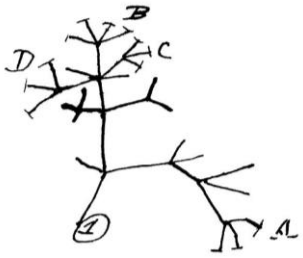

AP BIOLOGY SYLLABUS
2016-2017
MR. WEBER

Email - kweber@dbqschools.org
Phone - (563) 552-5623

"Nothing in biology makes sense except in the light of evolution."
--- Theodosius Dobzhansky

"Chance favors the prepared mind!"
--- Louis Pasteur

All students need to be challenged with the opportunity to experience science as a "real" process and not just learn biology as a collection of facts. This will be best exemplified in AP Biology as we will emphasize how scientists use their observations, inferences, and collection of data to ask novel questions that can lead to new experiments. These experiments often build on the work of others and eventually lead to solutions to problems on many different topics and in many different domains of science. This investigative process will be used throughout this AP Biology course. It is important for students to become excited with discovery as they ask and answer their own questions about natural/biological phenomena that they see, read about, or experience in the laboratory and in the field. In addition, it is critical that students connect new concepts with what they know, with each connection they help themselves build a solid framework of biological knowledge and scientific know-how. This framework will help students to enter their future, prepared for whatever may lie ahead of them regardless of their major or career path.

This course is structured around the four big ideas and the enduring understandings identified in the AP Biology Curriculum Framework and listed below. All essential knowledge will be covered and all learning objectives will be addressed through this curriculum. The course will focus on inquiry-based laboratory work and the use of the seven science practices in both lab and non-lab activities.

The FOUR BIG IDEAS are:

Big Idea 1: The process of evolution drives the diversity and unity of life.

Enduring Understanding

1A: Change in genetic makeup of a population over time is evolution.

1B: Organisms are linked by lines of descent from common ancestry.

1C: Life continues to evolve within a changing environment.

1D: The origin of living systems is explained by natural processes.

Big Idea 2: Biological systems utilize free energy and molecular building blocks to grow, to reproduce and to maintain dynamic homeostasis.

Enduring Understanding

2A: Growth, reproduction and maintenance of the organization of the living systems requires free energy and matter.

2B: Growth, reproduction and dynamic homeostasis require that cells create and maintain internal environments that are different from their external environments.

2C: Organisms use feedback mechanisms to regulate growth and reproduction, and to maintain dynamic homeostasis.

2D: Growth and dynamic homeostasis of a biological system are influenced by changes in the system's environment.

2E: Many biological processes involved in growth, reproduction and dynamic homeostasis include temporal regulation and coordination.

Big Idea 3: Living systems store, retrieve, transmit and respond to information essential to life processes.

Enduring Understanding

3A: Heritable information provides for continuity of life.

3B: Expression of genetic information involves cellular and molecular mechanisms.

3C: The processing of genetic information is imperfect and is a source of genetic variation.

3D: Cells communicate by generating transmitting and receiving chemical signals.

3E: Transmission of information results in changes within and between biological systems.

Big Idea 4: Biological systems interact, and these systems and their interactions possess complex properties.

Enduring Understanding

4A: Interactions within biological systems lead to complex properties.

4B: Competition and cooperation are important aspects of biological systems.

4C: Naturally occurring diversity among and between components within biological systems affects interactions with the environment.

The Investigative Laboratory Component

The course is also structured around inquiry in the lab and the use of the seven science practices throughout the course. Students are given the opportunity to engage in student-directed laboratory investigations throughout the course for a minimum of 25% of instructional time. Students will conduct a minimum of eight inquiry-based investigations (two per big idea throughout the course). Additional labs will be conducted to deepen students' conceptual understanding and to reinforce the application of science practices within a hands-on, discovery based environment. All levels of inquiry will be used and all seven science practice skills will be used by students on a regular basis in formal labs as well as activities outside of the lab experience. The course will provide opportunities for students to develop, record, and communicate the results of their laboratory investigations. ***Student will be required to keep an online laboratory notebook throughout the year using OneNote. Students will occasionally present findings and conclusions from selected labs to the class in the form of mini-posters or PowerPoint style presentations.*** The following are skills and tasks that students will use throughout their laboratory experience in AP Biology.

Science Practices

1. The student can use representations and models to communicate scientific phenomena and solve scientific problems.
2. The student can use mathematics appropriately.
3. The student can engage in scientific questioning to extend thinking or to guide investigations within the context of the AP course.
4. The student can plan and implement data collection strategies appropriate to a particular scientific question.
5. The student can perform data analysis and evaluation of evidence.
6. The student can work with scientific explanations and theories.
7. The student is able to connect and relate knowledge across various scales, concepts and representations in and across domains.

