COURSE OVERVIEW

In AP Biology, an emphasis is on students making connections between the big ideas within the AP Biology Curriculum Framework. 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. By structuring the course around the four big ideas, enduring understandings, and science practices I assist students in developing an appreciation for the study of life and help them identify and understand unifying principles within a diversified biological world.

Lab techniques are utilized through researching journal papers, hands-on labs which make up at least 25% of instructional time, and possible field trips to. 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. Students are required to report on all laboratory investigations. 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.

TEACHING PHIOLOSOPHY

My philosophy is to actively engage students in the process of science through class assignments and discussions which inform their laboratory experiences. What we know today about biology is a result of inquiry. Science is a way of knowing. All students need an opportunity to experience science as a process and not just learn biology as a collection of unrelated facts. Therefore, the process of inquiry in science and developing critical thinking skills is the most important part of this course.

This means that the course should emphasize how scientists use their observations and readings to ask questions that can lead to new experiments. These experiments build on the work of others and eventually lead to additional evidence on different topics. This investigative process will be used throughout this AP Biology course. It is important for students to become excited with discovery as they ask and answer their own questions about natural/biological phenomena that they see, read about, or experience in the laboratory and field. In addition, it is critical that students connect new concepts with what they know, with each connection they help themselves build a solid framework of biological knowledge and scientific know-how. This framework will help students to enter their future, prepared for whatever may lie ahead of them.

INSTRUCTIONAL CONTEXT

I teach AP Biology to juniors and seniors at a high school that employs a block schedule. I meet with students for an 80-minute period and a 45-minute period every other day. For a total of either 320 minutes or 280 minutes per week depending on rotation of schedule.

Campbell, Neil and Reece, Jane B. 2008. *AP Edition Biology, Eighth Edition*, San Francisco, CA: Pearson Benjamin Cummings.

Campbell, Neil. *Student AP Edition Biology Student Study Guide*, Eighth Edition (ISBN 0-8053-7155-9)

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

Released Multiple Choice Exams and Free Response Biology Questions from 1968 to present.

WEBSITES/ELECTRONIC MEDIA

http://apcentral.collegeboard.com/apc/public/courses/teachers_corner/2117.html (AP central materials)

www.campbellbiology.com (The website to accompany the main text provides animations, investigations, PowerPoint and other audio-visual sources to enhance instruction)

http://eduweblabs.com/ or Lab Bench(This website offers labs as excellent online practice for students)

Others:
The Biology Project - University of Arizona
Prentice Hall - The Biology Place
Cells Alive

ADVANCED PLACEMENT BIOLOGY CONTENT

This AP course is structured around the four big ideas, the enduring understandings within the big ideas and the essential knowledge

within the enduring understanding. All essential knowledge will be taught and all learning objectives will be addressed through this curriculum.

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.

Students will be given a 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 room. 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.

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 or part of a novel that includes biology content in the story-line. For the novel, students must explain the science and science processes in the book, as well as describe the accuracy of their use and presentation in the book. In addition, students will need to be prepared to engage in weekly current event forums online for our class and 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.

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. Students will conduct a minimum of eight inquiry-based investigations (two per big idea throughout the

course). 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.

LAB NOTEBOOK:

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

- 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.
- Poster presentations (create poster with main investigation components; present to small groups or whole class; field questions).
- 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.

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.

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.

COURSE OVERVIEW: The amount of time spent on topics.

UNITS: The name of the unit, the big ideas it addresses, and the specific topics addressed.

READINGS: Include textbook, journal articles, videos, books, etc. Students are provided with guided reading questions and are required to take notes.

COURSE WORK: Some activities are expected to be performed outside of class time & students are expected to hand in lab reports for evidence of completion.

ASSESSMENT:A variety of assessments are used throughout the course. A representative sample is included here in the course schedule.

COURSE OVERVIEW:	UNITS:	READINGS:	COURSE WORK:	ASSESSMENT:
Time Spent on Topics	Big Ideas Topics	Campbell's AP 8th Edition References Other Readings	Labs Case Studies	Quizzes/Tests Lab Reports Projects

		*To be completed before you come to class	Other Activities	Lab Notebooks
1 Week	**UNIT 1: INTRODUCTION**			
	INTRODUCTION to AP BIOLOGY -General Review of Biological Topics -Introduction to AP Course overview	Chapter 1	• Reviewing Lab Safety Practices (RRR science rap song) • Reviewing Use of Microscopes • Introduce Lab Notebooks	Safety and Microscope Quiz Lab Notebook Set Up
2 Weeks	**UNIT 2: THE CHEMISTRY OF LIFE**			
	Big Idea 4 Polarity of water & its importance to biological systems Carbon's role in the molecular diversity of life Monomers, polymers & reactions involved in building & breaking them down considering polar/ nonpolar interactions Various levels of	Chapters 2-5	Using kits to build macro–molecule models Use toobers to remember protein structure (or Amino Acid Kits) LAB: Water molecule models from 3D Molecular Models Demo: Water properties changing color of a flower or celery LAB: Acid/base/buffer DEMO/LAB: Adhesion/ cohesion	Student generated concept maps Reading quizzes Written lab reports Weekly Article Responses on Moodle Unit Test with free response practice

