AP Biology Syllabus

	Curricular Requirements	Page (s)
CR1	Students and teachers use a recently published (within the last 10 years) college-level biology textbook	2
CR2	The course is structured around the enduring understandings within the big ideas as described in the AP® Biology Curriculum Framework.	2,3,4,6,7,8, 10,11
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.	3,10
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.	3,5,6
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.	3,10,11
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.	3,5
CR4a	The course provides students with opportunities outside of the laboratory investigations to meet the learning objectives within Big Idea 1.	3,9,10,11
CR4b	The course provides students with opportunities outside of the laboratory investigations to meet the learning objectives within Big Idea 2.	3,5,6
CR4c	The course provides students with opportunities outside of the laboratory investigations to meet the learning objectives within Big Idea 3.	3,6,7,8,11
CR4d	The course provides students with opportunities outside of the laboratory investigations to meet the learning objectives within Big Idea 4.	3,11,13
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.	7,8,10, 11,13
CR6	The student-directed laboratory investigations used throughout the course allow students to apply the seven science practices defined in the AP Biology Curriculum Framework and include at least two lab experiences in each of the four big ideas.	2,5,6,7,8,9,10, 12,13,14
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.	2,14
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.	2,5,6,7,8,9,10, 12,13,15

Course Overview

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

My philosophy is to actively engage students in the process of science through class assignments and discussions which inform their laboratory experiences. For example, I increase students' critical thinking and problem solving abilities by actively requiring them to anticipate experimental set ups in group discussions, journal readings and hand-on labs. Emphasis is also given to journal article readings in order to expose students to present day technologies and procedures to familiarize them to limitations of testable hypotheses in order to develop better designed experimental investigations.

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

Materials

Urry, Lisa A. 2017. *AP Edition Campbell Biology in Focus*, Second Edition, Boston, MA: Pearson **[CR1]**

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

Course Organization

This course is structured around the 4 big ideas and the enduring understanding identified in the Curriculum Framework. **[CR2].** All essential knowledge will be taught and all learning objectives will be addressed through this curriculum. The course will focus on inquiry-based laboratory work and the use of the seven science practices in both lab and non-lab activities.

The four Big Ideas are:

- **Big Idea 1**: The process of evolution drives the diversity and unity of life.
- **Big Idea 2**: Biological systems utilize free energy and molecular building blocks to grow, to reproduce and the maintain dynamic homeostasis.
- **Big Idea 3**: Living systems store, retrieve, transmit and respond to information essential to life processes.

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

Students will be given copy of the big ideas and enduring understandings to self-monitor mastery of these major organizing tools. The big ideas and enduring understandings will also be posted in the classroom. As connections are made across big ideas, a line will join the related enduring understandings, visually building a web of relatedness as the course progresses. The learning objectives will be used as a guide to build the rest of the class discussions, not as a checklist to be marked off through the year, but as a way to help students learn a focused amount of biological content with the use of specific scientific process skills. Skills will be practiced every day, not necessarily all skills every day, but each day at least one skill will be used to introduce the biological content students study. **[CR2], [CR3a], [CR3b], [CR3c], [CR3d], [CR4a], [CR4b], [CR4c], & [CR4d]**

Course Schedule

Readings: Include textbook / journal articles. Students are provided with guided reading questions and are required to take notes.

Assessment: A variety of assessments are used throughout the course. This can include but is not limited to quizzes, tests, lab reports, free response practice, presentations, and multiple choice practice questions.

Big Ideas

The big ideas are interrelated, and they will not be taught in isolation. The course will connect the enduring understandings from one big idea with those of the others whenever practical. Students will maintain a curricular map of the big ideas and enduring understandings showing connections as they are made by the students themselves.

Topics and Timelines (Modified Block Schedule of four classes per week = day 1 = 43 minutes, day 2 = 43 minutes, day 3 = 87 minutes, day 4 = 43 minutes)

Units of Instruction

Unit 1: First week and Introduction (4 classes) **[CR2]**
Big Ideas: 1,2,3,4
Connected to enduring understandings:

- 1.A Change in the genetic makeup of a population over time is evolution.
- 2.A Growth, reproduction and maintenance of the organization of living systems require free energy and matter.

