Advanced Placement Course Audit

Course: AP Biology

Course Overview

This course is the equivalent of an introductory college laboratory course for Biology majors. We will move quickly through the material not only because this course is college-level, but because we have less class time to explore the material than we would in a university setting. This course allows students to investigate biological concepts at a deeper level than in our regular or Honors biology courses, and students can expect to be challenged by the material and will be expected to keep up with a demanding schedule. Major topics investigated will include Molecules and Cells, Heredity and Evolution, and Organisms, and Populations. All students who take AP Biology are expected to take the College Board's Advanced Placement Biology Examination. The main emphasis of the class will be on preparation for the AP Exam, especially by doing all the recommended labs.

Our school is on a modified year-round schedule. We start mid-July, and finish the end of May, with two-week breaks in the fall, winter, and spring. Winter break is the division between first and second semesters. The class meets four days each week. Three of these days are 60-minute periods, while one day each week is a 95-minute block. Labs usually are scheduled for the block days, but we frequently carry out parts of labs during the one-hour periods as well. We carry out the twelve recommended labs as well as several others intended to reinforce the course concepts.

The course is organized around the concepts found in the AP Biology Course Description provided by the College Board, the eight themes presented there, and is based on the syllabi presented in the AP Biology Teacher's Guide. I also utilized information and input from the excellent AP Summer Institute presented by Diane Catron in Albuquerque, NM (Summer 2006).

The primary textbook adopted by our district is *Biology* (7th edition; Campbell and Reece 2005). Our school is the first high school in the US designed around providing students with laptops instead of physical textbooks. For this course, we initially used only the internet-based version of the textbook. The online resources (tutorials, self-quizzes, video clips, animations, etc.) are excellent and an important part of the class. Due to the formatting of the website, however, students found reading the main body of the online textbook awkward and difficult. For that reason, we have obtained physical texts for their use in addition to the online resources. We will also utilize other print, electronic, and online resources to further reinforce the concepts introduced in the class.

The eight themes of AP Biology (Science as a Process; Evolution; Energy Transfer; Continuity and Change; Relationship of Structure to Function; Regulation; Interdependence in Nature; Science, Technology, and Society) are discussed and taught both explicitly and also as part of our continuing discussions throughout the course.

The textbook reinforces this AP Biology thematic framework as it is organized around eleven similar themes that unify biology. In addition, the course emphasizes the central role of evolution in biology by discussing it in the context of each unit, beginning with the evolution of macromolecules such as proteins. As we study each later unit (cells, cellular energetics, etc.,) we include an evolutionary perspective, as well as examining the personal and social aspects of each unit.

Placing advancements in science and society in the context of changes in technology, knowledge, and culture is always an important of my classes. We frequently discuss topics in the context of local ecology, local biotechnology and research, local conservation groups, etc. In the past, we have had guest speakers and

collaborations with scientists at the University of Arizona (including the Tree of Life Project), the Rincon Institute, the Cienega Corridor Conservation Council, the Arizona Fish and Game Department, and Saguaro National Park.

AP Biology is essentially a college course offered to high school students. We do not limit enrollment only to Honors students. The course may be taken by juniors or seniors. We encourage all students who earned a "B" or better in their previous science course to enroll. They are required to have completed one year of high school biology. They are encouraged to take chemistry before AP Biology, but are not required to do so. For this reason we have a good mix of interests and abilities in each class. Because this class is structured like a college course, the following grade breakdown is used:

Homework and class work	15%	Labs/projects	35%
Unit Tests/quizzes	35%	Final exam	15%

Tests are patterned after the AP Biology Exam with both multiple-choice and essay sections. The multiple-choice section includes both conceptual and application questions, while the essay (free-response) section emphasizes the conceptual themes and rewards critical thinking.

