Course Overview

Teaching advanced placement biology gives me the opportunity to show my students that biology is not about memorization but is every day, and practical application. Upon completion of my course, students will have the knowledge and understanding an equivalent of an introductory college level biology student.

My approach on teaching biology is to engage the students by using current events, topics, and media. Thanks to popular television shows, biotechnology and forensics have become a booming area of interest. Healthcare is a routine topic in the political arena, and the war on cancer is constantly on the nightly news. Most of my students are innately intrigued by biology, by job is to harness that energy and make them see how the smaller mechanisms work. I want my students to see how our content, as tedious as it may seem at times, does apply to their surroundings. This is why I try and instill the importance of the understanding the fundamentals of biology, not just because of AP Biology, but because the information can be an important life long tool for a knowledgeable citizen.

I try and design a classroom where inquiry is routine practice. We discuss current issues and topics that are applicable to our classroom content. My students are engage in activities where they are learning by doing, rather than constant lecture. I would estimate that 40% of our time together is on labs, activities and projects. There is at least one lab per marking period where the students must independently design their investigation when given a problem. They have to determined which beakers, what solutions, how much of each etc. Those labs are usually the most difficult for them, they realize how much thought, strategy and time it takes to design an investigation. I have found that independent investigations leave the biggest impression on my students because of the forethought it requires.

I have divided into themes have been developed with the four big ideas of the AP biology curriculum framework in mind:

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.

My course has been structured to touch on all four big ideas in each unit of the course. The course organization that I have demonstrated will show how each unit address all four big ideas. Utilizing the essential knowledge of the curriculum framework we complete many student directed and inquiry based investigations. These investigations and their respective seven science practices have been summarized in the table matrix following the course organization.

Hopefully by the end of the course, they can realize the subtleties that may have previously gone unnoticed. Biology is not just facts and vocabulary; it’s a complex process dependent on observations from our surroundings.

Instructional Context:

We meet for seven, 45-minute periods weekly (on two days we meet for 90 minutes, the other three 45 minutes). My lecture on content is usually about 15-20 minutes; we spend most of the time on investigations, problems, labs and activities. I find that students discover content and understand concepts if they are given the opportunity to find it, rather just being told via lecture. We have number of opportunities for group's projects and presentations throughout the year as well. My students are mostly seniors, as juniors typically take AP Chemistry.

Textbooks and resources
Campbell, Neil and Reece, Jane B. 2007. AP Edition Biology, Seventh Edition, SanFrancisco, CA: Pearson Benjamin Cummings.

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

Biology Laboratory Manual, 8/e by Vodopich and Moore, 2008

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

Additional reading:

- Skloot, Rebecca. *The Immortal Life of Henrietta Lacks*. New York: Crown, 2010.
- Shubin, Neil. *Your Inner Fish: A Journey into the 3.5-billion-year History of the Human Body*. New York: Pantheon, 2008.
- Weiner, Jonathan. *The Beak of the Finch: A Story of Evolution in Our Time*. New York: Knopf, 1994.
- Coyne, Jerry A. *Why Evolution Is True*. New York: Viking, 2009
- Carroll, Sean B. *The Making of the Fittest: DNA and the Ultimate Forensic Record of Evolution*. New York, NY: W.W. Norton &, 2006.

Released multiple choice tests and Free Response biology questions from 1968 to present.

**** Sample Syllabus #1 and #4 were very useful and inspirations in the design/layout of this audit.

Course Organization

Units	ESSENTIAL KNOWLEDGE & Big Idea(s)	Chapters and topics	ACTIVITY/LABS	ASSESSMENT
1. Molecules & Biochemistry	1D.2 2A.1, 2A.2, 2A.3, 2C.1, 2D.1 3A.1 4A.1, 4B.1, 4C.1 Big Idea: 1,2,3,4	Chapters: 2-5 • Introduction to the course, developing a controlled experiment. • Biochemistry • Chemistry Review • Properties of Water • Properties of Organic Molecules • Macromolecule Structure and Function	• Using model kits to build inorganic and organic compounds • "Biohunt" Activity: Students have to "hunt" for various organic molecules and functional groups through a card deck • Lab: Using indicators to determine the presence of organic compounds • Acid/Base/Buffer Activity • Investigative Lab: Pineapples and Bromelain, Students create their own independent lab to test the presence of Bromelain enzyme on Jello®. • How to Design a controlled experiment activity. Students create a their own test on how various activities impact heart rate. • Campbell Case Study 1: Picture Perfect	Lab Reports for indicator lab and pineapple lab Unit Test with free response practice Reading Quiz Properties of Water Poetry Concept Maps
2. Cell Biology and Cell division	1B.1, 1D.2 2A.1, 2A.2, 2A.3, 2B.1, 2B.2, 2B.3, 2C.1, 2C.2, 2D.1, 2E.1 3A.1, 3B.1, 3B.2, 3D.1, 3D.2, 3D.3, 3D.4 4A.2, 4B.2, 4C.1	Ch 6,7, 11, 12,13 • Cell Biology • The Endomembrane	• Inquiry Lab #4: Diffusion and Osmosis • Lab: Microscopy, creating wet mount samples or various cell types • Investigative Lab: Mystery Solutions, Students must design their own lab to	Lab Reports for Diffusion and Osmosis Experiment design, data, and proposal for Mystery Solutions activity

