

AP Biology Syllabus 2012-2013

AP Biology: Curricular Requirements (CR)

CR1: Students and teachers use a recently published (within the last 10 years) college-level biology textbook. (pg 4)

CR2: The course is structured around the enduring understandings within the big ideas as described in the AP Biology Curriculum Framework. (pgs 4, 5, 6, 7, 8, 9, 10, 11, 13, 15)

CR3a: Students have opportunities to connect the AP Biology enduring understandings within big idea 1 (the process of evolution drives the diversity and unity of life) to at least one other big idea. (pg 7)

CR3b: Students have opportunities to connect the AP Biology 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. (pgs 6, 7, 8)

CR3c: Students have opportunities to connect the AP Biology 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. (pg 13)

CR3d: Students have opportunities to connect the AP Biology 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. (pg 16)

CR4a: Students are provided with opportunities outside of laboratory investigations to meet the learning objectives in the AP Biology Curriculum Framework within big idea 1. (pgs 13, 14)

CR4b: Students are provided with opportunities outside of laboratory investigations to meet the learning objectives in the AP Biology Curriculum Framework within big idea 2. (pgs 6, 7, 8, 9)

CR4c: Students are provided with opportunities outside of laboratory investigations to meet the learning objectives in the AP Biology Curriculum Framework within big idea 3. (pgs 9, 10, 11, 14)

CR4d: Students are provided with opportunities outside of laboratory investigations to meet the learning objectives in the AP Biology Curriculum Framework within big idea 4. (pgs 14, 16)

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. (pgs 10, 11, 13, 14, 16)

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. (pgs 4, 7, 8, 9, 11, 12, 15,16)

CR7: Students are provided the opportunity to engage in investigative laboratory work integrated throughout the course for a minimum of 25% of instructional time. (pgs 3, 4)

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. (pgs 7, 8, 9, 11, 12, 15)

Course Overview

This course is equivalent to a first year biology course in college. It is structured around the College Board Biology Course Description and is designed to offer students a solid foundation for college courses in biological sciences. As in all college level science courses, great emphasis is placed laboratory skills, data collection, and data analysis. All material will be presented in units related to the major themes outlined by College Board and the labs utilized are the suggested labs from College Board as well. Some technology will be integrated into this course with the use of CBL units for data collection in some labs as well as personal computers in the computer lab at school for data input and analysis of lab results.

Biology is a great course to teach because it affords me the opportunity to demonstrate to my students how everything ties together in this world. Students are able to see links between themselves and every topic we study. Students are able to determine how their actions in life and interactions with our planet can decide its future, and they see the effects of their behavior on our environment – first-hand. For example, in this course students must relate their biological knowledge of cloning, genetic mutation, and artificial selection to their impact on the US economy and the global economy as related to marketable plants and animals. It is very important students always tie the material taught in class back to a personal link in order to convert that material to knowledge so they become scientifically literate citizens.

Instructional Context

The 2012-13 school year will be the fourth year AP Biology has been offered for students in this district. There will be one AP biology class consisting of a maximum of 20 students who are seniors. These students will have completed regular biology in tenth grade as well as chemistry their junior year. The class period is 45 minutes/five days a week/the entire school year.

Teaching Strategies and Techniques

Most of the class time is spent conducting hands on activity related to the outside reading or class lecture and conducting lab activities related to the unit. I use drawings, overheads, videos, magazines – anything necessary to supplement my class plans to help students understand the material we cover. Most of the lectures are presented in a manner where the material we are covering is linked back to the previous or upcoming topic to show the underlying link between all things biology. I try to include a hands-on activity with every lecture topic or one that is carried out as part of our lecture presentation for the day or the entire unit.

The AP labs in the AP Investigative Labs Manual are used in full or in some modified version to fit my class needs and time constraints. I will also use many outside activities from other sources to help students grasp the concepts covered and see the link between each topic.