Lab Component

Because one important emphasis of this course is the understanding and practice of the process of science, labs are the central focus of the class. The core of the lab component of the course is the set of twelve labs outlined in the College Board's *AP Biology Course Description* and *AP Biology Lab Manual for Students*. All are carried out as full wet labs. Labs 1, 3, 4, 5, 7, 8, 10, and 11 are carried out using traditional equipment as written in the *AP Biology Lab Manual for Students* while labs 2, 9, and 12 are carried out as modified for use with Pasco digital instrumentation as provided by Carolina Biological Supply. Lab 6 (Molecular Biology) is carried out using kits and equipment from Bio-Rad Laboratories. This combination of traditional and high-tech approaches gives students the broadest experience in research methods. The labs using Pasco or Bio-Rad modifications meet or exceed the objectives of the traditional forms of those labs.

In addition to the twelve traditional labs, we also have labs designed to further reinforce the concepts introduced n the course. These include labs on molecular structure, macromolecules and polymers, cell structure and function, cell diversity, DNA extraction, plant tissues and structure, and desert plant adaptations.

Since a central theme of the course is the process of science and experimental design, in many labs students design and carry out their own extensions to the above labs.

Full formal lab reports are expected for half of the labs, and include background research, sources, purpose, hypothesis, procedures, data, and conclusions. Other lab reports utilize the forms in the *AP Biology Lab Manual for Students*, or the worksheets/forms supplied by the above vendors. Students are encouraged to gather these and other course documents into a multimedia (print and electronic) portfolio as part of their Senior Exit Project requirements (required by the district for graduation) and also to show to their college to assist in gaining lab credit for the work they have done (if they achieve a sufficient score on the AP Biology Exam).

As scheduled for the 2007-2008 school year, these labs will take up at a minimum 29 sixty-minute periods and 15 ninety-five-minute blocks (not including time involved with the year-long Plant Phenology Project), for a total of 52.75 hours. Instructional time for the class for the year is 101 sixty-minute periods and 34 ninety-five-minute blocks for a total of 154.83 hours.

The Plant Phenology Project is a long-term research project carried out by the students over the course of the school year. They choose a minimum of five native Sonoran Desert plants in their yard or neighborhood,

research the plants and their ecology, and make weekly observations of their growth and reproduction throughout the year as the climate changes. They share their observations and conclusions on a public research website and blog, and include a photographic and/or video record of the changes observed. Some class time is used for plant identification, discussion of ecology, and work on the research website, but observations are done outside of class. The time involved in this project varies, so is not included in the estimation of lab time for the class.

The percentage of class time devoted to labs, then, is 34% (well in excess of the 25% requirement). Additionally, this does not take into account days with abbreviated schedules due to assemblies, parent/teacher/student conferences, or inservice days. Since the timing of these days was known at the time the tentative course schedule was drawn up, no labs were schedule on those days, so the actual percentage of lab time will actually be marginally higher than the 34% given. Also, this coming summer I plan to work up several additional labs that may be incorporated for the coming year. In no case will the percentage of lab time be lower than 34% stated.

Primary Sources

Campbell, Neil, and Reece, Jane. *Biology* 7th edition. Pearson Education Inc., 2005. (Physical text and online resources)
Carr, Nancy, *et al. The Nature of Life: Readings in Biology*. Great Books Foundation, 2001.
The College Board. *AP Biology Lab Manual for Students*. The College Board, 2001.
The College Board. *AP Biology Lab Manual for Teachers*. The College Board, 2001.

Selected websites used extensively:

- DNA Interactive (http://dnai.org) Dolan Learning Center, Cold Spring Harbor Labs, 2003.
- The Biology Project (http://www.biology.arizona.edu/) Department of Biochemistry and Molecular Biophysics, University of Arizona, 2004.
- Understanding Evolution (http://evolution.berkeley.edu/) University of California Museum of Paleontology, 2007.

When possible, primary research articles and review articles from scientific literature are also used.

Course Plan

Note: Exam days and several days with known reduced schedules were not counted in the following approximate time frames.