Connected to learning Objectives:

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Chapters:

- Chapter 1: Introduction: Evolution and the Foundations of Biology

- Chapter 2: The Chemical Context of Life

Unit 1 Overview of Lecture and Discussion Topics:

1. Inquiry as a way to learn science
2. Darwin and the Theory of Natural Selection
3. Atom structure
4. Water Properties

Activities:

1. Assignment: Scientific Method Project (SP 2,3,4,5)
    a. Open Inquiry of a biological topic of choice
    b. Research topic to formulate a question
    c. Hypothesize
    d. Design a controlled experiment to test the hypothesis (run multiple trials)
    e. Analyze data and make conclusions
    f. Prepare a presentation of the scientific work
2. Students will use construction paper to make models of atoms and molecules to explain the basic chemistry concepts. These concepts would include essential elements of life, bonding, ions, properties of water due to hydrogen bonding and how these properties impact living systems. (SP 1,7)

<u>Unit 2: Biochemistry and Introduction to the Cell</u> (12 classes) **[CR2]**

Big Ideas 1,2,3,4

Connected to enduring understandings:

- 1.B Organisms are linked by lines of descent from common ancestry.
- 2.D Growth and dynamic homeostasis of a biological system are influenced by changes in the system's environment.
- 3.D Cells communicate by generating, transmitting and receiving chemical signals.
- 2.A Growth, reproduction and maintenance of the organization of living systems require free energy and matter.
- 2.B Growth, reproduction and dynamic homeostasis require that cells create and maintain internal environments that are different from their external environments.
- 3.A Heritable information provides for continuity of life.
- 4.A Interactions within biological systems lead to complex properties.
- 4.B Competition and cooperation are important aspects of biological systems.

Chapters:

- Chapter 3: Carbon and the Molecular Diversity of Life
- Chapter 4: A Tour of a Cell
- Chapter 5: Membrane Transport and Cell Signaling
- Chapter 35: The Immune System

Unit 2 Overview of Lecture and Discussion topics:

1. The impact of carbon as the "backbone of life"
2. How monomers build polymers, including carbohydrates, lipids, proteins, and nucleic acids.

3. Examples of organelles that are membrane bound to compartmentalize their function.
4. Eukaryotic vs. Prokaryotic cells
5. Membrane structure and function
6. Osmosis and Diffusion

Activities / Labs:

1. Diffusion and Osmosis Lab Advanced Inquiry Lab (Big Idea 2, Investigation 4). A demonstration using dialysis tubing will allow students to make observations and to provide evidence for diffusion of molecules; students set up an experiment regarding osmosis and concentration gradients after hypothesizing the outcome; data collection, calculations of percent change, graphing percent change in mass of dialysis bags of varying sucrose molarities placed in water, and analysis of the data will follow. All work will be kept in the laboratory research notebook. (SP 2,4,5) **[CR3b], [CR6], & [CR8]**
2. Egg Osmosis / Diffusion Lab. Students will place egg in vinegar to remove shell. Then students will design a controlled experiment to test the hypothesis. Students will need to run multiple trials in various environments with their eggs. Students will analyze the data and make conclusions. Students will keep all work in their laboratory research notebook. (SP 2,3,4,5) **[CR4b] & [CR8]**
3. Students will identify, explain and justify how intracellular structures interact with each other, such as rough endoplasmic reticulum and the Golgi apparatus, or mitochondria and chloroplasts in plants, or the DNA inside the nucleus and the ribosomes outside the nucleus. (LO 4.18) **[CR3d]**
4. Students will build a cell membrane. Students will connect the enduring understanding that the structure and function of polymers are derived from the way their monomers are assembled (4A.1) to big idea 1 because all organisms share core processes (1B.1) such as regulating what is and is not allowed into the cell. **[CR3d]**

<u>Unit 3: Cellular Energy and Related Processes</u> (12 classes) **[CR2]**

Big Ideas: 2,4

Connected to enduring understandings:

- 2.A Growth, reproduction and maintenance of the organization of living systems require free energy and matter.
- 4.B Competition and cooperation are important aspects of biological systems.