Students will always answer items in the lab manual related to the lab and complete a written lab report regarding the experiment conducted making sure to include a title, background data, method of study, procedure, collected data, results of experiment, analysis of collected data, conclusion, limitations/problems, and their recommendations for future experiments. I want to see that they understand the scientific procedure each time we carry out a lab activity. Labs and lab activities will comprise a minimum of 25% of the course time. (CR7)

Student Evaluation

I use homework, quizzes, unit exams, projects, lab reports and lab questions, and the individual semester project to evaluate student learning and determine student grades in this course. A grade is determined and reported for four separate grading periods throughout the year for each student as follows:

Homework/ Class assignments – 20%

Projects 20%

Unit Exams / Labs 40%

Nine-Week Comprehensive Exam each quarter 20%

Instructional Resources

Reece, Jane, et al., *Campbell Biology*, 9th Edition, 2011, Pearson Benjamin Cummings (CR1)

Giffen, Cynthia and Heitz, Jean. *Practicing Biology* (ancillary text), 3rd Edition, 2008, Pearson Benjamin Cummings.

AP Biology Investigative Labs: an Inquiry Based Approach.

Project Learning Tree. *Environmental Education Activity Guide*. American Forest Foundation. 2006.

Additional Web Resources:

www.campbellbiology.com

www.apcentral.collegeboard.com

www.biologyjunction.com

www.sciencespot.net

www.biologycorner.com

Advanced Placement Biology Content

This course is structured around the four big ideas, the enduring understandings within the big ideas, and the essential knowledge within the enduring understanding. (CR2)

The big ideas:

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 to 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

The Investigative Laboratory Component

The course is also structured around inquiry in the lab and the use of the seven science practices throughout the course.

Students are given the opportunity to engage in student-directed laboratory investigations throughout the course for a minimum of 25% of instructional time. (CR7) Students will conduct a minimum of eight inquiry-based investigations (two per big idea throughout the course). (CR6) Additional labs will be conducted to deepen students'

conceptual understanding and to reinforce the application of science practices within a hands-on, discovery based environment. All levels of inquiry will be used and all seven science practice skills will be used by students on a regular basis in formal labs as well as activities outside of the lab experience.

The course will provide opportunities for students to develop, record, and communicate the results of their laboratory investigations.

Science Practices (SP)

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.

Topics and Timelines

Schedule consists of 5 – 45 minute classes per week

Units of Instruction

Unit 1: First Week and Introduction (10 Classes) **(CR2)**

Big ideas: 1, 2

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.

Chapters:

1. Introduction: Themes in the Study of Life
2. The Chemical Context of Life
3. Water and the Fitness of the Environment

Unit 1 Overview of Lecture and Discussion Topics:

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

Activities:

1. Students use construction paper to make models of atoms and molecules with magnetic backs in order to facilitate discussion and functionally explain (using a magnetic board/white board), basic chemistry concepts including essential elements of life, bonding, ions,

properties of water due to hydrogen bonding and how these properties impact living systems. (SP 1, 7)

2. Assignment: Science Project (SP 2, 3, 4, 5)

Open inquiry of a biological topic of choice:

Research topic to formulate a question

Hypothesize

Design a controlled experiment to test the hypothesis (multiple trials)

Analyze data and make conclusions

Prepare a folder of the scientific work and prepare for a visual presentation

Unit 2: Biochemistry and Introduction to the Cell (15 Classes) (CR2)

Big ideas: 1, 2, 3, 4

Connected to enduring understandings:

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.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.

4.C: Naturally occurring diversity among and between components within biological systems affects interactions with the environment.

Chapters:

4. Carbon and the Molecular Diversity of Life

5. The Structure and Function of Large Biological Molecules

6. A Tour of the Cell

7. Membrane Structure and Function

Unit 2 Overview of Lecture and Discussion topics:

1. The impact of carbon as the “backbone of life”

2. How monomers build polymers, including the roles of nucleic acids

3. Examples of organelles that are membrane bound to compartmentalize their functions

4. Membrane structure and function

Activities/Labs:

1. From *Practicing Biology*, 3rd Edition.

Activity 4.1/5.1 “How can you identify organic macromolecules?”