Summer

Summer Assignment: Diversity of Life Review
Time Frame: Dependent on student
Textbook chapters: 26-34
Content:

I. Origin and Evolution of Early Life (Chapter 26)
II. Diversity of Organisms (Chapters 27-34)
    A. Survey of diversity of life
    B. Phylogenetic classification and evolutionary relationships of the major divisions of life.

Major Project: Working individually, students complete an analytical study of life's origin and diversity, in conjunction with Chapters 26-34 in the textbook. The project is due the first day of class.

Semester 1

Introduction
Time Frame: 2-3 days (2-3 60' periods)
Textbook chapters: 1
Content:

- Course introduction, policies, and procedures.
- What is AP Biology?
- Core themes in biology (Chapter 1 (*Biology*, 7th ed., Campbell and Reece))

Unit 1- Biological Chemistry
Time Frame: 4 weeks (10 60' periods, 4 95' periods)
Textbook chapters: 2, 3, 4 ,5, 8
Content:

I. Atoms and Molecules (Chapters 1,2,3,4,5)
   A. Basic Chemistry Review: Atomic theory, types of bonding, properties of molecules.
   B. Properties of water; Acids, buffers, dissociation of water molecules.
   C. Role of carbon in living things; basic organic chemistry.
   D. Biological Molecules: Structure and function of carbohydrates, lipids, proteins and nucleic acids

II. Metabolism and Enzymes (Chapter 8)
   A. Metabolism introduction: What is metabolism? Nature of chemical reaction (rate, redox, equilibrium), thermodynamics of chemical reactions.
   B. Enzymes: Structure and function, coenzymes, environmental effects on enzymes, enzymes and the control of metabolic pathways, regulation of metabolic pathways, ATP structure and function.

Major Assignments and Assessments:
Major Laboratory Assignments: AP Lab 2- Enzyme Catalysis; Basic chemical models lab; Organic molecules and polymers lab
Major Projects: Water Properties Student Presentations
Major Assessment: Chemistry Unit Exam

Unit 2- Cell Structure and Function
Time Frame: 4 weeks (10 60' periods, 4 95' periods)
Textbook Chapters: 6, 7, 12 (Ch 11 optional)
Content:

I. Cell Structure and Function (Chapter 6)
   A. Prokaryotic cell structure and function
   B. Eukaryotic cell structure and function: The endomembrane system, chloroplasts and mitochondria, other eukaryotic organelles

II. The Cell Membrane (Chapter 7)
   A. Structure and Function of the Cell Membrane: fluid-mosaic model, function of membrane proteins, cellular receptors
   B. Transport: Diffusion/osmosis, active transport, endocytosis/exocytosis.
   C. Signal Transduction.

III. The Cell Cycle (Chapter 12)
   A. Role of cell division; Cellular organization of the genetic material; Distribution of chromosomes during cell division.
   B. Stages of the cell cycle; Binary fission and cytokinesis; evolution of mitosis.
   C. Mitosis review
   D. Control of the cell cycle; Cancer as disruption of cell cycle controls.

Major Assignments and Assessments:
Major Laboratory Assignments: AP Lab 1- Diffusion and Osmosis; Cell Survey and Microscopy Review Laboratory Activity; AP Lab 3- Mitosis and Meiosis
Major Projects: Student group presentations on cell structures, endomembrane system. Chapter 11 (Cell Communications) recommended additional reading.
Major Assessment: Cell Structure and Function Unit Cumulative Exam

Fall Break Assignment: (To be determined, based on time constraints and student interests)

Unit 3- Cellular Energetics
Time Frame: 3 weeks (8 60' periods, 3 95' periods)
Textbook Chapters: 9,10
Content:

I. Respiration (Chapter 9)
   A. Overview of Respiration: Redox reaction review, chemiosmotic model, mitochondria structure and function.
   B. Glycolysis: Overview, reactants and products, fermentation vs. aerobic respiration.
   C. Krebs Cycle: Overview, acetyl-CoA cycle, reactants and products.
   D. Electron Transport Chain: Overview, oxidative phosphorylation vs. substrate level phosphorylation, Control of oxidative phosphorylation.
   E. Respiration Extensions: Overall energy, relationship of respiration to other catabolic pathways, anabolic pathways.

