Curricular Requirements

A.P. Biology Course Audit

Brief Description of Course

This course meets 90 consecutive days for 90 minutes. For each enduring understanding in the AP curriculum, students are given guiding questions to take notes from the text (and/or do research). They have a reading/prior knowledge quiz in class before my lecture and our discussion during/after lecture extends and reinforces their readings. Students are then given questions to complete in class to make connections between the material in the enduring understandings and real life situations and information found in other Big Ideas. AP Lab Investigations and other labs and activities are spaced appropriately through each unit. Long term assignments include AP practice exams and a book report based on a science and society issue.

(In January of 2013, our school board voted to change our schedule from a 4 block schedule to a traditional 6 period, full year schedule. In 2012-2013, this course met for 90 consecutive periods, each 90 minutes long…8,100 minutes. In 2013-2014, the course will meet 180 periods for 57 minutes per period…10,260 minutes. This rubric is written for the 90 by 90 block. Additional activities will be added next year to delve further into concepts, and new lab investigations will be possible with the additional time.)

In our district, there are very loose requirements for entry into an Advanced Placement course. Students need only have completed Biology (Honors or Academic) to take this course. Some Juniors are enrolled concurrently in Chemistry. No instructor input (from the previous Biology course or the AP teacher) is taken into consideration.

There is no requirement for students to sit for the AP exam. In the past, approximately 15% of students take the AP exam. This is due to a combination of student need and an honest evaluation of student preparation. AP Seminars are offered for those students who take the exam. These optional review sessions are held after school between the end date of the course in January and the AP Exam in May.

Textbooks: (provided for each student)

Audesirk, Gerald, Bruce E. Byers, and Teresa Audesirk. *Biology: Life on Earth*. Upper Saddle River, NJ: Prentice Hall. 8th edition, 2008

Marieb, Elaine. *Essentials of Human Anatomy and Physiology*. San Francisco: Pearson Benjamin Cummings, 8th edition, 2006 (Note: The version of the Audesirk textbook our school purchased does NOT have the physiology component. To make up for this omission, we use our school's Human Anatomy and Physiology textbook to supplement the main text.)

Supplemental texts (2 copies available in classroom, most recent editions obtained from publisher)

Campbell, Neil A., and Jane B. Reece. *Biology*. Upper Saddle River, NJ: Prentice Hall.

Purves, William K., et al. *Life: The Science of Biology*. Cranbury, NJ: Sinauer Associates, Inc.

Course Outline

Located in the following outline is the list of topics that are covered in class. Each **big idea**/unit is assessed using an exam, in addition to reading quizzes for each **enduring understanding**/section.

A.P. Biology Sequence - Syllabus

Big Ideas were kept together as much as possible when designing the sequence of each unit. Prior knowledge needed to cover each topic was the main determining factor in the ordering of the enduring understandings to be taught in the unit sequence presented.

Unit 1 – Introduction to Experimental Design, Biochemistry and Energy – 12 days

Introduction to the Science Processes, questioning, experimental design, modeling, data collection, and communication.		
Big Idea #4: Interactions	*End. Und. 1: Chemical Structure and Function*	
Big Idea #2: Energy	*End. Und. 1: Energy – ATP & Enzymes*	Lab Investigation #12: Enzyme Activity

Unit 2 – The Cell – 24 days

Big Idea #2: Biological systems utilize free energy, and molecular building blocks to grow, reproduce, and maintain dynamic homeostasis.	*End. Und. 1: Energy Processes and Exchange*	Lab Investigation #4: Diffusion and Osmosis
	End. Und. 2: Maintain Internal Environments	Lab Investigation #5: Photosynthesis
	End. Und. 3: Feedback Mechanisms	Lab Investigation #6: Cellular Respiration
	End. Und. 4: Homeostasis	
	End. Und. 5: Regulation & Coordination	
Big Idea #3: Information Transfer	*End. Und. 4: Cellular Communication*	

Unit 3 – DNA, Genetics, Biotechnology – 27 days

Big Idea #3: Living systems store, retrieve, transmit, and respond to information essential to life processes.	*End. Und. 1: Inheriting Information*	Lab Investigation #7: Cell Division Lab
	End. Und. 2: Gene Regulation	Investigation #8: Bacterial Transformation
	End. Und. 3: Genetic Variation	Lab Investigation #9: Restriction Enzyme Analysis of DNA