Activity 4.2/5.2 “What predictions can you make about the behavior of organic macromolecules if you know their structure?”

Activity 4.2/5.2 Test Your Understanding “Explain your reasoning as to the outcome of experiments whose outcomes depend on the chemical characteristics of the four major types of macromolecules.” **(CR3b) & (CR4b)**

2. BUILD-A-MEMBRANE: <<http://learn.genetics.utah.edu/>> Cut, fold, and paste biological molecules to create a three-dimensional cell membrane with embedded proteins, followed by

whole class discussion of membrane structure and function. (SP 1) Students complete animations and activities from Amazing Cells page of this website. **(CR3b)**

3. Diffusion and Osmosis Lab Inquiry. A demonstration using dialysis tubing (model) will allow students to make observations and to provide evidence for the 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 1, 2, 3, 4, 5, 6) **(CR3b), (CR6) & (CR8)**

4. Whole Class Discussion (Campbell, pg 91) Evolution Connection: Would you expect the amino acid sequences of all the proteins of a given set of living species to show the same degree of divergence? Why or why not? (SP 6)

Unit 3: Cellular Energy and Related Processes (15 Classes) **(CR2)**

Big ideas: 1, 2, 4

Connected to enduring understandings:

- 1.A: Change in the genetic makeup of a population over time is evolution.
- 1.D: The origin of living systems is explained by natural processes.
- 2.B: Growth, reproduction and maintenance of the organization of living systems require free energy and matter.
- 4.A: Interactions within biological systems lead to complex properties.
- 4.B: Competition and cooperation are important biological systems.

Chapters:

- 8. An Introduction to Metabolism
- 9. Cellular Respiration
- 10. Photosynthesis

Unit 3 Overview of Lecture and Discussion Topics:

- 1. Metabolic pathways
- 2. Laws of Energy Transformation
- 3. How ATP powers cellular work
- 4. Enzyme structure and function
- 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:

- 1. From *Practicing Biology*, 3rd Edition (SP 1)

Activity 9.1 A Quick Review of Energy Transformations.

Activity 9.2 Modeling cellular respiration: How can cells convert the energy in glucose to ATP.

Activity 10.1 Modeling photosynthesis: How can cells use the sun's energy to convert carbon dioxide and water into glucose (10.1 Test Your Understanding)

Activity 10.2 How do C₃, C₄, and CAM photosynthesis compare? (Connection of big idea #2 to enduring understanding 1.A) **(CR3a) & (CR4b)**

2. THE EVOLUTION OF THE CELL: <<http://learn.genetics.utah.edu>> The endosymbiotic theory explains how relatives of ancient bacteria ended up in modern-day cells. A whole class discussion is used to analyze the endosymbiotic theory, encouraging students to question how prokaryotes can carry on energy transfer processes without true membrane bound organelles. Students are given 5 minutes to write a conclusion to the discussion on a post-it note for posting on their way out of class. (SP 3, 6) **(CR3b) & (CR4b)**

Big idea #2 Laboratory Investigations:

1. Pea Respiration. Using knowledge of the process of cellular respiration and of how to set timed experiments using the carbon dioxide probes and CBL based equipment, students will engage in the process of inquiry as they conduct an experiment to measure the rate of cell respiration in germinating peas at room temperature. Next, students will design a controlled experiment to answer a question of their choice that they asked while conducting the experiment at room temperature. Students will collect and determine cellular respiration rates and demonstrate an understanding of concepts involved by preparing a report in their laboratory research. (Supports big idea 2; SP 2, 3, 4, 5) **(CR6) & (CR8)**