II. Photosynthesis (Chapter 10)
   A. Overview of Photosynthesis: Nature of light, chlorophyll and other pigments, chloroplast structure and function.
   B. Light Dependent Reactions: Photosynthetic membranes, photosystem structure and function, cyclic and non-cyclic electron flow, reactants and products.
   C. Light Independent Reactions: Calvin cycle, rubisco structure and function, reactants and products.
   D. Photosynthesis Extensions: Overall Energy, products of photosynthesis, relationship between light dependent and light independent reactions, photorespiration, C3 and C4 plants.

Major Assignments and Assessments:
Major Laboratory Assignments: AP Lab 5- Cell Respiration; AP Lab 4- Plant Pigments and Photosynthesis
Major Assessment: Cellular Energetics Cumulative Exam

Unit 4- Classical Genetics
Time Frame: 3 weeks (6 60' periods, 3 95' periods)
Textbook Chapters: 13, 14, 15
Content:

I. Meiosis (Chapter 13)
   A. Meiotic Cell Division: Haploid vs. Diploid, meiosis and life cycle, phases of meiosis, meiosis in humans.
   B. Mitosis vs. Meiosis: Comparisons, asexual and sexual reproduction.

II. Classical Genetics Review (Chapter 14, 15)
   A. Early ideas about heredity.
   B. Probability and statistics.
   C. Mendel's experiments: Process of Mendel's experiments, law of segregation, law of independent assortment, dominant and recessive alleles, monohybrid and dihybrid crosses.
   D. Human genetics.
   E. Non-Mendelian genetics: Codominance, Multiple alleles (blood groups), epistasis, pleiotropy,

penetrance, expressivity.

F. The relationship of an organisms environment and its heredity on its phenotypes.
G. Sex-linkage: T.H.Morgan's experiments, sex-linked traits in humans and fruit flies, sex-linked human conditions, karyotype analysis, pedigree analysis.
H. Chromosomal basis of inheritance: linkage mapping, three-point test cross.

Major Assignments and Assessments:
Major Laboratory Assignments: AP Lab 7- Genetics of Organisms; Chi-Square M and M Analysis.
Major Assessment: Classical Genetics Cumulative Exam.

Unit 5- DNA and Molecular Genetics
Time Frame: 4.5 weeks (12 60' periods, 4 95' periods)
Textbook Chapters: 16, 17, 18, 19
Content:

I. DNA Structure and Function (Chapter 16)
   A. The Modern Synthesis: historical modification of the gene concept, relationship between DNA and protein, Griffith experiments, Hershey-Chase experiments, Chargaff's experiments.
   B. The Structure of DNA: Watson and Crick model, evidence for DNA structure, Rosalind Franklin. Base pairing rules.
   C. DNA Replication: How and why.
II. Protein Synthesis (Chapter 17)
   A. Gene Structure: Promoters, enhancers, coding region.
   B. Genetic Code overview: History of deciphering the genetic code, codons, relationship of DNA and RNA.
   C. Transcription: Process, prokaryotes vs. Eukaryotes. RNA processing.
   D. Translation: Process, prokaryotes vs. Eukaryotes.
   E. Mutations: Types of mutations, effects of mutations, hemoglobin structure and sickle cell mutation effects. Mutagenesis. Role of mutations in generation of variety.
III. Gene Regulation (Chapter 18, 19)
   A. Virology: Viral life-cycles, prokaryotic and eukaryotic viruses, HIV life cycle.
   B. Bacterial: Recombination mechanisms in bacteria, transformation, transduction, conjugation. Gene regulation in bacteria, operon structure and function.
   C. Eukaryotic: Structure and function of eukaryotic genome, human genomics, nucleosome structure and function, transposable elements, current understanding of the constitution of the human genome.

Major Assignments and Assessments:
Major Laboratory Assignments: DNA Extraction Lab.
Major Assessment: DNA and Molecular Genetics Cumulative Exam.