Resources

TEXT - Biology, 8th Edition (2008). Campbell, Neil A. and Reece, Jane B. Person Education Inc.
Evoultion, The Story of Life. Hosler, Jay. 2001.

ONLINE – Canvas LMS
Microsoft OneNote – for online lab notebook
Bozeman Biology Website. http://www.bozemanscience.com/ap-biology/
TED Talks

Grading

Student's grades will depend on unit tests at the end of each unit, laboratory assignments and other miscellaneous assignments (quizzes, presentations, etc.) Tests and quizzes are the major part of your grade and will count for approximately 75% of your grade. The remaining 25% will be composed of laboratory assignments/questions, writing assignments and other miscellaneous tasks. There will be a semester final and a year-end final. They are both cumulative over the material we have covered up to that point. The grading scale is as follows:

A	100-90%	B-	75-72%	D+	59-56%
A-	89-85%	C+	71-68%	D	55-52%
B+	84-80%	C	67-64%	D-	51-50%
B	79-76%	C-	63-60%	F	↓ 50%

Course Topics and General Timeline

Below you will find a general outline of the AP Biology course. Included are the units/chapters, main topics in each unit, estimated time frame of each unit, related lab work and possibly information on assignments specific to that unit. This is designed around the AP Biology Curriculum Framework established by the College Board.

Unit 1 --- Introduction and Biochemistry (1-2 week)
Text: Chapters 1, 2, 3, 4, 5

- Science Investigations and Experimental Design
- Basic Chemistry
- Chemical Bonds
- Properties of Water (3-D water model kit)
- Carbon Molecules and Macromolecules (Carbohydrates, Lipids, Proteins, Nucleic Acids)
- Activity: Pipe Cleaners and Protein (Enzyme) Structure
- Activity: Relative Size of Molecules and Cells
- Video: TED Talk, Adam Savage "How Simple Ideas Lead To Scientific Discoveries" 2012
- Video: TED Talk, Ben Goldacre "Battling Bad Science" 2011
- Video: TED Talk, Chris Jordan "Turning Powerful Stats Into Art" 2008
- Lab: Mystery Jars
- **AP Lab: Animal Behavior in Fruit Flies (Chi Square Test)**
- Animal Behavior Video Clips
  - http://www.youtube.com/watch?v=Mt4N9GSBoMI
  - "Pavlov Altoid Theory" clip from "The Office."

Unit 2 --- Cellular Components and Specialization (2-3 weeks)
Text: Chapters 6, 7 and 32

- Compare Prokaryotes vs. Eukaryotes (Endosymbiosis)
- Cell Structure and Function (Cell Parts)
- Cell Membrane
- Cellular Transport
- Cell-Cell Interactions
- Cell Specialization – Cell > Tissue > Organ, Gastrulation, Tissues Layers, Waste Removal, Digestion, Circulation
- Stem Cells and Issues Surrounding Their Use
- **AP Lab: Diffusion and Osmosis (Surface Area to Volume Ratios, Water Potential Calculations)**
- Video: TED Talk, Drew Berry "Animations of Unseeable Biology": 2012
- Video: TED Talk, Anthony Atala "Growing New Organs" 2010 and "Printing A Human Kidney" 2011
- Video: Inner Life of a Cell

Unit 3 --- Cell Communication/Signaling (2-3 weeks)
Text: Chapter 11, 48 (and 49.2), 45, 39 and 43

- Cell Signaling
- Nervous System and Neuron Function
- Immune System and Response
- Lab: Reaction Time and Reflexes
- Video: TED Talk, Ed Boyden "A Light Switch For Neurons" 2011

- Video: TED Talk, Tal Danino: Programming bacteria to detect cancer (and maybe treat it)
- Hormones and Endocrine System (Homeostasis and Feedback Mechanisms)
- Plant Hormones and Tropisms
- **AP Lab: Transpiration (Rate Calculations, Surface Area Calculations)**

Unit 4 --- Energy and Enzymes (2 weeks)
Text: Chapters 8

- Metabolic Pathways
- Oxidation-Reduction Reactions
- Energy of Activation
- Enzymes and Regulation
- ATP
- Research one biochemical pathway involving at least one enzyme. Describe enzyme, its regulation, and the overall pathway involved.
- **AP Lab: Enzymes in Turnips (Rate Calculation, Graph Types, Q_{10}, Spectrophotometer)**

