AP Biology

Philosophy

The Advanced Placement Biology course is designed to be the equivalent of a college introductory biology course taught in a high school setting. As such, the students will be required to do college-level work in order to be successful. *AP Biology* is a course designed for students that have a strong interest in, or desire to pursue a career in, the sciences. The *AP Biology* course is designed to offer students topics that are covered in a freshman Biology course at the university level. Students accepting the challenge of an Advanced Placement course will be required to actively participate in all lectures and laboratory activities that are conducted during the year.

To succeed in *AP Biology*, students must be highly motivated to learn. Reading requirements for the course are rigorous and require a daily commitment in order to stay caught up in the class. Exams generally cover two chapters in the text and occur every week depending on the content being covered and the labs being conducted to give students a fair representation of a university-level Biology course. Before they delve into this awesome task, they should seriously examine why they are here. If it is for college credit, then they should establish if their future school accepts *AP* credit; if it is for an intellectual challenge, then I will gladly help them with this goal.

Materials

Campbell, Neil and Reece, Jane B. 2011. *AP Edition Biology,* Ninth Edition, San Francisco, CA: Pearson Benjamin Cummings. [CR1]

Campbell, Neil. *Student AP Edition Biology Student Study Guide,* Ninth Edition (ISBN - 13: 978-0-321-62992-0)

Biology Laboratory Manual, 8/e by Vodopich and Moore, 2011
AP Biology Investigative Labs: An Inquiry-Based Approach, The College Board, 2012

Course Overview

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

My philosophy is to actively engage students in the process of science through class assignments and discussions which inform their laboratory experiences. For example, I increase students' critical thinking and problem solving abilities by actively requiring them to develop labs through group discussions, journal readings and hands-on labs. Emphasis is also given to journal article readings in order to expose students to present day technologies and procedures to familiarize them to limitations of testable hypotheses in order to develop better designed experimental investigations.
Lab techniques are learned through researching journal papers, hands-on labs which make up at least 25% of instructional time, and at least one field trip to west coast tide pools. [CR7] Labs emphasize development and testing of the hypothesis, collection, analysis and presentation of data, as well as discussion of results to discover unanswered questions about the particular topics addressed. A minimum of two labs in each big idea will be conducted. [CR6] Students are required to report on all laboratory investigations. [CR8] The student-directed and inquiry-based laboratory investigations used throughout the course enable students to apply the seven science practices as defined in the Curriculum Framework.

Evaluation Scheme

Students will be graded primarily on tests, quizzes, homework and laboratory work a la a typical college, entry-level Biology course. Course grades will be calculated on total point system using traditional grading scale of 100-90% (A), 89-80% (B), 79-70% (C), 69-60% (D), and 59%-below (F). Unlike non-AP courses, assignments may be graded formally – many assignments may not.

Tests: 60%
Free-Response Questions: 10%
Labs: 25%
Homework: 5%

Research Project

Each semester the students are required to do a project. The first semester, they are to create a cell book. The book includes three chapters. First chapter is a model of a cell constructed on transparencies showing the structures and parts of a cell. Each page holds a different organelle. Included are the functions of each part. The must have a minimum of 16 organelles. Second chapter must include a description and summary on two

different types of cell. Also, how the cells impact a multi-cellular body. Chapter three, they need to research two diseases that impact cells specifically.

The second semester they create a power point presentation, covering a major concept found in AP Biology. They need to describe and discuss how this concept has impacted Science, technology, and society (environmental and social concerns).

Instructional Material

Online Campbell Biology Book
Scientific Articles: Newspapers, magazines, news broadcasts, Internet, public forums
Videos
DVDs
Speakers: When available
Journals: (optional)
Cells Alive