Semester 1 assessment:
Semester cumulative review (3 60' periods)
Semester cumulative Final Exam

Winter Break Assignment: Evolution Review. Read Chapters 22-26. Chapter review packets and chapter picture essay summaries for each chapter are due the first day of class.

Semester 2

Unit 6- Biotechnology
Time Frame: 2 weeks (6 60' periods, 2 95' periods)
Textbook Chapters: 20

Content:

I. Biotechnology (Chapter 20)
   A. Strategies for genetic manipulation in prokaryotes and eukaryotes.
   B. Gene technology: Process and applications
   C. Ethical implications and considerations of genetic engineering.
   D. Societal and Environmental Concerns of Biotechnology.

Major Assignments and Assessments:

Major Laboratory Assignments: AP Lab 6A- pGLO Bacterial Transformation; AP Lab 6B- Restriction Analysis.

Major Assessment: Exam is combined with that of Unit 7, below.

Unit 7- Evolution

Time Frame: 3 weeks (7 60' periods, 3 95' periods)

Textbook Chapters: 22, 23, 24, 25,

Content:

I. Natural Selection (Chapter 22)
   A. Historical concepts of evolution
   B. Darwin and Natural Selection: The theory of Natural Selection, evidence for evolution by natural selection.

II. Population Genetics (Chapter 23)
   A. Hardy-Weinberg principle
   B. Factors affecting allelic frequencies in populations

III. Speciation (Chapter 24)
   A. Mechanisms of reproductive isolation
   B. Allopatric speciation and sympatric speciation.
   C. Adaptive Gradation
   D. Patterns of Evolution: Gradualism and Punctuated Equilibrium
   E. Effects of Genetic alterations on the evolution of a species.

IV. Phylogeny and Systematics (Chapter 25)
   A. Historical Development and Current Models

Major Assignments and Assessments:

Major Laboratory Assignments: AP Lab 8- Population Genetics and Evolution. Independent research projects due.

Major Assessment: Biotechnology and Evolution Cumulative Exam.

Unit 8- Plant Structure and Function

Time Frame: 2 weeks (5 60' periods, 4 95' periods)

Textbook Chapters: 35, 36, 37, 38, 39

Content:

I. Plant Anatomy and Growth (Chapters 35)
   A. Types of Plant Tissue.
   B. Patterns and control of plant growth

II. Plant Physiology (Chapters 36, 37, 38, 39)
   A. Transpiration and Translocation.
   B. Plant Nutrition.
   C. Hormones and Regulation of Plant Growth: Auxins, Gibberellins, cytokinins, abscisic acid, ethylene.
   D. Flowering and Photoperiodism.
   E. Plant Defense and Wounding Response.

Major Assignments and Assessments:

Major Laboratory Assignments: AP Lab 9A- Transpiration; AP Lab 9B- Plant tissue microspcopy. Additional plant tissue microscopy lab. Plant adaptations to desert environment lab.
Major Assessment: Plant Structure and Function Cumulative Exam.

Spring Break Assignment: Ecology Review
Time Frame: Dependent on student
Textbook chapters: 50, 51, 52, 53, 54
Content:

I. Ecology
   A. Ecology introduction (Chapter 50)
   B. Behavioral Ecology (Chapter 51)
   C. Population Dynamics (Chapter 52)
   D. Communities and Ecosystems (Chapters 53, 54)
   E. Global Issues

Note in explanation: *Most students come in to this class from my Biology Honors course. One of the last units of the year in that course is Ecology, and we go into a great deal of depth. Using an Ecology Review as a project over break for AP Biology is a natural extension to this and also helps us with the time constraints of the year. Some of this material is revisited in the context of AP Lab11 and AP Lab 12.*

Major Assignments and Assessments:
Major Project: Chapter review packets and chapter picture essay summaries for each chapter are due the day we return to class.