	structures in protein & carbohydrates Enzyme structure as a special protein Cohesion, adhesion, specific heat of water & its importance to biological systems Acids, bases, and buffers		Students do variations by adding different macromolecules to solution to see effects adhesion etc. Given specific heat equation, in groups students try to come up with a way to determine specific heat of water	
3 Weeks	**UNIT 3: THE CELL**			
	Big Ideas 1, 2, 3 Explain similarities, differences & evolutionary relationships between prokaryotic & eukaryotic cells Cell membrane structure & function Cell communication (signals, receptors, responses hormones) Methods of transport across membranes Cell Cycle mechanism &	Chapters 6, 27, 7, 11, 12, 13 Outline notes Guided reading questions Journal articles on organelle based health issues Use TED David Bolinsky animation Lecture (10min)	Mini poster/ models comparing structures of cells from 3 different cell types from 3 different kingdoms LAB: Normal vs Plasmolyzed Cells using Plant cells Mini Poster Presentations comparing 3 feedback mechanisms **Investigation Lab 4:** Diffusion and Osmosis LAB: Microscope techniques for observing & measuring different types of cells. LAB: Bacteria Lab	Student generated concept maps Reading quizzes Weekly Article Responses on Moodle Mini poster comparing structures of cells from 3 different kingdoms Written lab reports Cell Size lab calculations **Formal Lab Write**

	control Chromosomes Sexual vs asexual reproduction & evolutionary advantages Stages of meiosis Genetic variation in offspring, mechanisms & impact on evolution Investigating genetics: environmental influences		String Game: Parts of a Cell Research: Cancer Project **Investigation Lab 7:** Cell Division Meiosis and Mitosis	**up for Investigative Lab 4: Diffusion & Osmosis** Microscope drawings & calculation Analyze & Discuss chart comparing different types of cells & their functions in the human body Discussion of the endosymbiont hypotheses of the evolution of eukaryotic cells **Formal Lab Write up for Investigative Lab7: Cell Division** Students choose & research controversial topics and the arguments supporting their genetic and/or environmental basis. Ex. Obesity, alcohol-ism, etc. Unit Test with free

				response practice
3 Weeks	**UNIT 4: ECOLOGY**			
	Big Ideas 1, 3, 4 Ecological interactions- biotic vs abiotic Behavioral ecology- natural selection involvement Population dynamics- growth & its regulations Communities & Ecosystems energy levels & flows, cycles, symbiosis & impact on evolution Human influences positive & negative	Chapters 52, 53, 54, 55, 56	**Investigative Lab 10: Energy Dynamics** LAB: Dissolved Oxygen & Aquatic Primary Productivity FIELD TRIP/LAB: field trip where students perform water quality surveys on local rivers, lakes and streams Activity – "My footprint" http://www.myfootprint.org/	Student generated concept maps Reading quizzes Weekly Article Responses on Moodle **Formal Write Up for Investigative Lab 10** Presentation: Students present lab results to class with ways to improve water quality of their local river/stream/lake Personal Project: Students complete "My Footprint" on-line and write a paper discussing their individual impact on Earth Unit Test with free response practice
3 weeks	**UNIT 5:**			

	MOLECULAR GENETICS			
	Big Ideas 1 and 3 Patterns of inheritance Predicting genetic outcomes genetic counseling Gene linkage & mapping Mutations revisited Regulation of gene expression	Chapters 14-18 Read Assigned parts of Matt Ridley's *Genome* *Scientific American* Article Reading	LAB Activity: Looking at corn crosses & analyzing results **Investigation 8: Biotechnology: Bacterial Transformation (BioRad pGLO)**	Student generated concept maps Reading quizzes Weekly Article Responses on Moodle Journal article discussions **Formal Write Up of Investigative Lab 8** Unit Test with free response practice
2 weeks	**UNIT 6: APPLICATION OF GENETICS**			
	Big Ideas 1 and 3 Viruses Gene expression in bacteria Biotechnology DNA Technology, Recombinant DNA, PCR, Gel	Chapters 19-21 Journal Article Reading Article by Kary Mullis on PCR.	**Investigation 9: Biotechnology: Restriction Enzyme Analysis of DNA** Lab: BioRad PCR Crime Scene	Student generated concept maps Reading quizzes Journal article discussions Weekly Article Responses on Moodle

