **Discussion Topics and Skills:** Chapters 13, 14, 15

1. Evidence of Evolution
   - Describe and justify the evidence Darwin used to develop the theory of natural selection
2. Microevolutionary Processes
   - Distinguish between microevolution and macroevolution
   - Relate differences that occur in gene pools, alleles, and allele frequency to each other
   - Calculate allele frequencies in populations in Hardy-Weinberg equilibrium selection
   -Distinguish the founder effect from a bottleneck
   -Distinguish between an adaptation and an evolutionary adaptation
3. Evolutionary Patterns, Rates, and Trends
   - Discuss the biological species concept; and how pre/post-zygotic mechanisms; allopatric and sympatric speciation contribute to this concept
   - Explain the relationship between gene flow and genetic divergence
   - Evaluate phylogenetic trees to see how taxonomy reflects evolutionary history
   - Create a model illustrating mass extinctions
4. Life's Origin and Early Evolution
   - Summarize and compare current hypotheses for how and where life began
   - Explain how we know that DNA is the hereditary material, as opposed to other molecules
   - Describe how the endosymbiosis theory may help explain the origin of eukaryotic cells; describe the modern evidence supporting this theory
   - Understand the basic timeline of the evolution of life and the key events along the timeline
5. Discuss and compare the kingdoms in relation to evolution of structures, metabolism, and cellular organization; classification (systematics, phylogeny, cladograms); role in the biosphere (niche); life cycles **[CR3a], [CR3b] & [CR3d]**

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.

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.

Assignments:

1. Cladograms: students will understand the nature of cladograms based on various types of data; learn how to read and analyze cladograms; construct cladograms and Venn diagrams from provided data. **[CR3d]**
2. Evolutionary Agents: determine allele frequencies for a gene in a model population; calculate expected ratios of phenotypes based on Hardy-Weinberg proportions; describe factors that influence Hardy-Weinberg equilibrium of a population; describe the effects of different selection pressures on identical model populations; identify the level at which selection operates in a population; describe the impact of the founder effect on the genetic structure of populations.
3. BLAST (used here and in unit 8) (Big idea 1 connected to Big idea 4)

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.

Free Response questions from previous AP Exams:

2011B-4
2009-3
2008B-4
2008B-3
2005B-2
2004-2

The Big Picture

Unit 3. Ecology and Behavior (15 - 20 days) [CR2]
Enduring understandings to be addressed: 1A; 2A,C-E; 3E; 4
Discussion Topics and Skills: Chapters 34, 35, 36, 37

1. Population Ecology **[CR3d] & [CR4d]**
   - Analyze and interpret logistic and exponential growth curves
   - Convert data tables into different survivorship curves and age structure diagrams
2. Community Structure and Biodiversity **[CR3d] & [CR4d]**
   - Contrast types of symbiosis
   - Relate community interactions to co-evolution
   - Compare succession within different communities
3. Ecosystems **[CR3d] & [CR4d]**
   - Compare biogeochemical cycles in terms of the role of different organisms
   - Analyze trophic levels and calculate flow of energy through food chain/web/pyramid
4. Biosphere **[CR3d] & [CR4d]**
   - Students report on different biomes
   - Discussion topic: Impact of humans on the biosphere. What can we do? What should we do? How do our decisions/actions affect other species?
5. Behavioral Ecology **[CR3d] & [CR4d]**
   - Compare animal behavior in different environments and to different stimuli
   - Compare/contrast the role of the environment and genes on behavior with both animal and plant examples
   - Explain how adaptive behavior, social behavior, selfish behavior, and altruism can all promote an individual's reproductive success (fitness); what are the costs/benefits of each behavior?

CR2: The course is structured around the enduring understandings within the big ideas as described in the AP Biology Curriculum Framework.

CR4d: The course provides students with opportunities outside of the laboratory investigations to meet the learning objectives within Big Idea 4.

Assignments:

1. Ecology: Graphically depict the survivorship curves of three different species and explain the differences between them. **[CR4d]**
2. Competition or Cooperation: determine whether competition or cooperation among team members is more efficient when it comes to completing a task.
3. Make connections to other populations. Discuss how different strategies provide fitness/evolutionary advantages to different organisms.
4. Behavior Lab **[CR6]**

Free Response questions from previous AP Exams:

2011B-2
2011B-3
2010-4
2008
2007-3

The Supporting Details

Unit 4. Introduction to Homeostasis & Response to the Environment (10 - 15 days) [CR2]

Enduring understandings to be addressed: 1B-C; 2A-D; 3B, D-E; 4

Discussion Topics and Skills: Chapters 4, 5, 25, 26.3, 27.1

1. Demonstrate proper microscope techniques
2. Cell Structure and Function
   - Review basic cellular components focusing on structure and function and their evolution
   - Calculate surface-to-volume ratios in comparing cells of different sizes
   - Construct models comparing key differences between prokaryotic vs. eukaryotic cell structure
3. A Closer Look at Cell Membranes
   - Create representations of the fluid mosaic model
   - Explain the concept of selective permeability as it applies to cell membrane function
   - Distinguish between passive and active transport
   - Compare cell communication processes in different types of organisms
4. Plants and Animals—Common Challenges **[CR3a] & [CR3b]**
   - Define homeostasis in relation to the internal environment of an organism
   - Compare negative and positive feedback processes in a plant and an animal
   - Illustrate, with examples, how a cell uses diffusion and active transport to maintain an internal environment
   - Evaluate data that are suggested to indicate circadian rhythms in organisms
   - Explain the process of apoptosis as a normal process

Assignments:

Diffusion and Osmosis Lab **[CR6]**

CR4d: The course provides students with opportunities outside of the laboratory investigations to meet the learning objectives within Big Idea 4.