Unit 9- Animal Structure and Function
Time Frame: 5 Weeks (11 60' periods, 3 95' periods)
Textbook Chapters: 41, 42, 43, 44, 45, 46, 48, 49
Content:

I. Vertebrate Systems
   A. Digestive System: Evolution of vertebrate digestion, Comparisons of animal digestive systems, overview of mammalian digestive system.
   B. Circulatory System: Evolution of vertebrate circulation, comparisons of animal circulatory systems, overview of mammalian circulatory system, structure and function of mammalian heart.
   C. Respiratory System: Evolution of vertebrate respiratory system, comparisons of animal respiratory systems, overview of mammalian respiratory system, structure and function of mammalian lung.
   D. Immune System: Evolution of animal immune system, overview of mammalian immune system. Structure and function of mammalian humoral and cell-mediated immune response.
   E. Excretory System: Evolution of animal excretory system, overview of mammalian excretory system. Structure and function of mammalian kidney.
   F. Regulatory System: Evolution of animal regulatory systems, overview of mammalian nervous and endocrine systems. Structure and function of human brain. Structure and function of neuron.
   G. Reproductive System: Evolution of animal reproductive systems, overview of mammalian reproductive systems.
   H. Development: Role of genetics in embryological development. Comparative embryology of amphibian, bird and human embryo.

Major Assignments and Assessments:
Chapters 21, 40, 47 as reading/review assignments only.
Major Laboratory Assignments: AP Lab 10- Physiology of the Circulatory System
Major Assessment: Animal Structure and Function Cumulative Exam (also includes Ecology assessment, below).

Unit 10- Ecology

Time Frame: 2 weeks (3 60' periods, 2 95' periods)
Textbook Chapters: 50, 51, 52, 53, 54, 55
Content:
Students review the content material as their Spring Break Project (above). Class time is primarily devoted to AP Lab 11 and AP Lab 12.
Major Assignments and Assessments:
Major Laboratory Assignments: AP Lab 11- Animal Behavior; AP Lab 12- Dissolved Oxygen and Aquatic Primary Productivity.
Major Assessment: Combined with Animal Structure and Function Cumulative Exam (above).

Semester 2 assessment:
Year's cumulative review (4 60' periods, 1 90' Period)
Semester Cumulative Final Exam (optional for those taking the AP Biology Exam)
AP Biology Exam

A detailed description of the labs follows this page.

Laboratories	Laboratory Objectives	Lab time
1. Diffusion & Osmosis	• Measure the water potential of a solution in a controlled experiment • Determine the osmotic concentration of living tissue or an unknown solution from experimental data • Describe the effects of water gain or loss in animal and plant cells • Relate osmotic potential to solute concentration and water potential	2 60' period 1 95' period
2. Enzyme Catalysis	• Measure the effects of changes of temperature, pH, enzyme concentration, and substrate concentration on reaction rates of an enzyme-catalyzed reaction in a controlled experiment • Explain how environmental factors affect the rate of enzyme-catalyzed reactions • Make a hypothesis and then evaluate the validity of that hypothesis based on collected data	2 60' 1 95'
3. Mitosis & Meiosis	• Recognize the stages of mitosis in a plant or animal cell • Calculate the relative duration of the cell cycle stages • Describe how independent assortment and crossing over can generate genetic variation among the products of meiosis • Use chromosome models to demonstrate the activity of chromosomes during Meiosis I and Meiosis II • Relate chromosome activity to Mendelian segregation and independent assortment • Demonstrate the role of meiosis in the formation of gamete or spores in a controlled experiment using an organism of your choice • Calculate the map distance of a particular gene from a chromosome's center for between two genes using an organism of your choice in a controlled experiment • Compare and contrast the results of meiosis and mitosis in plant cells • Compare and contrast the results of meiosis and mitosis in animal cells	1 60' 1 95'
4. Plant Pigments & Photosynthesis	• Separate pigments and calculate their Rf values • Describe a technique to determine photosynthetic rates • Compare photosynthetic rates at different temperatures, different light intensities, and different wavelengths of light in a controlled experiment • Explain why the rate of photosynthesis vary under different environmental conditions	2 60' 1 95'
5. Cell Respiration	• Test the effects of temperature on the rate of cell respiration in ungerminated versus germinated seeds in a controlled experiment • Use a carbon dioxide gas sensor to measure the concentration of carbon dioxide • Calculate the rate of cell respiration from experimental data • Relate gas production to respiration rate	2 60' 1 95'