Unit 4 – Evolution – 13 Days

Big Idea #1: The process of evolution drives the diversity and unity of life.	*End. Und. 1: Natural Selection*	Lab Investigation #2: Mathematical Modeling
	End. Und. 2: Common Descent	Lab Investigation #3: Comparing DNA Sequences
	End. Und. 3: Change over Time	
	End. Und. 4: Origins of Life	

Unit 5 – Interactions – 14 days

Big Idea #4: Biological systems interact, and these systems and their interactions possess complex properties.	*End. Und. 2: Competition and Cooperation*	Lab Investigation #11: Transpiration
	End. Und. 3: Interactions with the Environment	
Big Idea #3: Information Transfer	*End. Und. 5: Information Changes Systems*	

<u>Laboratory Component</u>: <u>Requirement</u>: 90 days x **25%** = 22.5 days <u>This Course</u>: AP Lab Investigations listed total 29 days = 32.2%

AP Lab Investigations: The number of days for each investigation is based on the actual number of days in lab in the 2012 school year used to complete the new AP Lab Investigations, and usually include 1) lab process instruction, 2) inquiry/experimental design and completion, and 3) presentation of data. It is these AP Lab Investigations that add up to 29 days.

The other activities listed are NOT calculated into the total. Only inquiry-based labs are calculated. *This is the <u>smallest</u> representative list of activities completed. Other activities will be added as time permits and according to student need. This will be analyzed at the end of the first year of teaching the new curriculum and more activities/investigations will be added with our school's new schedule in 2013-14.*

The only reason AP Lab Investigations 1, 10 and 13 were not chosen to be completed is due to the time limitations of the block schedule.

All labs completed required a formal, written <u>lab report</u> to be submitted and compiled in a lab portfolio. These included an abstract, hypothesis, materials and methods, data collection, and analysis section. Mini <u>lab posters</u> were a requirement for several labs (photosynthesis, cell respiration) in order to introduce graphical communication of ideas. <u>Verbal reports</u> were given for all labs and came in two kinds: short ("what was your variable and how did it affect the results?") and long (a full description of the hypothesis, methods, data, and conclusions.) Short verbal reports were used in investigations such as bacterial transformation and restriction enzyme analysis of DNA, since all students needed to use the same procedures except for their one changed variable.

Practices – 7 Science "The student can…" Lab Investigation/Activity	Use representations & models to communicate scientific phenomena & solve problems	Use mathematics appropriately	Engage in scientific questioning to extend thinking or guide investigations	Plan and implement data collection strategies appropriate to a particular question	Perform data analysis and evaluation of evidence	Work with scientific explanations & theories	Connect and relate knowledge across various scales, concepts, and representations in and across domains
Big Idea #1: The process of evolution drives the diversity and unity of life.							
Lab Investigation #2: Mathematical Modeling (3 days)	X	X	X	X	X	X	X
Lab Investigation #3: Comparing DNA Sequences (3 days)	X	X	X	X	X	X	X
Origin of Life activity	x		x	x	x	x	x
Big Idea #2: Biological systems utilize free energy, and molecular building blocks to grow, reproduce, and maintain dynamic homeostasis.							
Lab Investigation #4: Diffusion and Osmosis (4 days)		X	X	X	X	X	X
Lab Investigation #5: Photosynthesis (2.5 days)		X	X	X	X	X	X
Lab Investigation #6: Cellular Respiration (2.5		X	X	X	X	X	X

days)							
Animal Behavior			x	x	x	x	X
Cell Diffusion Races	x	X	x	x	x	x	X
Big Idea #3: Living systems store, retrieve, transmit, and respond to information essential to life processes.							
Lab Investigation #7: Cell Division (4 days)	x	X	X	X	X	X	X
Lab Invest. #8: Bacterial Transformation (2.5 days)		X	X	X	X	X	X
Lab Invest. #9: Restriction Enzyme Analysis of DNA (2.5)		X	X	X	X	X	X
Restriction Enzyme Simulation	x		x			x	X
DNA Fingerprinting Simulation	x		x		x	x	X
Genetic Corn	x	X	x	X	x	x	X
Genetic Dice	x	X	x	x	x	x	X
lac Operon Simulation	x					x	x
Big Idea #4: Biological systems interact, and these systems and their interactions possess complex properties.							
Lab Investigation #11: Transpiration (2.5 days)		X	X	X	X	X	X
Lab Investigation #12: Enzyme Activity (2.5 days)		X	X	X	X	X	X
Organic Molecules	x					x	X
Carrying Capacity		X	x		X	x	X
Human Population Growth		X	X		x	X	X

<u>Curricular Requirement 4: Opportunities outside the lab investigation sequence to meet the learning objectives of each Big Idea (all activities above that are not from the AP curriculum are described below.)</u>

Learning Objectives (LO) are listed besides the description of each activity.