Chapters:

- Chapter 6: An Introduction to Metabolism
- Chapter 7: Cellular Respiration and Fermentation
- Chapter 8: Photosynthesis

Unit 3 Overview of Lecture and Discussion Topics:

1. Metabolic pathways
2. Laws of Energy Transformation
3. How ATP powers cellular work
4. Structure and function of enzymes

5. Harvesting chemical energy: glycolysis, citric acid cycle, oxidative phosphorylation
6. Light reactions and the Calvin Cycle
7. Evolution of alternative mechanism of carbon fixation

Activities / Labs:

1. Photosynthesis in Leaf Disks Advanced Inquiry Lab (Big Idea 2, Investigation5). Student-directed and inquiry based investigations about photosynthesis using the floating leaf disks procedure. A write-up of the design and discussion of the outcome will be kept in their laboratory research notebook. (SP 1,2,3,6,7) **[CR6] & [CR8]**
2. Virtual Lab: Cellular respiration. Students will work through a virtual lab on cell respiration. Students will understand the relationships between temperature, pressure and volume. Students will read respirometers and complete calculations to determine the rate of respiration. Students will complete the virtual lab and the results will be recorded in the laboratory research notebook. (SP 2,3,5,7) **[CR3b] & [CR8]**
3. Students will make short movies showing the relationship between molecular events and global cycles such as between photosynthesis/respiration and global carbon cycles. (LO 2.9) **[CR3b]**

<u>Unit 4: Cell cycle and Meiosis</u> (8 classes) **[CR2]**

Big Idea: 3

Connected to enduring understandings:

- 3.A Heritable information provides for continuity of life.
- 3.C The processing of genetic information is imperfect and is a source of genetic variation.

Chapters:

- Chapter 9: The Cell Cycle
- Chapter 10: Meiosis and Sexual Life Cycles

Unit 4 Overview of Lecture and Discussion Topics:

1. How mitosis produces genetically identical daughter cells.
2. Evolution of Mitosis
3. How the eukaryotic cell cycle is regulated by a molecular control system.
4. How meiosis reduces the number of chromosomes (diploid to haploid)
5. Evolutionary significance of genetic variation that results from sexual life cycles

Activities / Labs:

1. Modeling the cell cycle. Students construct a model of the cell cycle, explain and present the major events in a presentation. (SP1) **[CR4b]**
2. Using mitosis cards students estimate the time a cell spends in each of the mitotic stages and develops an appropriate graph to reveal data. (SP 5) **[CR4b]**
3. Students will use a chromosome bead kit to simulate the process of meiosis and explain when haploidy occurs. (SP 1) **[CR4c]**
4. Environmental Effects on Mitosis Advanced Inquiry Lab (Big Idea 3, Investigation 7). Student directed and inquiry based laboratory. Onion roots are treated with bean lectin to

increase mitotic rate in cells. Students design a controlled experiment to test the effect of treated root squashes and use Chi Square to analyze data. A write-up of the laboratory and outcome, including calculations and analysis of data will be prepared in the laboratory research notebook. (SP 1,5,6,7) **[CR6]** & **[CR8]**

5. Cancer and the Loss of the Cell Cycle Control Advanced Inquiry Activity (Big Idea 3, Investigation 7). Student directed and inquiry based laboratory. Activity begins with students comparing normal karyotypes to two known cancerous karyotypes. After these karyotypes have been identified, students will evaluate and assess two unknown karyotypes. Students will conduct research into aneuploidy and translocation in a cancer type of their own choice. Students then prepare a mini-poster or presentation to share with their peers. (SP 1,2,5,6,7) **[CR6]** & **[CR8]**

Unit 5: Genetic Basis of Life (7 classes) **[CR2]**
Big Ideas 1,3,4
Connected to enduring understandings:

- 3.A Heritable information provides for continuity of life.
- 3.B Expression of genetic information involves cellular and molecular mechanisms.
- 3.C The processing of genetic information is imperfect and is a source of genetic variation.

Chapters:

- Chapter 11: Mendel and the Gene Idea
- Chapter 12: The Chromosomal Basis of Inheritance

Unit 5 Overview of Lecture and Discussion Topics:

1. Genes are passed from parents to offspring by the inheritance of chromosomes
2. Concepts of Mendelian genetics (laws, inheritance patterns)
3. Genes located along chromosomes (concepts of gene linkage, mapping distance between genes, causes of genetic disorders) **[CR5]**

Activities / Labs:

1. Knowing the % of each color in packages of M & M's as published by the packaging company, students will count the colors in packages and apply the null hypothesis concept and Chi Square calculations on the data. (SP 2) **[CR4c]**
2. Transgenic Fly Virtual Lab. Students will complete a virtual lab to insert DNA into flies which are used to study circadian rhythms. Students will record information completed online in their laboratory research notebook. (SP 2,5) **[CR4c]**

Unit 6: Gene Activity and Biotechnology (14 classes) **[CR2]**
Big Ideas: 2, 3, 4
Connected to enduring understandings:

- 2.A Growth, reproduction and maintenance of the organization of living systems require free energy and matter.
- 2.C Organisms use feedback mechanisms to regulate growth and reproduction, to maintain dynamic homeostasis.