	electrophoresis Applications of DNA technology Use of bioinformatics to analyze genomes Comparing & discussing genomic sequences in relation to evolution			**Formal Write Up of Investigative Lab 9** Students present their case of analysis of the crime scene to the class. Unit Test with free response practice
2 weeks	**UNIT 7: MECHANISMS OF EVOLUTION**			
	Big Idea 1, 3 Darwin's explorations and theory of descent with modification & natural selection Galapagos Islands Overview Evidence for evolution (molecular analyses & morphological analyses Phylogeny & systematics Evolution of populations Hardy-Weinberg Law	Chapters 22-25 Louise Leakey's TED Lecture on Humanity's Origins (15 min) Online Lecture: Robert full TED lecture http://www.ted.com/index.php/talks/robert_full_on_engineering_and_evolution.html NOVA: Becoming Human Series (3 parts)	**Investigative Lab 1: Artificial Selection** LAB: Geological Time on a Calendar LAB: PTC Taste Paper ACTIVITY: The Great Clade Race Discussion of The Blue People of Kentucky Assign a chapter each of *Darwin Origin of Species* for Project **Investigative Lab 2: Mathematical Modeling: Hardy-Weinberg** ACTIVITY: Genetics Survey Project	Student generated concept maps Weekly Article Responses on Moodle **Formal Write Up of Investigative Lab 1 and 2** Students work in groups to create a calendar/timeline/ representation of evolution throughout geological time Presentations to class about Darwin's Ideas

		Journal Article Reading *Beak of the Finch* by Jonathan Weiner	analyzing traits of those around us	Book Discussions and Reading Quizzes Unit Test with free response practice
3 weeks	**UNIT 8: EVOLUTIONARY HISTORY OF BIOLOGICAL DIVERSITY**			
	Big Idea 1, 3, 4 Early life on earth Evolution of prokaryotes & eukaryotes Characteristics (body plans & systems) of invertebrates as you go up the phylogenetic tree How plants colonized land Evolution of seed plants	Chapters 26-34 *Endless Forms Most Beautiful* by Sean Carroll Part of Richard Dawkin's *Ancestor's Tale* *Darwin Origin of Species*	LAB: Activity Studying Phylogenic Trees LAB: Examining Different Types of Bacteria and Protists Project: Researching Malaria **Investigative Lab 3: Comparing DNA Sequences to Understand Evolutionary Relationships with BLAST** Students are to find an article involving genetic recombination using prokaryotes and present to class	**Formal Lab Write Up of Investigative Lab 3** Weekly Article Responses on Moodle Article Presentation in small groups Unit Test with free response practice
3 weeks	**UNIT 9: CELL ENERGETICS**			

	Big Idea 4	Chapters 8-10	**Investigative Lab 13: Enzyme Activity** **Investigative Lab 6: Cellular Respiration** **Investigative Lab 5: Photosynthesis** Project: Comparing Cellular Respiration and Photosynthesis	**Formal Lab Write Up for Investigative Lab 13** **Formal Lab Write Up for Investigative Labs 5 and 6** Weekly Article Responses on Moodle Presentation of Project Unit Test with free response practice
4 weeks	**UNIT 10: PLANT FORM AND FUNCTION**			
	Big Idea 1, 2, 3, 4 Structure, growth & development Plants responses to internal & external stimuli Plant nutrition Angiosperm Reproduction	Chapters 35-39 Video: Use Attenborough's Plant Clips from YouTube	LAB: Observing Stomata and Flower Dissection LAB: Students conduct a long term lab investigation plant growth from seeds under various conditions in our green-house. Inquiry Lab: Gibberellin Mystery Seed FastPlants lab (plant hormones) Project: Essential Oils of Flowers Poster **Investigative Lab 11: Transpiration**	Formal Write Up for Students own plant Weekly Article Responses on Moodle **Formal Lab Write Up for Investigative Lab 11** Flower/Plant Practical Practical Test specimen

			DEMO: Chromatography Lab	identification & placing on phylogenetic tree Unit Test with free response practice
4 weeks	**UNIT 11: ANIMAL FORM AND FUNCTION**			
	Big Idea 1, 2, 3, 4 Basic anatomy principles Analysis of structure & function of body systems Digestive, Circulatory, Respiratory, Excretory, Endocrine, Nervous, Muscular Systems	Chapters 40-51	Lab: Sea Urchin Development **Investigative Lab 12: Fruit fly behavior** Animal Behavior: Taxis, Kinesis, and Agonistic Behavior LAB: Examining Goldfish Circulation Lab Guest Lecture: Heart Lecture and Dissection LAB: Heart Dissection LAB: Fetal Pig Dissection Survey of animal phyla in concept map/chart form generated by students (Practical with actual animal specimens)	**Formal Lab Write Up for Investigative Lab 12** Student generated concept maps (one for each system & animal diversity examination) Weekly Article Responses on Moodle Unit Test with free response practice Practical test with dissection specimen
2 weeks	**UNIT 12: REVIEW**			

	FOR AP EXAM			
	Big Ideas 1, 2, 3, 4	All Chapters	Review All Investigative Labs Review All Major Concepts in the Big Ideas Review the setup of the AP Exam Practice AP Tests	