AP Biology Syllabus

Currucular Requirements		Pages
CR1	Students and teachers will use a recently published (within last 10 years) college-level textbook.	1
CR2	The course is structured around the enduring understanding within the big ideas as described in the AP Biology Curriculum Framework.	2,3,4,5,6,7,8,9,10
CR3a	Students connect the enduring understandings within Big Idea 1 (the process of evolution dreives the diversity and unity of life) to at least one other big idea.	3,4,9
CR3b	Students connect the enduring understandings within Big Idea 2 (biological systems utilize free energy and molecular building blocks t grow, to reproduce, and to maintain dynamic Homeostasis) to at least one other big idea.	4
CR3c	Students connect the enduring understanding within Big Idea 3 (living systems store, retrieve, transmit, and respond to information essential to life processes) to at least one othert big idea	6
CR3d	Students connect the enduring understanding within Big Idea 4 (biological systems interact and these systems and their interactions possess complex properties) to at least one other big idea.	2,3,5,10
CR4a	The course provides students with opportunities outside of the laboratory investigations to meet the learning objectives within Big Idea 1.	2,3,4,8
CR4b	The course provides students with opportunities oustside of the laboratory investigations to meet the learning objectives within Big Idea 2.	2.3.4.5
CR4c	The course provides students with opportunities oustside of the laboratory investigations to meet the learning objectives within Big Idea 3.	3,4,6
CR4d	The course provides students with opportunities oustside of the laboratory investigations to meet the learning objectives within Big Idea 4.	3,10
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 scientically literate citizens.	4,5,6,9,10
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 includes at least two lab experiences in each of the four big ideas.	1,2,3,4,5,6,7,8,9,10
CR7	Students are provided the opportunity to engage in ivestigative labortory work integrated throughout the course for a minimum of 25 percent of intructional time.	1
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.	1,2,3,4,5,9,10

MOLCEULES, CELLS & ENERGY		Big Ideas 1, 2, 3 & 4 [CR2]	
TOPICS	**READINGS**	**ACTIVITY/LABS**	**ASSESSMENT**
A. MOLECULES Big idea 4 Polarity of water & its importance to biological systems Carbon's role in the molecular diversity of life Monomers, polymers & reac- tions involved in building & break- ing them down considering polar/ nonpolar interac- tions Various levels of structures in protein & carbohydrates Enzyme structure as a special protein Cohesion, adhe- sion, specific heat of water & its importance to biological systems Acids, bases, and buffers	Chemistry of Life Chapters 2-5 from textbook	Using kits to build macro-molecule models [CR4a] (SP 1) Exercises: protein folding software [CR4b] Acid/base/buffer lab activity [CR6] (SP 2) Adhesion/ cohesion lab Students do variations by adding different macro-molecules to solution to see effects adhesion etc. (EU4.A connects to BI 1) [CR3d] (SP 4) Given specific heat equation, in groups students try to come up with a way to deter- mine specific heat of water-15min (EU 4.C connects to BI 1) [CR3d], [CR4a] & [CR4b] (SP 3)	Student generated concept maps Reading quizzes Unit test with free response practice Written lab reports [CR8]

CR2: The course is structured around the enduring under- standings within the big ideas as described in the AP Biology Curriculum Frame- work.

CR4a: The course provides students with opportunities outside of the labora- tory investigations to meet the learning objectives within Big Idea 1.

CR4b: The course provides students with opportunities outside of the labora- tory investigations to meet the learning objectives within Big Idea 2.

CR6: The student-directed laboratory investigations used throughout the course allow students to apply the seven science practices defined in the AP Biology Curriculum Frame- work and include at least two lab experi- ences in each of the four big ideas.

MOLCEULES, CELLS & ENERGY		Big Ideas 1, 2, 3 & 4 [CR2]	
TOPICS	**READINGS**	**ACTIVITY/LABS**	**ASSESSMENT**
Identifying macro-molecules in our foods Supplements & Add. ons: Cohesion/ adhesion in nature Various macro-molecules in our foods Cycling of chemical elements in ecosystem	Portion of Chapter 55	LAB: Using and under-standing how different indicators are used to identify proteins, lipids, carbohydrates (incl. reducing sugars analysis) using Biuret, Benedict's, Sudan etc. [CR6] (SP 6) Research exploring how animals use water's properties for survival (comparing specific heat) (EU 4.C connects to BI 1) [CR3d] Students make posters of different element cycles including relative amts. of transfer [CR4b], [CR4d] & [CR8])	Students compose chart comparing structural differences & how indicators physically work Students use chart to predict contents of unknown samples Students share one example they have found how animals use water's properties for survival. Student generated short PowerPoints on macro-molecules and nutrition. (Ex. Butter vs margarine vs oil OR summariz- ing different artificial sweeteners)
B. HISTORY OF LIFE Big idea 1 Theories of how macro-molecules joined to support origin of life Was RNA 1st genetic material? Age of earth	Text chapter 25 outline notes guided reading	Clay catalyzed RNA polymerization activity with role playingfocus on theories, redevelopment of theories over time (EU 1.B connects to BI 3) [CR3a] & [CR4c] (SP 6, 7) Discussion of journal article	Concept maps Reflection on the development and reformulation of scientific theories (extra) model or cartoon explaining the theories of origin of life [CR4a]