Laboratories	Laboratory Objectives	Lab time
6. Molecular Biology	• Use plasmids as vectors to transform bacteria with a gene for antibiotic resistance in a controlled experiment • Demonstrate how restriction enzymes are used in genetic engineering • Use electrophoresis to separate DNA fragments • Describe the biological process of transformation in bacteria • Calculate transformation efficiency • Be able to use multiple experimental controls • Design a procedure to select positively for antibiotic resistant transformed cells • Determine unknown DNA fragment sizes when given DNA fragments of known size	5 60' 2 95'
7. Genetics of *Drosophila*	• Investigate the independent assortment of two genes and determine whether the two genes are autosomal or sex-linked using a multi-generation experiment • Analyze the data from your genetic crosses chi-square analysis techniques • Describe the different types of insect mating behaviors	1 60' 2 95'
8. Population Genetics	• Calculate the frequencies of alleles and genotypes in the gene pool of a population using the Hardy-Weinberg formula • Discuss natural selection and other causes of microevolution as deviations from the conditions required to maintain Hardy-Weinberg equilibrium	1 60' 1 95'
9. Transpiration	• Test the effects of environmental variables on rates of transpiration using a controlled experiment • Make thin sections of stem, identify xylem and phloem cells, and relate the function of these vascular tissues to the structures of their cells	1 60' 1 95'
10. Physiology of the Circulatory System	• Measure heart rate and blood pressure in a human volunteer • Describe the effect of changing body position on heart rate and blood pressure • Explain how exercise changes heart rate • Determine a human's fitness index • Analyze pooled cardiovascular data • Discuss and explain the relationship between heart rate and temperature	1 60' 1 95'
Pillbugs (11)	• Describe some aspects of animal behavior, such as orientation behavior, agnostic behavior, dominance display, or mating behavior • Understand the adaptiveness of the behaviors you studied • Measure the effects of environmental variables on habitat selection in a controlled experiment • Make a hypothesis and then evaluate the validity of that hypothesis based on collected data	2 60' 1 95'

Laboratories	Laboratory Objectives	Lab time
Dissolved Oxygen & Aquatic Primary Productivity (12)	• Measure primary productivity based on changes in dissolved oxygen in a controlled experiment • Investigate the effects of changing light intensity and/or inorganic nutrient concentrations on primary productivity in a controlled experiment	2 60' 1 95'
Basic Molecules Lab	• Review basic bond types and simple molecules	1 60'
Organic Molecules and Polymers Lab	• Students review molecular structures of common types of biological macromolecules • Students review process of polymer formation from monomers of the main categories of biological macromolecules	1 60' 1 95'
Cell Survey Lab	• Students practice microscopy while examining diversity of prepared and live prokaryotes, simple eukaryotes, and tissue sample slides of advanced eukaryotes. • Students compare/contrast prokaryotic and eukaryotic cell types	2 60'
DNA Extraction Lab	• Students carry out DNA extraction from human cheek cells (Bio-Rad Genes in a Bottle Lab)	1 60'
Plant Tissues Lab	• A More detailed examination of plant tissues by microscopy. Builds on and extends Lab 9B	1 60'
In situ Desert Plant Adaptations Lab	• Students examine desert plants in their habitat. Combines plant physiology and ecology. Includes investigations into plant defenses	1 60'
Plant Phenology Project	• Students observe changes in five plants at their home or neighborhood throughout the year and relate those changes to changes in climate. Five class days used throughout the year constructing online observation blogs/websites which include photographs and video. Observation is done outside class time.	All year