- 2.E Many biological processes involved in growth, reproduction and dynamic homeostasis include temporal regulation and coordination.
- 3.A Heritable information provides for continuity of life.
- 3.B Expression of genetic information involves cellular and molecular mechanisms.
- 3.C The processing of genetic information is imperfect and is a source of genetic variation.
- 4.A Interactions within biological systems lead to complex properties.
- 4.B Competition and cooperation are important aspects of biological systems.
- 4.C Naturally occurring diversity among and between components within biological systems affect interactions with the environment.

Chapters:

- Chapter 13: The Molecular Basis of Inheritance
- Chapter 14: Gene Expression: From Gene to Protein
- Chapter 15: Regulation of Gene Expression
- Chapter 16: Development, Stem Cells, and Cancer
- Chapter 17: Viruses
- Chapter 18: Genomes and Their Evolution

Unit 6 Overview of Lecture and Discussion Topics:

1. DNA is the genetic material (DNA structure and function, DNA replication)
2. Flow of genetic information (transcription, translation, genetic code)
3. Mutations
4. Gene expression (prokaryotes, eukaryotes)
5. Virus (structure and activity)
6. Restriction enzymes, plasmids, transformation
7. DNA technology (how gel electrophoresis works and application of this technology) **[CR5]**

Activities / Labs:

1. Model of an operon: Following lecture and discussion of structure and function of an operon system, material are made available for students to create a model of an operon and demonstrate to their classmates. (SP 1,6) **[CR4c]**
2. DNA Extraction: Students will extract DNA from a strawberry and another substance of their choice. Students will record all information from this activity in the laboratory research notebook. (SP 3,4) **[CR4c]**
3. Restriction Enzyme Analysis of DNA Student Laboratory Kit (Big Idea 3, Investigation 9). In this experiment, restriction enzymes are introduced as a tool to digest DNA at specific nucleotide sequences. Bacteriophage lambda DNA has a linear structure and multiple recognition sites. Separation by agarose gel electrophoresis of digests of lambda DNA will yield several bands corresponding to the DNA fragments. Students will estimate the size of the fragments and determine which restriction enzyme was used to digest the DNA. The entire laboratory study will be documented in the laboratory research notebook. (SP 3,6) **[CR6] & [CR8]**

Unit 7: Evolution and Phylogeny (20 classes) **[CR2]**

Big Ideas: 1, 2, 3,4

Connected to enduring understandings:

- 1. A Change in the genetic makeup of a population over time is evolution.
- 1.B Organisms are linked by lines of descent from common ancestry.
- 1.C Life continues to evolve within a changing environment.
- 1.D The origin of living systems is explained by natural processes.
- 2.A Growth, reproduction and maintenance of the organization of living systems require free energy and matter.
- 2.E Many biological processes involved in growth, reproduction and dynamic homeostasis include temporal regulation and coordination.
- 3.A Heritable information provides for continuity of life.
- 3.C The processing of genetic information is imperfect and is a source of genetic variation.
- 4.A Interactions within biological systems lead to complex properties.

Chapters:

- Chapter 19: Descent with Modification
- Chapter 20: Phylogeny
- Chapter 21: The Evolution of Populations
- Chapter 22: The Origin of Species
- Chapter 23: Broad Patterns of Evolution
- Chapter 24: Early Life and the Diversification of Prokaryotes
- Chapter 25: The Origin and Diversification of Eukaryotes

Unit 7 Overview of Lecture and Discussion Topics:

1. How natural selection serves as a mechanism for evolution
2. Scientific evidence supporting evolution
3. Hardy-Weinberg concept
4. How allele frequencies can be altered in a population
5. Concepts of speciation
6. Origin of life; Fossil records
7. Early prokaryotes and eukaryotes

Activities / Labs:

1. Examining the fossil record: students will examine fossils arranged on the paper. Students will answer questions after analyzing the pictures. Students will be able to determine if it was punctuated equilibrium or gradualism. (SP 5,6) **[CR4a]**
2. Mathematical Modeling: Hardy Weinberg (Big Idea 1, Investigation 2). Students will use a spreadsheet to model allele frequencies. Students will see how mathematical models can be used to investigate relationships between allele frequencies in populations of organisms and see how evolutionary change takes place. Students will record information in a laboratory research notebook. (LO 1.6) (SP1,2,5) **[CR6] & [CR8]**
3. Understanding Evolutionary Relationships Advanced Inquiry Activity (Big Idea 1, Investigation 3). Students will use BLAST (Basic Local Alignment Search Tool), a bioinformatics computer comparison tool, to research the gene sequence for a protein

found in each organism. Once they become comfortable, students will use the tool to answer questions of their choice regarding gene sequences. (SP 1,5) **[CR6] & [CR8]**

4. NOVA; PBS video: "What Darwin Never Knew." This video will be utilized in conjunction with whole class discussions to take a look at Charles Darwin's observations and conclusions and how modern day molecular biology is confirming what Darwin documented. (Connects big idea 1 to enduring understanding 3.C) **[CR3c], [CR4a] & [CR5]**
5. Students will examine evidence regarding speciation of major groups of plants and major extinctions on Earth. Students will plan, design, and carry out data collection plans to evaluate these scientific claims. (LO 1.21) **[CR3a]**

<u>Unit 8 Diversity in the Biological World: Organism Form and Function</u> (20 Classes) **[CR2]**
Big Ideas 1,2,3,4

Connected to enduring understandings:

- 1.A Change in the genetic makeup of a population over time is evolution.
- 1.B Organisms are linked by lines of descent from common ancestry.
- 2.A Growth, reproduction and maintenance of the organization of living systems require free energy and matter.
- 2.C Organisms use feedback mechanisms to regulate growth and reproduction, and to maintain dynamic homeostasis.
- 2. D Growth and dynamic homeostasis of a biological system are influenced by changes in the system's environment.
- 2.E Many biological processes involved in growth, reproduction and dynamic homeostasis include temporal regulation and coordination.
- 3.D Cells communicate by generating, transmitting and receiving chemical signals.
- 3.E Transmission of information results in changes within and between biological systems.
- 4.A Interactions within biological systems lead to complex properties.
- 4.B Competition and cooperation are important aspects of biological systems.

Chapters:

- Chapter 26: The Colonization of Land
- Chapter 27: The Rise of Animal Diversity
- Chapter 28: Plant Structure and Growth
- Chapter 29: Resource Acquisition, Nutrition, and Transport in Vascular Plants
- Chapter 30: Reproduction and Domestication of Flowering Plants
- Chapter 31: Plant Responses to Internal and External Signals
- Chapter 32: The Internal Environment of Animals: Organization and Regulation
- Chapter 33: Animal Nutrition
- Chapter 34: Circulation and Gas Exchange
- Chapter 36: Reproduction and Development
- Chapter 37: Neurons, Synapses, and Signaling
- Chapter 38: Nervous and Sensory Systems

Unit 8 Overview of Lecture and Discussion Topics: This section covers a broad survey of the diversity of life; specific topics will connect big ideas and enduring understandings.

1. Evolutionary trends (endosymbiosis, plant adaptations, movement of plants from water to land, angiosperms reproductive adaptations, roles of fungi, body plans of animals)
2. Life cycle of angiosperms
3. Signal transduction pathways of plant and animal hormones
4. Photoperiodism in plants
5. Feedback control loops in animals
6. Thermoregulation in animals
7. Energy allocation and use in animals
8. Examples of functioning units in mammal systems (alveoli in lungs, villi of small intestine, nephrons in kidneys)
9. Structure and function of the nervous system including the brain
10. Structure and function of the circulatory system including gas exchange

Activities / Labs:

1. Working with cladograms and phylogenetic trees: given groups of organisms and some of their distinguishing characteristics, students will construct a cladogram and properly interpret and analyze it in terms of how it shows common ancestry. (SP 1,3,5) **[CR4a] & [CR4d]**
2. Jumpin' the Gap: http://learn.genetics.utah.edu Students act out communication at the neural level by behaving as vesicles, neurotransmitters, receptors, secondary messengers and transporters. (SP 1,7) **[CR4d]**
3. Research: Can stem cell-based therapy be used in brain and spinal cord injuries? Students will prepare presentations of their findings and responses to questions such as: Should embryonic stem cell research continue to be permitted? Should it be supported by government funding? Do the origins of embryonic stem cell lines make a difference? (SP 3) **[CR4c] & [CR5]**
4. Evolution Lab – Simulation showing how organisms evolve over time in response to environmental conditions. Students will record information in laboratory research notebook. (SP1,5) **[CR4a]**
5. Students will work with models demonstrating the immune system, digestive system, action potential, action at the nephron, working of the sarcomere, and cellular communication, which allow students to problem solve as they change conditions within the model. Students will model the effect of change (examples would be disease or drugs) and communicate the results predicted due to the change. (LO 3.36)
6. Students will select and read an article in a scientific journal on a medical procedure, device, drug trial, or similar event. Students will statistically analyze and evaluate the data and report on the findings. (LO 3.37) **[CR3c]**