CR2: The course is structured around the enduring under-standings within the big ideas as described in the AP Biology Curriculum Frame- work.

CR4d: The course provides students with opportunities outside of the labora- tory investigations to meet the learning objectives within Big Idea 4.

CR4b: The course provides students with opportunities outside of the labora- tory investigations to meet the learning objectives within Big Idea 2.

CR3d: Students connect the endur- ing understandings within Big Idea 4 (biological systems interact and these systems and their interactions possess complex properties) to at least one other big idea.

MOLCEULES, CELLS & ENERGY		Big Ideas 1, 2, 3 & 4 [CR2]	
TOPICS	**READINGS**	**ACTIVITY/LABS**	**ASSESSMENT**
C. CELLS (struc- ture & function) Big idea 1 & 2 Explain similari ties, differences & evolutionary relationships between prokary- otic & eukaryotic cells Cell membrane structure & function Cell communica- tion (signals, re- ceptors, responses hormones) Methods of transport across membranes	Text chapters 6,7,11 Outline notes Guided reading questions Journal articles on organelle based health issues [CR5]	Mini poster/ models comparing structures of cells from 3 different cell types from 3 differ- ent kingdoms (EU 1.A connects to BI 3) [CR3a], [CR4a], [CR4c] & [CR8] LAB: Normal vs Plasmo- lyzed Cells using Plant cells (teacher generated) [CR6] Eduweblabs:Osmosis & diffusion prelabs 1 & 2 [CR4b], [CR4c] & [CR6] Cell size lab teacher generated Mini Poster Presentations comparing 3 feedback mechanisms [CR8] Inquiry lab # 4 Diffusion and Osmosis [CR6] (SP 3, 4) LAB: Microscope techniques for observing & measuring different types of cells.	Student generated concept maps Reading quizzes Mini poster comparing structures of cells from 3 different kingdoms Unit test with Free Response practice Written lab reports [CR8] Eduweblabs graph & calculations Cell Size lab calculations Formal Lab Writeup for Inquiry lab Diffusion & Osmosis [CR8] 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 eukary- otic cells [CR3b]
D. IMMUNITY Bigidea 2&3 Innate vs Acquired Response Humoral responses B cells vs T cells Self vs non-self Field Trip to Pharmaceutical Company	Text chpt. 43 Background information on immuno- assays from the company.	LAB: Immunoassays: Antibody purification Dot Blot (1 full day at BTI Pharmaceutical company where students completely perform both labs) [CR6] (SP 5)	Student generated concept maps Flow chart for immunoassay labs Post-fieldtrip quiz

CR3a: Students connect the enduring under- standings within Big Idea 1 (the process of evolu- tion drives the diversity and unity of life) to at least one other big idea.

CR4c: The course provides students with opportunities outside of the labo- ratory investigations to meet the learning objectives within Big Idea 3.

CR3b: Students connect the endur- ing understandings within big idea 2 (biological systems utilize free energy and molecular build- ing blocks to grow, to reproduce, and to maintain dynamic homeostasis) to at least one other big idea.

CR8: The course provides opportuni- ties for students to develop and record evidence of their verbal, written and graphic communica- tion skills through laboratory reports, summaries of litera- ture or scientific in- vestigations, and oral, written, or graphic presentations.