Units	ESSENTIAL KNOWLEDGE & Big Idea(s)	Chapters and topics	ACTIVITY/LABS	ASSESSMENT
	Big Idea: 1,2,3,4	System • Energy & Matter Processing Organelles • Cellular Structure & Support • Cell Membrane Structure & Function • Transport of Molecules • Cell Division • Mitosis Control of Cell Division Meiosis Chromosomal Abnormalities	determine the molar concentrations of various unknown solutions • Cell Type Concept Maps: students create a concept map comparing the various cells from the kingdoms. • Inquiry Lab 7: Mitosis and Meiosis • Lab: Sordaria, Identifying the % recombination • Karyotyping Activity (normal male karyotype VS one that presents nondisjunction, such as Kleinfelter's) • Using Beads to simulate mitosis and meiosis, Students will use a chromosome bead kit to simulate the process of meiosis and explain when haploidy occurs • 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	Reading quizzes Cell Size/Volume Calculations Microscope lab and calculations (field of view, sample size estimations) Unit Test with free response practice Project: Organelle summary booklet
3. Genetics	1A.2, 1A.3, 1A.4, 1B.1, 1C.1, 1C.3 2C.1, 2D.1, 2E.1	14,15,16, 17,18,19,20 • Classi	• Electrophoresis Simulation using Microsoft WORD, students will cut "Lambda" DNA and determine fragment	Mendelian Genetics Problems and Pedigree's

Units	ESSENTIAL KNOWLEDGE & Big Idea(s)	Chapters and topics	ACTIVITY/LABS	ASSESSMENT
	3A.1, 3A.2, 3A.3, 3A.4, 3B.1, 3B.2, 3C.1, 3C.2, 3C.3 4A.1, 4A.2, 4A.3, 4A.4, 4B.1, 4B.2, 4C.1, 4C.2 Big Idea: 1,2,3,4	cal Genetics • Mendelian Genetics Extensions to Mendelian Genetics Human Genetic Diseases • Molecular Genetics • Historical Approaches to Determination of DNA Structure and Function DNA Replication • Protein Synthesis Regulation of Gene	sizes. • Inquiry lab 8: Bacterial recombination • Inquiry lab 9: Restriction analysis • Campbell Case Study 3: Donor's Dilemma • Modeling transcription and translation: What processes produce RNA from DNA and protein from MRNA • KNEX Models: DNA structure and replication. • Reading: Immortal Life of Henrietta Lacks, Rebecca Skloot • Mini Poster Presentation: DNA History, present an important contribution to understanding DNA structure and function	Lab Quiz Unit Test with free response practice Calculations for Bacteria Transformation efficacy. Formal Lab Reports Reflection paper and Quiz on Henrietta Lack's book.

Units	ESSENTIAL KNOWLEDGE & Big Idea(s)	Chapters and topics	ACTIVITY/LABS	ASSESSMENT
		Expression Biotechnology: Tools, Applications & Ethics Systems Perspectives on Genetics: Development & Genomics		
4. Metabolism	1B.1, 1D.2 2A.1, 2A.2, 2A.3, 2C.1, 2C.2, 2D.1, 2D.3, 2E.1, 3B.2, 4A.1, 4A.2, 4A.4, 4B.1, 4B.2, 4C.1 Big Idea: 1,2,3,4	Ch. 8,9,10 • Biological Energetic • Enzyme Structure & Function • Chemoheterotrophic Nutrition: • Fermentation & Aerobic • Respiration Photoautotrophic	• Inquiry lab 13: Enzyme Activity • Inquiry lab 5: Photosynthesis • Inquiry lab 6: Cell respiration • Toothpickase and Web Lab on Enzyme activity • Campbell Case Study 2: Bean Brew	Concept maps Lab Reports on enzyme Activity Unit Test with free response practice Endosymbiosis Theory