<u>Connections</u> to other Big Ideas topics are listed underneath appropriate entries.

<u>Big Idea 1: Evolution</u>

Origin of Life activity (Carolina Investigations for AP Biology) – Students model environmental conditions that allow for coacervate formation. LO 1.32 The student is able to justify the selection of geological, physical, and chemical data that reveal early Earth conditions. LO 1.30 The student is able to evaluate scientific hypotheses about the origin of life on Earth. LO 1.31 The student is able to evaluate the accuracy and legitimacy of data to answer scientific questions about the origin of life on Earth.

Connection to Big Idea 2 cell structure and function and origins of cell membranes

Big Idea 2: Energy and Homeostasis

Animal Behavior – Based on former AP Lab 11, introduction to the course, experimental design, and animal behavior. LO 2.21 The student is able to justify the selection of the kind of data needed to answer scientific questions about the relevant mechanism that organisms use to respond to changes in their external environment.

Connection to Big Idea 1 describing instinctual behaviors as an adaptation for survival

Cell Diffusion Races – Students design a cell to maximize the rate of diffusion (a Kim Foglia lab). LO 2.6 The student is able to use calculated surface area-to-volume ratios to predict which cell(s) might eliminate wastes or procure nutrients faster by diffusion. & LO 2.7 Students will be able to explain how cell size and shape affect the overall rate of nutrient intake and the rate of waste elimination.

Connection to Big Idea 4.A.2: Structure and function of cellular components and their interactions provide essential cellular processes.

Big Idea 3: Information Transfer

Restriction Enzyme Simulation Lab – students use paper plasmids and genes to model genetic recombination, cleavage, and transformation. LO 3.5 The student can justify the claim that humans can manipulate heritable information by identifying at least two commonly used technologies.

DNA Fingerprinting Simulation Lab – students use beads to represent genes as they use restriction enzymes (scissors) to cleave the DNA and then model gel electrophoresis using the size of the fragments. LO 3.5 The student can justify the claim that humans can manipulate heritable information by identifying at least two commonly used technologies.

Connection to Big Idea 4 in that structure of molecules give physical and chemical properties to be analyzed

Genetic Corn Lab – genetic corn is used to model test crosses. LO 3.14 The student is able to apply mathematical routines to determine Mendelian patterns of inheritance provided by data sets.

Genetic Dice Lab – students use dice representing the alleles for human blood types to study probability and multiple alleles. LO 3.17 The student is able to describe representations of an appropriate example of inheritance patterns that cannot be explained by Mendel's model of the inheritance of traits.
Connection to Big Idea 1, Hardy Weinberg analysis of blood type allele frequency in populations throughout the world

lac Operon Simulation – Students use models to demonstrate how genes can be regulated. LO 3.21 The student can use representations to describe how gene regulation influences cell products and function
Connection to Big Idea 4 structure and function of polymers

Big Idea 4: Interactions

Building Organic Molecules lab – students model and bond the monomers of carbohydrates, lipids, and proteins, reviewing the concepts of dehydration synthesis and hydrolysis. LO 4.1 The student is able to explain the connection between the sequence and the subcomponents of a biological polymer and its properties. LO 4.2 The students is able to refine representations and models to explain how the subcomponents of a biological polymer and their sequence determine the properties of that polymer.
Connection to Big Idea 2, cell structure and function.

Carrying Capacity activity – students collect simulated food while portraying a newly introduced species to an area over several generations to be able to graph carrying capacity. LO 4.19 The student is able to use data analysis to refine observations and measurements regarding the effect of population interactions on patters on species distribution and abundance.
Connection to Big Idea 1, coevolution by competition

Analysis of *human population growth & implications for our future.* Using the article about Dr. James Lovelock called "The Prophet" and modified activities from Populations Connections, students analyze human population, carrying capacity, resource availability,, and future implications. LO 4.16 The student is able to predict the effects of a change of matter or energy availability on communities.