MOLCEULES, CELLS & ENERGY		Big ideas 1, 2, 3 & 4 [CR2]	
TOPICS	**READINGS**	**ACTIVITY/LABS**	**ASSESSMENT**
E. CELL ENERGY ATP structure & function Redox reactions in relation to cellular respiration Enzyme catalysis Activation energy & specificity Cellular respira- tion glycolysis, citric acid cycle, electron transport chain & chemios- mosis Mitochondria form & function Photosynthesis mechanisms; light/ dark Compare/contrast to respiration Alternative mechanisms Understanding light energy & the nano scale (the size of small things inside cells)	Text chpts 8, 9, 10 Outline notes Guided reading questions	Eduweblabs: Prelab "Enzyme Catalysis" Investigative lab #13: Enzyme Activity (EU 4.A connects to BI 2) [CR3d] & [CR6] Prelab: Toothpickase Investigative Lab: Enzymes: Factors affecting the rate of activity [CR6] (SP 2, 5) Eduweblab: Respiration [CR4b] Investigative Lab #6 Cellular Respiration [CR6] (SP 2) Fermentation in Yeast Lab (Flynn kit) student generated variations required Eduweblabs: Prelab Plant pigments [CR4b] Eduweblabs: Prelab Photosynthesis [CR4b] Investigative Lab #5 Photosynthesis [CR6] Internet activity comparing different wavelengths of light in relation to photosynthesis (teacher generated) Discussion on nanotech- nology & implications of our smaller world [CR5]	Student generated concept maps Reading quizzes Unit test with free response practice Eduweblab graphs Toothpickase graphs & questions Presentation of stu- dents group lab results to class [CR8] Eduweblabs graphs & calculations Presentations of lab data and results [CR8] Graphs & discussion onYeast Lab with variations [CR8] Eduweblabs chroma- tography calculations, graphs Presentations on lab results Lab writeup and analysis [CR8] Students make a chart comparing sizes of cellular parts & larger items to evaluate range of metric dis- tance measurements down to the nano scale [CR4b]

CR3d: Students connect the endur- ing understandings within Big Idea 4 (biological systems interact and these systems and their interactions possess complex properties) to at least one other big idea.

CR5: The course provides students with opportunities to connect their bio- logical and scientific knowledge to major social issues (e.g., concerns, technologi- cal advances, innova- tions) to help them become scientifically literate

CR4b: The course provides students with opportunities outside of the labora- tory investigations to meet the learning objectives within Big Idea 2.

CR6: The student-directed laboratory investigations used throughout the course allow students to apply the seven science practices defined in the AP Biology Curriculum Frame- work and include at least two lab experi- ences in each of the four big ideas.

HEREDITY, GENETICS & EVOLUTION Big Ideas 1 & 3 [CR2]			
TOPICS	**READINGS**	**ACTIVITY/LABS**	**ASSESSMENT**
A. MOLECULAR BASIS OF INHERITANCE DNA structure & replication RNA structure Protein Synthesis transcription & translation Mutations - basis for natural selec- tion	Text chapters 16, 17 Journal Article Read- ing Watson and Crick's origi- nal Nature paper from 1953	DNA extraction Comparing DNA & pro- tein sequences from an internet based computer database in discussing evolutionary implications of mutations (SP 7)	Student generated concept maps Reading quizzes Journal article discussions Unit test with Free Response practice Bioinformatics results
B. MITOSIS & MEOSIS Cell Cycle mechanism & control Chromosomes Sexual vs asexual reproduction & evolutionary advantages Stages of meiosis Genetic variation in offspring, mecha- nisms & impact on evolution Investigating genetics: environ- mental influences	Text chapters 12, 13	Eduweblabs: Prelab Crossing Over Lab Investigative Lab #7: Mitosis and Meiosis (EU 3.A connects to BI 1) [CR3c] & [CR6] Karyotyping exercise (teacher generated, students will have to do this on their own time) [CR4c]	Student generated concept maps Reading quizzes Unit test with Free Response practice Eduweblabs results Investigative LAB Analyses Karyotyping results Students choose & research controversial topics and the argu- ments supporting their genetic and/or environmental basis. Ex. Obesity, alcohol- ism, etc. [CR5]

CR2: The course is structured around the enduring under- standings within the big ideas as described in the AP Biology Curriculum Frame- work.

CR3c: Students connect the endur- ing understandings within Big Idea 3 (living systems store, retrieve, transmit, and respond to informa- tion essential to life processes) to at least one other big idea.

CR4c: The course provides students with opportunities outside of the labora- tory investigations to meet the learning objectives within Big Idea 3.