2. Photosynthesis Laboratory: Student-directed and inquiry based investigations about photosynthesis using the floating leaf disc procedure. A write-up of the design and discussion of the outcome will be kept in their laboratory research notebook. (Supports big idea 2; SP 2, 3, 4) **(CR6) & (CR8)**

3. Laboratory: Students will be allowed to explore with the CBL equipment and a gas pressure probe, learning how to set up timed experiment. Concepts related to enzyme structure and function will have been learned. In this inquiry based investigation, students will design an experiment to test a variable on the rate of reaction of catalase with hydrogen peroxide. Appropriate materials will be available to them to test the variable of their choice and to explore to find answers to open ended questions that they have. Posters or powerpoints will be prepared for presentations to the class of the outcome, including rate calculations and meaning of data as it relates to enzyme structure and function. (Supports big idea 2; SP 2, 3, 4, 5) **(CR6)**

Unit 4: Cell Communication and the Cell Cycle (18 Classes) **(CR2)**

Big ideas: 1, 2, 3

Connected to enduring understandings:

- 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.D: Cells communicate by generating, transmitting and receiving chemical signals.

Chapters:

- 11. Cell Communication
- 12. The Cell Cycle

Unit 4 Overview of Lecture and Discussion Topics:

1. Evolution of cell signaling
2. Reception, transduction, response
3. Apoptosis
4. How mitosis produces genetically identical daughter cells
5. Evolution of Mitosis
6. How the eukaryotic cell cycle is regulated by a molecular control system
7. Origin of cell communication

Activities:

1. Pathways with Friends: <<http://learn.genetics.utah.edu>> Directed by instructional cards, students kinesthetically model cell communication by acting as components in a cell signaling. Whole class discussion follows, assessing student understanding of cell communication. Animations of Cell Communication, An Example of Cell Communication, The Fight or Flight Response, How Cells Communicate during the Fight or Flight Response (These animations provide students with a model example of the concepts involved in cell signaling). (SP 1) **(CR4c)**
2. *Practicing Biology*, 3rd Edition Activity 11.1 How are chemical signals translated into cellular responses? **(CR4c)**
3. Whole class discussion: How do hormones and other signaling molecules work? (Animals and Plants, Chapters 45 and 39) **(CR4c)**
4. Modeling the Cell Cycle. Students construct a model of the cell cycle, explain and present the major events in a presentation. (SP 1) **(CR4b)**
5. Using mitosis cards (such as from Ward's Natural Science), students estimate the time a cell spends in each of the mitotic stages and develops an appropriate graph to reveal data. (SP 5) **(CR4b)**

Big idea # 3 Laboratory Investigations:

Cell Division and Mitosis. 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.

(Supports big idea 3; SP 2, 3, 4, 5) **(CR6) & (CR8)**

Unit 5: Genetic Basis of Life (15 Classes) **(CR2)****Big ideas: 1, 3, 4****Connected to enduring understandings:**

- 1.A: Change in the genetic makeup of a population over time is evolution.
- 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.C: Naturally occurring diversity among and between components within biological systems affects interactions with the environment.

Chapters:

13. Meiosis and Sexual Life Cycles
14. Mendel and the Gene Idea

15. 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. How meiosis reduces the number of chromosomes (diploid to haploid)
3. Evolutionary significance of genetic variation that results from sexual life cycles
4. Concepts of Mendelian genetics (laws of probability, inheritance patterns)
5. Genes are located along chromosomes (concepts of gene linkage, mapping distance between genes, causes of genetic disorders) **(CR5)**

Activities:

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. Students will be given data from a Genetics of Drosophila laboratory involving three crosses of the fruit flies. All of the observations will be given to them. They will develop a null hypothesis as to the mode of inheritance based on the data, and they will use the Chi Square statistical analysis to determine whether to accept or reject the hypothesis. (SP 2, 5)
3. Students will use a chromosome bead kit to simulate the process of meiosis and explain when haploidy occurs. (SP 1)

Laboratory Investigation:

Meiosis in Sordaria. Students analyze outcomes of Sordaria crosses, determine phenotypes due to crossover or non-crossover, and determine percent recombination and map units. They will compare their observations with the known map distance from gene to centromere. (SP 2, 5)

Unit 6: Gene Activity and Biotechnology (16 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.C: Organisms use feedback mechanisms to regulate growth and reproduction, and 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.