Other Course Materials

Website Resources:

apbiopmwest.wikispaces.com – Course website with links to course documents.

www.prenhall.com/audesirk Our textbook's website. Students complete the Multiple Choice, Fill In, and Labeling questions for extra credit. The site is also used for their animation and review activities.

www.biology.com (from Prentice Hall) LabBench for review of the AP Labs (the old sequence...but still useful for review, absences, and remediation)

Periodicals:

Goodell, J. (2007, November 1). The Prophet. *Rolling Stone*, 1038, 59-63, 95. James Lovelock is profiled and covers issues associated with climate change. Used for the social/ethical component of the course.

Other articles and information vary year to year, dependent on current topics. Used when and if appropriate.

Additional Course Activity:

Guided Reading Questions: Students are given guiding questions to review the 'facts' while reading each chapter before class. This is done before the class lecture and discussion. Many times these questions are just a review of previously learned knowledge from their prior Biology class.

Example: What are the chemical properties of fats? What are the monomers of different classes of lipids? How are phospholipids arranged, and what is their function? How do steroids differ from other lipids? What are their functions?

Review Questions: After the lecture and discussion of a particular chapter, review questions are then given to the students. These questions connect the information discussed to other topics and to real life situations. It is in these questions that the interconnection between Big Ideas is formally presented to students (followed by activities to reinforce the connections, where applicable.)

Example 1: Connecting BI1: Evolution to BI4: Interactions… "What has been the cause of every major mass extinction event in the history of life on Earth?" (Catastrophic environmental change) "Name environmental changes that are occurring right now…then list some possible evolutionary consequences. Use the concepts of fitness and adaptation in your response." (many answers possible, from natural disasters to climate change)

Example 2. Connecting BI2: Energy/Cell/Homeostasis to BI3: Info Transfer… "Compare and contrast the regulation of genes (such as an operon) and the regulation of metabolic pathways. In what ways do they work similarly? (feedback system, ability to be turned off/on) In what ways are they different? (Structures and molecules involved, complexity, etc)

Example 3: Connecting BI3: Info Transfer to BI1; Evolution… Natural selection acts on individuals, however only populations can evolve. What is it, in an individual, that natural selection acts on…and how can that be measured and collected as data in order to determine if evolution is occurring in a population? (phenotype and allele frequency, as an introduction Hardy-Weinberg.)

Example 4: Connecting BI4: Interactions to BI2: Cell… "You learned in basic chemistry that hydrophobic molecules tend to cluster when immersed in water. In talking about biological molecules, you discovered that a phospholipid has a hydrophilic head and hydrophobic tails. What do you think would be the configuration of phospholipids that are immersed in water?" (Structure and chemical properties of molecules connected to structure of cell membranes)

These are only a few examples of questions posed. Evolution is linked to all aspects of the course as the defining force of all of Biology once the groundwork of chemistry, the cell, and genetics is laid.

"At the Bell" Assignments

Our school requires the preparation of an assignment for students to complete as soon as they walk in the door…or 'at the bell.' For AP Biology, I chose to use multiple choice question sets from previous exams and third party preparation books. The questions always deal with the topic being covered. It is on these types of questions that my students have had the least success on the AP examination.

Book Report

Students must read a book in order to provide them with an experience to partially fulfill curricular requirement #5: "opportunities to connect biological and scientific knowledge to major social issues to help them become scientifically literate citizens." Books need to be recent (unless important in a historical context, such as *Silent Spring*).

Students must prepare a two page analysis of and reaction to the book. Students must prepare 25 citations of facts they found in the book, as if they were preparing a larger research project.

In 2012, I suggested that students read "The Immortal Life of Henrietta Lacks" due to its inclusion in Lab Investigation #7. However, students were free to choose, with instructor approval, any book that met the curricular requirement.

Exams

Exams model the AP exam. Students are given every AP Exam free response question from 1994 to present. One free response question is chosen from the packet and appears on the exam. There are other (shorter) essay questions and any mathematics concepts covered in the unit are also assessed (Hardy – Weinberg, statistical analysis such as chi-squared, cell volume to surface area, population growth rates, etc). All other questions are multiple choice, including lab data analysis and question sets.