Unit 9: Ecology (15 classes) **[CR2]**
Big Ideas 1,2,3,4
Connected to enduring understandings:

- 1.C Life continues to evolve within a changing environment
- 2.A Growth, reproduction and maintenance of the organization of living systems require free energy and matter
- 2.C Organisms use feedback mechanisms to regulate growth, reproduction and dynamic homeostasis

- 2.D Growth and dynamic homeostasis of a biological system are influenced by changes in the system's environment
- 3.E Transmission of information results in changes within and between biological systems.
- 4.A Interactions within biological systems lead to complex properties.
- 4.B Competition and cooperation are important aspects of biological systems.
- 4.C Naturally occurring diversity among and between components within biological systems affects interactions with the environment.

Chapters:

- Chapter 39: Motor Mechanisms and Behavior
- Chapter 40: Population Ecology and the Distribution of Organisms
- Chapter 41: Species Interactions
- Chapter 42: Ecosystems and Energy
- Chapter 43: Global Ecology and Conservation Biology

Unit 9 Overview of Lecture and Discussion Topics:

1. Aspects of animal behavior
2. Aspects of biomes
3. Population growth models
4. Regulation of population growth
5. Community interactions
6. Species diversity and composition
7. Community Biodiversity
8. Energy flow and chemical cycling in ecosystems
9. Energy transfer between trophic levels
10. Human activities that threaten biodiversity

Activities/Labs:

1. Rate of Transpiration Advanced Inquiry Lab (Big Idea 4, Investigation 11). Students will determine the approximate leaf area and therefore the approximate number of stomata for each plant. The study of the stomata and leaf area serves as a foundation for the inquiry portion of the lab when students are to develop their own testable hypothesis and open-inquiry experiment. Students will ask questions such as how does the weather and environment affect transpiration? Another question could be, are there ways to increase transpiration rate? Students will plan, discuss, evaluate, execute, and justify their experiment and results to their peers. Students will create a google slide presentation and record all information in their laboratory research notebook. (SP 1,2,4,5,6) **[CR6] & [CR8]**

2. Fruit Fly Behavior Advanced Inquiry Lab (Big Idea 4, Investigation 12). Students design their own controlled experiments to investigate a question they have about animal behavior (kinesis and taxis in isopods, fruit fly behavior with respect to selected stimuli). The entire laboratory and experimental design and analysis will be written in the laboratory research notebook. (SP 1,3,4,5,6,7) **[CR6] & [CR8]**

3. Peroxidase Enzyme Activity Advanced Inquiry Lab (Big Idea 4, Investigation 13). Students investigate the activity of turnip peroxidase by measuring its rate of reaction

with hydrogen perioxide and a natural reducing agent called guaiacol. Students measure the absorbance or color intensity of the orange product formed from guaiacol as a function of time for three different enzyme concentrations. Graphical analysis gives the rate of the reaction. Students then design experiments in search of additional evidence that may support or refute the mechanism of enzyme action. Students will record all items in their laboratory research notebook. (SP 4,5,6,7) **[CR 6] & [CR8]**

4. Bottle Biology. Students will use two-liter bottles to investigate factors that affect ecosystems. (SP3) **[CR4d]**
5. Virtual Lab: Population biology. Students will observe the competitive exclusion principle in populations of paramecium. (SP1) **[CR4d]**

Social and Ethical Concerns [CR5]

It is extremely important that students connect their classroom knowledge to socially important issues. The course will allow students to learn about and discuss many issues in a variety of formats. Issues will be discussed in a class setting, both live and electronically through such programs as a schoology discussion board, and students may research and report on a current topic that has social or ethical issues associated with it. Since the goal will be to discuss a timely event, the list below should be seen as illustrative as new issues continually appear.