Chapters:

16. The Molecular Basis of Inheritance
17. From Gene to Protein
18. Regulation of Gene Expression
19. Viruses
20. Biotechnology
21. Genomes and their Evolution

Unit 6 Overview of Lecture and Discussion Topics:

1. DNA is the genetic material (historical experiments, DNA structure and function, DNA replication)
2. Flow of genetic information (genetic code, role of other polymers, transcription, translation)
3. Mutations
4. Gene expression (operon systems in prokaryotes, eukaryotic gene expression)
5. Virus structure and activity
6. Restriction enzymes, plasmids, transformation
7. DNA technology (how gel electrophoresis works and applications of this technology)

(CR5)

Activities:

1. *Practicing Biology*, 3rd Edition.

Activity 16.1 Is the hereditary material DNA or protein?

Activity 16.2 How does DNA replicate? (modeling)

Activity 17.1 Modeling transcription and translation: What processes produce RNA from DNA and protein from MRNA (SP 1, 3, 4, 5, 6) **(CR4c)**

2. Model of an operon: Following lecture and discussion of structure and function of an operon system, materials are made available for students to create a model of an operon and demonstrate to their classmates. (SP 1, 6)

3. DNA and Histone Model <<http://learn.genetics.utah.edu>> A 3-D cut-and-paste model depicting how histone, acetyl and methyl molecules control access to DNA and affect gene expression. (Connection of big idea 3 to enduring understanding 4.A; SP 1, 6)

Big idea # 3 Laboratory Investigations:

1. Biotechnology Lab 1: Transformation. Students will perform a transformation experiment in which they transform a bacterial cell to contain a plasmid containing a gene which can be expressed so as to produce protein products which make the cell “glow”. Students will then study the structure of the plasmid and make predictions regarding growth on various agar plates (LB plates, plates with ampicillin and arabinose added). They will then examine the bacterial growth afterwards and collect quantitative data. They will calculate transformation efficiency. Students will then plan a controlled experiment that they think would improve the transformation efficiency. The entire laboratory study will be documented in the laboratory research notebook. (Supports big idea 3; SP 2, 3, 4, 5, 6) **(CR6) & (CR8)**

2. Students will use micro-techniques to restrict DNA, and using a marker DNA along with “crime scene” and “suspect” DNA, predict which suspect matches the crime scene. Students will understand the principles of gel electrophoresis. Students will collect quantitative data by using the marker DNA results to graph data. They will utilize band migration distances and extrapolate band sizes by extrapolating from their graphs. The entire laboratory study will be documented in the laboratory research notebook. (Supports big idea 3; SP 2, 3, 4, 5, 6)

Unit 7: Evolution and Phylogeny (19 Classes) (CR2)

Big ideas: 1, 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.
- 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.C: Naturally occurring diversity among and between components within biological systems affects interactions with the environment.

Chapters:

- 22. Descent with Modification: A Darwinian View of Life
- 23. The Evolution of Populations
- 24. The Origin of Species
- 25. The History of Life on Earth
- 26. Phylogeny and the Tree of Life
- 27. Bacteria and Archae

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. Events in the “history of life” (origin of single-celled and multicellular organisms; mass extinctions; adaptive radiations)

Big idea # 1 Laboratory Investigations:

- 1. After learning about and discussing experiments by Oparin, Miller and Urey, and others, students are guided through an inquiry in which they form coacervates by combining carbohydrate molecules with protein molecules as they vary pH. They observe the coacervates and collect quantitative data. Students then develop a question they would like to answer through experimentation about coacervate formation, and materials are made available as students design experiments to test the hypotheses they have made. The entire laboratory study will be documented in a laboratory research notebook. In addition, students will post outcomes on Moodle, and students will be required to comment on the findings of the various student groups. (SP 1, 3, 4, 5) **(CR6) & (CR8)**
- 2. Students will learn how to analyze cladograms and understand evolutionary relationships using the Basic Local Alignment Sequencing Tool. Students will analyze morphological details about a newly discovered fossil, hypothesize as to the position of the fossil in a pre-constructed cladogram, then test the hypothesis using BLAST. Once students become comfortable, they will use the tool to answer questions of their choice regarding gene sequences. Alternatively, students can explore and discover using Cold Spring Harbor DNA Learning Lab: DNA Subway. (Supports big idea 1; SP1, 3, 4, 5) **(CR6) & (CR8)**

Activities:

1. 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)**
2. Constructing a Phylogenetic Tree Using DNA Sequence Data Simulation: <<http://www.accessexcellence.org/AE/>> Students exchange the “ancestral DNA” with random mutations over time and make divergences into different evolutionary lines. A phylogenetic tree is constructed. Then, in a second part, students construct a phylogenetic tree of another group based strictly on nucleotide sequences of present-day organisms. (SP 1, 4, 5) **(CR4a)**
3. Evolutionary Time: The Geologic Time String <<http://www.accessexcellence.org/AE/>> The Time String involves the use of a string. The string is 4.6 meters long, and each millimeter on the string represents 1 million years. Knots tied at distinct locations along the string represent extinctions, beginning of Eras, and so forth, in the geologic time table. (SP 7) **(CR4a)**
4. *Practicing Biology*, 3rd Edition. Activity 23.1 A Quick Review of Hardy-Weinberg Population Genetics. Alternatively, present students with Hardy-Weinberg problems from a variety of resources. Students apply the Hardy-Weinberg equation to determine frequencies of phenotypes and alleles. (SP 2) **(CR4a)**
5. HHMI video: “Evolution” Students will view the lecture on artificial selection and a class discussion will follow

Unit 8 Diversity in the Biological World: Organism Form and Function(22 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.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:

40. Basic Principles of Animal Form and Function
43. The Immune System
48. Neurons, Synapses, and Signaling
- 49.2 The Vertebrate Brain

(Chapters 28-49 will be utilized to provide students with resources for the enduring understandings in this unit)

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, adaptations that allowed plants to move from water to land, reproductive adaptations of angiosperms, environmental roles of fungi, animal body plans, progressively complex derived characters in animal groups)
2. Unique features of the angiosperm life cycles
3. Signal transduction pathways (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 intestines, nephrons in kidneys)
9. Structure and function in immune systems
10. Structure and function in nervous systems (neurons, resting potential, action potential, synapses)
11. Structure and function of the human brain

Activities:

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. *Practicing Biology*, 3rd Edition.
Activity 29.3 How are the events in plant evolution related?
Activity 34.1 What can we learn about the evolution of chordates by examining modern chordates?
Activity 36.1 How are water and food transported in plants?
Activity 40.1 How does an organism's structure help it maintain homeostasis?
Activity 43.1 How does the immune system keep the body free of pathogens?
Activity 48.2 How do neurons function to transmit information?
3. 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)**
4. What affects urine production? <www.campbellbiology.com>, Chapter 44. Through animation, students explore the role of a solute gradient on maximum urine production. Next, they explore the effect of hormones on urine production. Animated experiments are run and data is collected. Students analyze the outcomes of the experiments. (SP 1, 5, 7) **(CR4a)**
5. 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? Look into new uses of stem cells in kidney transplants with donor kidney before surgery to reduce need for anti-rejection drugs after surgery (SP 3) **(CR4c) & (CR5)**

Unit 9: Ecology (17 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.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.
- 2.E: Many biological processes involved in growth, reproduction and dynamic homeostasis include temporal regulation and coordination.
- 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:

- 51. Animal Behavior
- 52.2. Interactions between organisms and the environment limit the distribution of species.
- 53. Population Ecology
- 54. Community Ecology
- 55. Ecosystems
- 56. Conservation Biology and Global Change

Unit 9 Overview of Lecture and Discussion Topics:

- 1. Aspects of animal behavior
- 2. Aspects of biomes
- 3. Models describing population growth
- 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. Primary productivity
- 10. Energy transfer between trophic levels
- 11. Human activities that threaten biodiversity

Big idea #4 Laboratory Investigations:

- 1. Fruit Fly Behavior Lab. 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. (Supports big idea 4; SP 1, 2, 3, 4, 5, 6, 7) **(CR6) & (CR8)**

2. Dissolved Oxygen and Primary Productivity. Through guided inquiry, students will investigate how to measure dissolved oxygen using the Winkler method (ex: How does temperature affect the dissolved oxygen concentration in samples of water?) Continuing, students will explore respiration and photosynthesis processes in samples of a *Chlorella* culture as they study gross and net primary productivity. Students will then be challenged to write and conduct a controlled experiment to test the effect of a variable on primary productivity. The study will involve hypothesizing, designing the experiment, data collection of dissolved oxygen concentrations, calculations of primary productivity, graphing and making a conclusion. The entire laboratory investigation will be written in the laboratory research notebook. (Supports big idea 4; SP 1, 2, 3, 4, 5, 6, 7) **(CR6)**

Activities:

1. Students will design a model of a biome that demonstrates knowledge of biological processes and concepts across scales. Class presentations will demonstrate their knowledge of understanding. (Connects big idea 4 to enduring understanding 2.A; SP 7) **(CR3d) & (CR4d)**
2. Community Project: A science center in the school district is working with an adjacent state park to collect water quality data (i.e.: nitrates, phosphates, and temperature) from storm water ditches after heavy rains. Baseline data is available. Data is uploaded on a web-based database. Students will analyze the data and participate in the study to find any effects of water run-off on water quality in the state park. (SP 4, 5) **(CR4d)**
3. Provide students with a copy of an article entitled “Invasive Plant Suppresses the Growth of Native Tree Seedlings by Disrupting Belowground Mutualisms”, by Kristina Stinson and others. Students will explore the research based study and analyze the data presented for its meaning. (SP 5) **(CR4d) & (CR5)**
4. Pose the following question to students: In order to improve species richness, you decide to add phosphate to a pond. How might you determine how much phosphate to add in order to avoid eutrophication? Students will prepare a visual on whiteboards and present their thinking to the class. Students will also supplement presentation with pictures or video from nearby ponds for examples in their presentations(SP 3, 4) **(CR4d) & (CR5)**
5. Animated investigation: How Does the Fungus *Pilobolus* Succeed as a Decomposer? From: <www.campbellbiology.com>, Chapter 31. Students investigate this fungus as a decomposer, hypothesizing and collecting data in this animated investigation; they will study the adaptiveness of certain spore dispersal methods. (Connects big idea 4 to enduring understanding 1.A; SP 5, 6, 7) **(CR4d)**
6. Animated Investigation: How do Abiotic Factors Affect Distribution of Organisms? From: <www.campbellbiology.com>, Chapter 52. Students will use a simple model for observing ecological impact that occurs when single abiotic factors are changes. By changing abiotic factors, data can be collected and analyzed. (Connection of big idea 2 to enduring understanding 4.A) **(CR4d)**

AP BIOLOGY EXAM REVIEW (all remaining class time – 10 classes max)

- Review for exam using old released items and new sample items from the collegeboard website
- Complete any unfinished lab activities

- Every student must be able to relate material we have studied throughout the year to each of the four big ideas and show how it ties into his/her life. I give an assignment here where every student pulls one theme from a hat each day of review and must stand in front of the class – read the theme – and give one example of how that theme can be explained with something we have learned this year and how it ties to them personally. (2 students per day)