HEREDITY, GENETICS & EVOLUTION Big Ideas 1 & 3 [CR2]			
TOPICS	**READINGS**	**ACTIVITY/LABS**	**ASSESSMENT**
C. MENDELIAN GENETICS MENDEL'S LAWS Patterns of inheri- tance Predicting genetic outcomes genetic counseling Gene linkage & mapping Mutations revisited	Text chapters 14, 15 Scientific American Article Reading	Prelab activity: Looking at corn crosses & analyzing results Eduweblabs: Prelab Population Genetics Eduweblabs: Prelab Fruit fly genetics	Student generated concept maps Reading quizzes Journal article discussions Unit test with free response practice Eduweblabs prelab report
D. MOLECULAR GENETICS Regulation of gene expression Viruses Gene expression in bacteria Biotechnology DNA Technology, Recombinant DNA, PCR, Gel electrophoresis Applications of DNA technology Use of bioinfor- matics to analyze genomes Comparing & discussing genomic sequenc- es in relation to evolution	Text chapters 18-21 Journal Article Reading Article by Kary Mullis on PCR.	Eduweblabs: Prelab Bacterial transformation Eduweblabs: Prelab DNA Electrophoresis Investigative lab #9: Bio- technology I and Biotech- nology II. BacterialTrans- formation and Restriction Enzyme Analysis of DNA [CR6]	Student generated concept maps Reading quizzes Journal article discussions Unit test with free response practice Eduweblabs results for both transforma- tion & electrophore- sis labs Analysis and group presentation of Inves- tigative lab

CR2: The course is structured around the enduring under- standings within the big ideas as described in the AP Biology Curriculum Frame- work.

CR6: The student-directed laboratory investigations used throughout the course allow students to apply the seven science practices defined in the AP Biology Curriculum Frame- work and include at least two lab experi- ences in each of the four big ideas.

MOLCEULES, CELLS & ENERGY		Big ideas 1, 2, 3 & 4 [CR2]	
TOPICS	**READINGS**	**ACTIVITY/LABS**	**ASSESSMENT**
E. EVOLUTIONARY BIOLOGY Darwin's explora- tions and theory of descent with modification & natural selection Galapagos Islands Overview Evidence for evolution (molecular analy- ses & morphologi- cal analyses Phylogeny & systematics Evolution of populations Hardy-Weinberg Law	Text chapters 22-25 Journal Article Read- ing Beak of the Finch by Jonathan Weiner	Activity: Genetics Survey Project analyzing traits of those around us Lab Investigation "2 Mathematical Modeling: Hardy-Weinberg [CR6] (SP2, 4, 5, 7) Activity: Students create Geologic timeline Activity: Hands on fossil analysis (obtained from nearby college) [CR4a] (SP 6, 7)	Student generated concept maps Reading quizzes Book discussions Unit test with Free Response practice

CR4a: The course provides students with opportunities outside of the labora- tory investigations to meet the learning objectives within Big Idea 1.

CR6: The student-directed laboratory investigations used throughout the course allow students to apply the seven science practices defined in the AP Biology Curriculum Frame- work and include at least two lab experi- ences in each of the four big ideas.