Units	ESSENTIAL KNOWLEDGE & Big Idea(s)	Chapters and topics	ACTIVITY/LABS	ASSESSMENT
		• Nutrition: Photosynthesis		
5. Evolution & Biodiversity	1A.1, 1A.2, 1A.3, 1A.4, 1B.1, 1B.2, 1C.1, 1C.2, 1C.3, 1D.1, 1D.2 2A.2, 2C.2, 2D.1, 2D.2, 3A.1, 3A.2, 3A.3, 3C.1, 3C.2, 4A.4, 4A.6, 4B.3, 4C.3, 4C.4 Big Idea: 1,2,3,4	Ch 22,23,24,25,26, • Natural Selection Forces of Evolution Evidence of Evolution Measuring Evolutionary Change • Speciation • Origin of Life • Biodiversity • Classification & Cladistics Phylogeny of Domains Phylogeny of Eukarya Phylogen	• Fossil Dig Activity (Flinn Kit): Students"dig" through sample rocks, find fossils, identify and catalog them. • Campbell Case Study 4: Tree Thinking • Web Activity: What does a T-rex taste like? http://www.ucmp.berkeley.edu/ • Activity: Students create Geologic timeline (From BSCS) • Inquiry Lab 1: Artificial Selection • Inquiry lab 3: Analyzing Genes with BLAST • Inquiry lab 2: Mathematical Modeling: Hardy-Weinberg	Lab Reports Unit Test with free response practice Dichotomous key Concept Maps Cladogram Analysis Book Discussion (Your Inner Fish, Neil Shubin or Beak of the Finch by Jonathan Weiner)

Units	ESSENTIAL KNOWLEDGE & Big Idea(s)	Chapters and topics	ACTIVITY/LABS	ASSESSMENT
		y of Chordates		
6. Organismal and Plant Physiology	1B.1, 1C.3, 1D.2 2A.1, 2A.2, 2A.3, 2C.1, 2C.2, 2D.1, 2D.2, 2D.3, 2D.4, 2E.2 3B.2, 3C.2, 3D.1, 3D.2, 3D.3, 3D.4, 3E.1, 3E.2, 4A.3, 4A.4, 4B.1, 4B.2, 4C.1, Big Idea: 1,2,3,4	PLANTS & THEIR DIVERSITY CH 29,30, 35,38 • How plants colonized land • Evolution of seed plants • Structure, growth & development • Plants responses to internal & external stimuli • Plant nutrition • Angiosperm Reproduction	• Lab: Transpiration • Lab: Survey of Plant Kingdom (microscope and live sample analysis) • Tropisms Demo • Lab: Factors affecting seed germination (student designed and generated) • Lab: Urinalysis (WARD's Kit) • Lab: Human Biology: Circulation and Blood Pressure • Lab: Spread of a disease! Students simulation "exchange of fluids" and attempt to determine patient zero • Campbell Case Study 6: Corn Under Construction • Campbell Case Study 7: Gallopers Gut • Campbell Case Study 9: Pandemic Flu	Lab Reports Concept Maps Plant Kingdom Lab Practical Unit Test with free response practice Lab report for self designed lab on seed germination Formal Lab report on Fetal Pig Dissections Fetal Pig Lab Practical

Units	ESSENTIAL KNOWLEDGE & Big Idea(s)	Chapters and topics	ACTIVITY/LABS	ASSESSMENT
		ANIMALS CH 40,41,42, 43,45, 47,49 • Characteristics (body plans & systems) of invertebrates as you go up the phylogenetic tree • Basic anatomy principles • Analysis of structure & function of body systems • Digestive, Circulatory, Respirato	• Fetal Pig Dissection	