CR6: The student-directed laboratory investigations used throughout the course allow students to apply the seven science practices defined in the AP Biology Curriculum Frame work and include at least two lab experiences in each of the four big ideas.

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.

Free Response questions from previous AP Exams:
2011-1 (connects to evolution)
2008B-2
2008-3
2006B-2
2005B-4
2004B-3
2002-4

Unit 5. Cell Processes/Connections: Respiration & Animal Homeostasis (15 - 20 days) [CR2]
Enduring understandings to be addressed: 1B-C; 2A; 4
Discussion Topics and Skills: Chapters 6, 7, 20, 24, 25, 26, 28, 29

1. How Cells Release Chemical Energy **[CR4b]**
   - Illustrate differences between anaerobic and aerobic respiration pathways
   - Compare the major stages of aerobic respiration in plants and animals; associate each to a particular cell component
   - List some sources of energy (other than glucose) that can be fed into the respiratory pathways
2. Animal Homeostasis: What roles do the following play in maintaining homeostasis in animals?
   - Neural Control
   - Sensory Perception
   - Endocrine Control
   - Immunity
   - Internal Environment

Discussion: Why is high blood pressure called the "silent killer?" What can you do to avoid high blood pressure (explore societal and environmental concerns) **[CR5]**

Discussion: What role can you play in the fight against childhood obesity? (explore societal and environmental concerns) **[CR5]**

Assignments:
1. Cellular Respiration Lab (Big idea 2 connects with Big idea 4)
2. Antibody Diversity (connects to genetics)

Free Response questions from previous AP Exams:
2011-2
2010B-2
2010-1
2009-2
2009B-4

CR2: The course is structured around the enduring understandings within the big ideas as described in the AP Biology Curriculum Framework.

CR4b: The course provides students with opportunities outside of the laboratory investigations to meet the learning objectives within Big Idea 2.

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.

Unit 6. Cell Processes/Connections: Photosynthesis & Plant Homeostasis (15 - 20 days) [CR2]
Enduring understandings to be addressed: 1B; 2A, E; 4A, C
Discussion Topics and Skills: Chapters 7, 32. 33

1. Where It Starts—Photosynthesis **[CR3a] & [CR4b]**
   - Create models of plant structures related to process of photosynthesis
   - Analyze data of energy use comparing autotrophs and heterotrophs
   - Describe the major processes that occur in the two stages of photosynthesis; associate each reaction to a particular cell component
   - Compare/contrast noncyclic and cyclic pathways; relate to evolution in plants
   - Describe evolutionary trends for dealing with differing climate conditions (C_3, C_4, and CAM plants)
2. Plant Homeostasis & Transport **[CR3b]**
   - Explain how plant cells regulate the movement of water and organic materials (bulk flow, translocation, and cohesion-tension theory)
   - Model the experiments leading to the understanding of the role of each class of plant hormones
   - Create time-lapse movie of tropisms and explain how each is regulated
   - Interpret data collected about the activity of organisms with circadian cycles and biological clocks and compare to organisms without photoperiodic responses
   - Describe the action of phytochrome and the role it plays in long-day, short-day, and day-neutral plants

Activities:
Transpiration Investigation (Big idea 4 connects to Big idea 2) **[CR3d]**

Free Response questions from previous AP Exams:
2011-4
2010B-1
2006-3
2006B-3
2003B-2
Photosynthesis/Cell Respiration, 1993

Unit 7. Making New Cells & Organisms (15 - 20 days) [CR2]
Enduring understandings to be addressed: 1A, C; 2A, E; 3A, C; 4A, C
Discussion Topics and Skills: Chapters 8, 9, 31 33

1. How Cells Reproduce **[CR3c] & [CR4c]**
   - Compare each stage of the cell cycle in normal versus cancerous cells
   - Explain the difference between mitotic division and cytokinesis; compare differences in the processes between animal and plant cells
   - Discuss the process by which cancers form **[CR5]**
   - Review experimental data about cell differentiation
2. Meiosis and Sexual Reproduction **[CR3c]**
   - Distinguish between the processes of mitosis and meiosis; distinguish between somatic and germ cells

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.

CR4b: The course provides students with opportunities outside of the laboratory investigations to meet the learning objectives within Big Idea 2.

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.

CR4c: The course provides students with opportunities outside of the laboratory investigations to meet the learning objectives within Big Idea 3.