ORGANISMS & POPULATIONS Big Ideas 1, 3 & 4 [CR2]			
TOPICS	**READINGS**	**ACTIVITY/LABS**	**ASSESSMENT**
A. BIOLOGICAL DIVERSITY & MICROBIOLOGY Early life on earth Evolution of prokaryotes & eukaryotes	Text chapters 25, 26, 27 Text 29.30	Students are to find an article involving genetic recombination using prokaryotes and present to class [CR5] Investigative LAB # 3: Analyzing Genes with BLAST (EU 1.B connects to BI 4) [CR3a] & [CR6]	Article presentation to class Student generated concept map Section test
B. PLANTS & THEIR DIVERSITY How plants colonized land Evolution of seed plants Structure, growth & development Plants responses to internal & external stimuli Plant nutrition Angiosperm Reproduction	Text 35, 36 Text 37..38, 39	Eduweblabs: Prelab Transpiration Investigative LAB # 11: Transpiration (EU 1.B connects to BI 4) [CR3a] & [CR6] (SP 2, 3, 5) LAB: Flower dissection LAB: Students conduct a long term (exp't) lab investigation plant growth from seeds under various conditions in our green- house. [CR6] (SP 3.5, 6, 7)	Practical Test specimen identifica- tion & placing on phylogenetic tree Student generated concept map Section test Eduweblab transpiration results Investigative labs analysis Flower dissection practical Formal writeup for students' own plant lab [CR8]
C. ANIMAL DIVERSITY Characteristics (body plans & systems) of inver- tebrates as you go up the phyloge- netic tree Basic anatomy principles Analysis of struc- ture & function of body systems Digestive, Circula- tory, Respiratory, Excretory, Endo- crine, Nervous, Muscular Systems	Text chapters 32-34 and 40-49	Survey of animal phyla in concept map/chart form generated by students (Practical with actual animal specimens) Eduweblabs - Daphnea heart rate Eduweblabs - Cardiac Physiology Human Biology: Circula- tion and Blood Pressure Lab: Examining circulation of the goldfish [CR6] (SP 7) Lab: Dissection - Cat	Student generated concept maps (one for each system & animal diversity examination) Reading quizzes Unit test with Free Response practice Eduweblab reports Practical quiz observ- ing various speci- mens and classifying them using students' own made chart of animal phyla Practical test with dissection specimen

CR5: The course provides students with opportunities to connect their bio- logical and scientific knowledge to major social issues (e.g., concerns, technologi- cal advances, innova- tions) to help them become scientifically literate .

CR3a: Students connect the enduring under- standings within Big Idea 1 (the process of evolu- tion drives the diversity and unity of life) to at least one other big idea.

CR6: The student-directed laboratory investigations used throughout the course allow students to apply the seven science practices defined in the AP Biology Curriculum Frame- work and include at least two lab experi- ences in each of the four big ideas.

ORGANISMS & POPULATIONS Big Ideas 1, 3 & 4 [CR2]			
TOPICS	**READINGS**	**ACTIVITY/LABS**	**ASSESSMENT**
D. ECOLOGY Ecological interac- tions- 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 & nega- tive	Text chapters 50-55	Eduweblabs: Prelab Animal Behavior Investigative LAB #12: Fruit fly behavior [CR6] (SP 3, 4) Animal Behavior: Taxis, Kinesis, and Agonistic Behavior [CR6] (SP 3, 4, 6) LAB: Termite Behavior (WARD'S) Wolbachia Project- PCR in conjunc- tion with the Marine Biology Institute in Boston, students will conduct research look- ing at the presence of symbiotic relationship in insects with Wolbachia (EU 4.A connects to BI 1) [CR3d] & [CR4d] (SP 3, 4, 5) Eduweblabs- Primary Productivity LAB: Dissolved Oxygen & Aquatic Primary Productivity (EU 4.A connects to BI 1) [CR3d], [CR5] & [CR6] (SP 2, 3, 4, 5, 6, 7) LAB: Local Burpee museum field trip where students perform water quality surveys includ- ing benthic macroinver- tebrate survey (EU 4.C connects to BI 1) [CR3d] & [CR6] Activity – "My footprint" (EU 4.A connects to BI 1) [CR3d] & [CR4d]	Student generated concept maps Reading quizzes Unit test with Free Response practice Eduweblab reports Investigative Lab #11 report [CR8] Termite lab questions, analysis and presentation [CR8] Eduweblab report on primary productivity Presentation: Students present lab results to class with ways to improve water quality of their local river [CR5] Personal Project: Students complete "My Footprint" on- line and write a paper discussing their individual impact on Earth [CR5]

CR5: The course provides students with opportunities to connect their bio- logical and scientific knowledge to major social issues (e.g., concerns, technologi- cal advances, innova- tions) to help them become scientifically literate.

CR3d: Students connect the endur- ing understandings within Big Idea 4 (biological systems interact and these systems and their interactions possess complex properties) to at least one other big idea.

CR8: The course provides opportuni- ties for students to develop and record evidence of their verbal, written and graphic communica- tion skills through laboratory reports, summaries of litera- ture or scientific in- vestigations, and oral, written, or graphic presentations.

Additional Websites:

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

- The Biology Project - University of Arizona