Total: 29 60' periods; 15 95' periods. All of the labs listed are hands-on/wet labs.
(Does not include approximately five periods involved in Plant Phenology Project

Correlation to Arizona Science Standards

Major Themes in AP Biology

I. Science as a Process (AZ Strand 1)
II. Evolution (AZ Strand 4, Concept 4)
III. Energy Transfer (AZ Strand 4, Concept 5)
IV. Continuity and Change (AZ Strand 4, Concept 2)
V. Relationship of Structure to Function (AZ Strand 4, Concept 1)
VI. Regulation (AZ Strand 4, Concept 1)
VII. Interdependence in Nature (AZ Strand 4, Concept 3)
VIII. Science, Technology, and Society (AZ Strand 3)

Topics covered by the AP Biology Exam and Suggested Percentage of Course:

I. Molecules and Cells (25%)

- **Chemistry of Life (7%)**
  - Water **(AZ S4C1PO3)**
  - Organic molecules in organisms **(AZ S4C5PO2)**
  - Free energy changes **(AZ S4C5PO1)**
  - Enzymes **(AZ S4C5PO1; S4C1PO1,4,5)**
- **Cells (10%)**
  - Prokaryotic and eukaryotic cells **(AZ S4C1PO2)**
  - Membranes **(AZ S4C1PO2,4; S4C5PO1,2)**
  - Subcellular organization **(AZ S4C1PO2; S4C5PO1,2)**
  - Cell cycle and its regulation **(AZ S4C1PO5; S4C2PO2,4)**
- **Cellular Energetics (8%)**
  - Coupled reactions **(AZ S4C1PO1; S4C5PO1,2)**
  - Fermentation and cellular respiration **(AZ S4C1PO3)**
  - Photosynthesis **(AZ S4C1PO3)**

II. Heredity and Evolution (25%)

- **Heredity (8%)**
  - Meiosis and gametogenesis **(AZ S4C2PO4; S4C1PO5)**
  - Eukaryotic chromosomes **(AZ S4C2PO1,2,3,4; S4C1PO5)**
  - Inheritance patterns **(AZ S4C2PO2,3)**
- **Molecular Genetics (9%)**
  - RNA and DNA structure and function **(AZ S4C2PO1)**
  - Gene regulation **(AZ S4C2PO1,2; S4C4PO2)**
  - Mutation **(AZ S4C2PO1,2,3; S4C4PO2)**
  - Viral structure and replication **(AZ S4C2PO2)**
  - Nucleic acid technology and applications **(AZ S4C2PO1; S4C5PO2)**
- **Evolutionary Biology (8%)**
  - Early evolution of life **(AZ S4C4PO1-5; S4C1PO2)**
  - Evidence for evolution **(AZ S4C4PO5)**
  - Mechanisms of evolution **(AZ S4C4PO1-5)**

III. Organisms and Populations (50%)

- **Diversity of Organisms (8%)**
  - Evolutionary patterns **(AZ S4C4PO5,6)**
  - Survey of the diversity of life **(AZ S4C4PO4,5,6)**
  - Phylogenetic classification **(AZ S4C4PO6)**

    - Evolutionary relationships **(AZ S4C4PO6; S4C1PO2)**
- **Structure and Function of Plants and Animals (32%)**
    - Reproduction, growth, and development **(AZ S4C5PO5; S4C1PO5)**
    - Structural, physiological, and behavioral adaptations **(AZ S4C4PO2)**
    - Response to the environment **(AZ S4C4PO4)**
- **Ecology (10%)**
    - Population dynamics **(AZ S4C3PO1-3; S4C5PO3-5)**
    - Communities and ecosystems **(AZ S4C3PO1-3; S4C5PO3-5)**
    - Global issues **(AZ S3C1PO1-5)**

Additionally, Strand 1 (Inquiry Process) and Strand 2 (History and Nature of Science) are addressed throughout.

This audit syllabus is loosely based on the examples and templates kindly shared by Franklin Bell and David Knuffke.