- Antibiotic resistance and the problems with improper antibiotic use (Big Idea 1)
- Stem Cell Research (Big Idea 3)
- Genetically Modified Food (Big Idea 3)
- The Use of Genetic Information (Big Idea 3)
- Global Warming (Bid Idea 4)

Application of the Science Practices in the Laboratory Program [CR6]

Students will be able to apply the science practices throughout their laboratory work; a matrix describing their application is below. Many of the science practices will be used in all of the student-directed laboratory and field investigations, however, some science practices will be emphasized to a greater degree than others in each particular investigation. Those that are emphasized are indicated by an "X" in the matrix. **[CR6]**

Science Practices

1. The student can use representations and models to communicate scientific phenomena and solve scientific problems.
2. The student can use mathematics appropriately.
3. The student can engage in scientific questioning to extend thinking or to guide investigations within the context of the AP course.
4. The student can plan and implement data collection strategies appropriate to a particular scientific question.
5. The student can perform data analysis and evaluation of evidence.
6. The student can work with scientific explanations and theories.

7. The student is able to connect and relate knowledge across various scales, concepts, and representations in and across domains.

Big Idea	Investigation	SP 1	SP 2	SP 3	SP 4	SP 5	SP 6	SP 7
1	# 2 Hardy-Weinberg	X	X			X		
1	# 3 BLAST	X				X		
1	Genetics of Drosophila Eye color	X		X	X	X	X	
2	#4 Diffusion and Osmosis		X		X	X		
2	Water Potential		X		X	X		
2	#5 Photosynthesis	X	X	X	X		X	X
3	# 7 Mitosis and Meiosis	X				X	X	X
3	Cancer and Cell Cycle	X	X			X	X	X
3	# 9 Restriction Enzyme Analysis			X			X	
4	# 11 Transpiration	X	X		X		X	X
4	# 12 Fruit Fly Behavior	X		X	X	X	X	X
4	#13 Enzyme				X	X	X	X

The Laboratory Program

The students will be engaged in investigative laboratory work for a minimum of 25% of instructional time. **[CR7]** These labs will be inquiry based, student-directed investigations. There will be at least two laboratory experiences per big idea selected from the AP Biology Investigative Lab Manual: An inquiry-based approach (2012). **[CR6]** These labs will be spread throughout the school year and will be conducted during at least one out of every four class meetings during the year. The descriptions below summarize the student inquiry portion of the investigation of the labs we will complete. Additional prescribed activities supplement the student inquiry.

Big Idea 1: Evolution

- Hardy-Weinberg: Spreadsheet development to investigate factors affecting Hardy-Weinberg equilibrium
- BLAST Activity: Students use an online database to compare DNA and protein sequences for organisms to test student-generated hypotheses on their relatedness.

Big Idea 2: Cellular processes; Energy and Matter

- Diffusion/Osmosis: Students investigate diffusion and osmosis in model systems and in plant tissue.
- Photosynthesis: Students investigate photosynthetic rate under a variety of student selected conditions.

Big Idea 3: Genetics and Information Transfer

- Cell Division: Mitosis and Meiosis. Students compare mitotic rate after exposure to lectin or other substances presumed to affect mitotic rate.
- Restriction Enzyme Analysis: Students investigate restriction enzyme analysis.

Big Idea 4: Interactions

- Fruit Fly Behavior: Students investigate chemotaxis in fruit flies.
- Transpiration: Students investigate the movement of water through plants in a model system.
- Enzyme Investigation: In an open inquiry lab, students will investigate and quantify factors that affect enzyme action.

Communication

Students will maintain a laboratory notebook and a portfolio throughout the course. In addition to the laboratory notebook, students will communicate to others in formats such as group presentations, google slides, poster sessions, and written reports. Communication tools are not only for the laboratory experiences, but represent examples of the collaboration, reflection, and articulation seen in the course as a whole. Students will use this collection of their work over time and reflect on the changes they can see in the quality or substance of their work through the year as they prepare to move into college courses and research experiences in the future. A key feature in the portfolio will be the requirement for student self-reflection in terms of the science practice skills that they have developed throughout the year. **[CR8]**

Additional Websites:

Websites for student use for review/homework/lab-prep are an irreplaceable tool for instructional purposes and student understanding. The following is a partial list of some of the sites I use on a daily / weekly basis.

- The Biology Project – University of Arizona
- Online Biology in Focus Book
- Lab Bench
- Learn.Genetics.Utah.edu
- Cells Alive