Units	ESSENTIAL KNOWLEDGE & Big Idea(s)	Chapters and topics	ACTIVITY/LABS	ASSESSMENT
		ry, Excretory, Endocrine (including female menstrual cycle), Nervous, Muscular Systems		
6. Ecology	1C.1, 1C.3 2A.1, 2A.2, 2A.3, 2C.1, 2C.2, 2D.1 , 2D.3, 2D.4, 2E.3 3E.1 4A.5, 4A.6, 4B.3, 4B.4, 4C.3, 4C.4 Big Idea: 1,2,3,4	CH 50,51,52,53,54,55 • Behavior Population Dynamics Community Interactions Ecosystem Structure Conservation Biology Human Impact	• Inquiry lab 12: Fruit Fly Behavior • Lab: Dissolved oxygen and primary productivity • Lab: Mark recapture with seeds • Lab: Predator Prey simulations (seeds buried in cat litter) • Web Activity: Internment Lab (students search various cemetery databases to correlate changes in the human population growth in the part 100 years) • Web Activity: How do abiotic factors affect distribution of organism? From Campbellbiology.com • Activity: Nitrogen Passport (Student role dice and travel throughout biosphere as N, pass through biotic and abiotic forms)	Lab Reports for Inquiry lab 12 and dissolved oxygen Concept Maps Unit Test with free response practice

Units	ESSENTIAL KNOWLEDGE & Big Idea(s)	Chapters and topics	ACTIVITY/LABS	ASSESSMENT
		• 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 influence		

Units	ESSENTIAL KNOWLEDGE & Big Idea(s)	Chapters and topics	ACTIVITY/LABS	ASSESSMENT
		s positive & negative		

Investigative Labs and Activities Matrix

	SP1. Use representatives and models	Sp 2. Uses Mathematics	Sp 3. Engages in scientific questioning	SP 4 plan and implement data collecting	SP 5 perform data analysis	SP 6 work with scientific explanations/theories	SP 7. Connect and relate knowledge	
<u>Unit 1: Molecular</u>								
Design a controlled experiment			X	X	X	X		
Pineapple Bromelain			X	X	X	X	X	
Acid/Base/Buffer			X	X	X	X	X	
Molecular Models	X						X	
Biohunt	X						X	
Indicator Lab			X	X	X	X	X	

	SP1. Use representatives and models	Sp 2. Uses Mathematics	Sp 3. Engages in scientific questioning	SP 4 plan and implement data collecting	SP 5 perform data analysis	SP 6 work with scientific explanations/theories	SP 7. Connect and relate knowledge	
Microscope Lab	X			X	X	X	X	
Mystery Solution	X	X	X	X	X	X	X	
Picture Perfect			X				x	
Unit 2: Cell Biology and Division								
Cellular Respiration	X	X	X	X	X	X	X	
Photosynthesis	X	X	X	X	X	X	X	
Diffusion and Osmosis	X	X	X	X	X	X	X	
Cell Division	X	X	X	x	X	X	X	
Unit 3: Genetics								
Bacterial Transformation	X	X	X	X	X	X	X	

	SP1. Use representatives and models	Sp 2. Uses Mathematics	Sp 3. Engages in scientific questioning	SP 4 plan and implement data collecting	SP 5 perform data analysis	SP 6 work with scientific explanations/theories	SP 7. Connect and relate knowledge	
Restriction Analysis	X	X	X	X	X	X	X	
Genetics Problem Set	X	X			X	X		
Unit 4: Energy								
Toothpickase	X	X		X	X			
Enzyme	X	X	X	X	X	X	X	
Energy dynamics								
Bean Brew		X	X		X	X	X	
Unit 5: Evolution								
Hardy Weinberg	X	X	X	X	X	X	X	
Fossil Activity	X		X	X	X		X	

	SP1. Use representatives and models	Sp 2. Uses Mathematics	Sp 3. Engages in scientific questioning	SP 4 plan and implement data collecting	SP 5 perform data analysis	SP 6 work with scientific explanations/theories	SP 7. Connect and relate knowledge	
Dichotomous Key	X		X		X	X	X	
Tree Thinking	X	X			X	X	X	
Unit 6: Human and Plant Physiology								
Urinalysis	X	X	X	X	X	X	X	
Cardiovascular lab	X	X	X	X	X	X	X	
Gallopers Gut			X		X	X	X	
Corn Under Construction			X			X	X	
Pandemic Flu		X	X			X	X	
Transpiration	X	X	X	X	X	X	X	

	SP1. Use representatives and models	Sp 2. Uses Mathematics	Sp 3. Engages in scientific questioning	SP 4 plan and implement data collecting	SP 5 perform data analysis	SP 6 work with scientific explanations/theories	SP 7. Connect and relate knowledge	
Seed Germination		X	X	X	X	X	X	
Epidemic Model: Spreading of disease			X	X	X	X	X	
Unit 7: Ecology								
Primary productivity	X	X	X	X	X	X	X	
Fruit Fly Behavior	X	X	X	X	X	X	X	
Predator Prey simulation	X	X		X	X	X		
Traveling Nitrogen	X					X	X	