- Explain why meiosis is important for survival of a species and relate to evolutionary processes
- Illustrate the cellular events that occur during each phase of meiosis I and meiosis II and explain the biological implication of each
- Communicate to fellow students the importance and mechanism of crossing over and how one would recognize if crossing over occurred

3. Reproductive Mechanisms **[CR3c]**
   - Discuss mechanisms that increase genetic variation; relationship to evolutionary fitness
   - Revisit alternation of generations in the context of evolution of organisms; sexual vs. asexual; viral replication
   - Describe the double fertilization that occurs uniquely in the flowering plant life cycle
   - Report on modern biotechnological techniques and parthenogenesis, vegetative propagation, and tissue culture propagation **[CR5]**
   - Differentiate between growth and development; discuss regulation mechanisms
4. Observing Patterns in Inherited Traits **[CR3c]**
   - Discuss the significance of the work of Mendel
   - Collect and analyze data related to several different inheritance patterns
   - Construct and interpret Punnett squares; apply product rule
   - Construct and interpret pedigrees
5. Chromosomes and Human Inheritance **[CR5]**
   - List several examples of human inheritance patterns

Discussion: What are some benefits of genetic screening and genetic counseling? Would you want to know if your child had a genetic disease?

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.

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.

Assignments:

1. Cell Division: Mitosis and Meiosis Investigation
2. Genetics of Organisms using Drosophila, C-Ferns, Fast Plants
3. Complete BLAST
4. Apply to enzyme of their choice
5. Blood Group Genetics **[CR5]**
6. Students act as blood geneticists at a medical lab and serve as expert witnesses in a case of disputed inheritance. Several inheritance patterns will be explored.

Free Response questions from previous AP Exams:

2011-3
2011B-1
2008-4
2004 #1
2002B-4
Plant Reproduction, 1987
2005-3
2006B-1

Unit 8. All About Proteins (20 - 25 days) [CR2]
Enduring understandings to be addressed: 1; 2E; 3A-C; 4A,C
Discussion Topics and Skills: Chapters 10, 11, 12

1. DNA Structure and Function **[CR3b] & [CR4d]**
   - Discuss the historical events leading to our current knowledge of DNA
   - Draw a DNA molecule, labeling the parts of a nucleotide
   - Create an illustration how double-stranded DNA replicates from stockpiles of nucleotides
2. From DNA to Protein **[CR3c]**
   - Compare/contrast DNA and RNA
   - Describe the stages of protein synthesis; translate a DNA code into a polypeptide chain
   - Cite an example of a change in one DNA base pair that has a profound effect on the human phenotype (sickle cell anemia); revisit heterozygote advantage of this trait and malaria **[CR5]**
   - Investigate some of the environmental agents that can cause mutations and the type of mutations these agents cause
   - Explain why mutations in germ cells are usually more of a problem than mutations in somatic cells

   Discussion: Why is the genetic code almost universal? What are the evolutionary implications of this?
3. Controls Over Genes **[CR3d]**
   - List and define the levels of gene control in eukaryotes; contrast this with prokaryotic gene control
4. Studying and Manipulating Genomes **[CR3d] & [CR5]**
   - Debate the value of using modern techniques, such as recombinant DNA, using DNA fragments, in the production and use of transgenic organisms
   - Explain how knowing the composition of genes can help scientists derive counterattacks against rapidly mutating organisms

   Discussion: How does knowing the genetic makeup of Earth's organisms help us reconstruct the evolutionary history of life?

   Discussion: What problems might be involved in trying to clone extinct animals? (explore societal and environmental concerns) **[CR3d] & [CR5]**

Assignments:

1. Biotechnology Investigation 1: Transformation (Big idea 3 connects to Big idea 1) **[CR3c]**
2. Protein Synthesis Activity: Objective: provide students with game format to "see" the relationship between DNA, RNA and proteins.
3. Molecular Evolution in the Test-Tube: In this paper and pencil activity, students explore how evolution can be studied in a test-tube system. The activity is based on research performed by Sol Spiegelman in the mid-1960s.

CR2: The course is structured around the enduring understandings within the big ideas as described in the AP Biology Curriculum Framework.

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.

CR4d: The course provides students with opportunities outside of the laboratory investigations to meet the learning objectives within Big Idea 4.

Free Response questions from previous AP Exams:

2009B-1
2009-4
2005-2
2005B-3
2002-1
2001 #4

Practice Tests; Semester Tests; Review of Course; Individual Student Investigation (15 - 25 days)

- Full-length, released tests used throughout course for diagnostic purposes.
- Review format determined by needs of students.
- Post-AP assignment varies from year to year; determined by interests of students; may include writing review sheets for General Biology class, mammalian dissections, performance of student-generated labs, making video for General Biology class, etc.
- Each student will select a single topic of investigation that is conducted over the last half of the year based on individual observations, interests, and questions generated during the course of the many investigations in the first part of the course. The student will then design, conduct, and collect and analyze data from this investigation and then report on his/her findings to the entire class.