Unit 5 --- Cell Respiration (2 weeks)
Text: Chapter 9

- Glycolysis
- Fermentation
- Aerobic Respiration
- Krebs Cycle
- Electron Transport Chain
- Regulation of Cellular Respiration
- Body size vs. Metabolic Rate
- Prokaryote Plasma Membrane → Electron Transport
- **AP Lab: Cellular Respiration in Peas (Rate Calculation, Standard Error and SEM Bars)**

Unit 6 --- Photosynthesis (2 weeks)
Text: Chapter 10

- Historical Experiments with Plants
- Biophysics of Light
- Pigments
- Light Reaction
- Calvin Cycle
- Photorespiration (C4 and CAM Pathways)
- Chemosynthesis
- Food Chains, Webs and Pyramids (Rule of 10 and Primary Productivity)
- Disruptions to Ecosystems/Food Chains (Invasive species)
- Lab: Plant Pigments (Rf value calculation)
- **AP Lab: Photosynthesis in Leaf Disks (ET_{50} Calculation)**

Unit 7 --- Cell Reproduction and Heredity (3 weeks)
Text: Chapters 12, 13, 14, 15

- Cell Cycle
- Mitosis and Cytokinesis
- Regulating the Cell Cycle

- Meiosis
- Gamete Production (Oogenesis/Spermatogenesis)
- **AP Lab: Cell Division – Timing of Cell Cycle in Onion Roots (Chi Square Calculation)**
- Video: Meiosis Square Dance
- Lab: Human Karyotype Production using Hela Cells

Unit 8 --- Mendel and Heredity
Text: Chapter 15

- Mendel's Experimental Design
- Patterns of Inheritance
- Pedigree Analysis
- Genetic Disorders
- Video Clip: Fruit Fly Mating
- Gene Mapping and Calculating Map Units
- Assignment: PowerPoint on Genetic Disorder and Their Genetic/Cellular Basis

Unit 9 --- Molecular Genetics (2-3 weeks)
Text: Chapter 16, 17 and 18

- Historical Experiments in Genetics Research
- DNA Structure
- Replication with emphasis on enzymes involved
- Protein Synthesis with emphasis on enzymes involved
- Regulating Gene Expression and Operons
- Mechanisms of Development
- Mutations and Cancer
- Biotechnology
- **AP Lab: Iowa State Biotechnology Lab - Red Colony Transformation (Plasmid Mapping, Transformation Efficiency)**
- Video: Transcription and Translation
- Video: HHMI - The Double Life of RNA
- Phet Simulation – Lactose Operon
- Video: HHMI – The Double Helix

Unit 10 --- Biotechnology (1-2 weeks)
Text: Chapter 19 and 20 (Only 20.1 and 20.2)

- Viruses
- Restriction Enzymes
- Electrophoresis
- PCR
- Cloning
- Recombinant DNA
- CRISPR technology
- Activity: Making Bacteria Plasmids Using Restriction Enzymes
- Assignment: Ethics Paper on Biotechnology and Research
- **AP Lab: Restriction Enzyme Analysis of DNA**
- Guest Speaker – Jolene Osterberger, Roche Biotechnologies
- Video: TED Talk, Richard Resnick "Welcome To The Genomic Revolution" 2011

- Video: TED Talk, Paul Root Wolpe “It’s Time To Start Questioning Bio-engineering” 2011
- Video: TED Talk, Barry Schuler “Genomics 101” 2008
- Video: TED Talk, Hendrik Poinar “Bring back the woolly mammoth!”
- TED Talk, Jennifer Kahn: Gene editing can now change an entire species – forever
- TED Talk, Jennifer Doudna: How CRISPR lets us edit our DNA

Unit 11 --- Evolution (2-3 weeks)
Text: Chapter 22, 23 and 24 (also Chapter 38 Pollination and Coevolution)

- Population Genetics
- Macro versus Microevolution
- Natural Selection – Emphasis on Inherited Traits
- Sexual Selection
- Coevolution in Angiosperm Pollination/Flower Development
- Assignment: Example of Pollination in Angiosperms and Coevolution
- Speciation
- **AP Lab:: Artificial Selection in Wisconsin Fast Plants (Histogram, Standard Deviation)**
- **AP Lab: Mathematical Modeling: Hardy-Weinberg**
- Video: Why Sex?
- Video: The Birds and the Bees
- Video: TED Talk, Yuval Noah Harari, “What explains the rise of humans?” 2015
- Video: TED Talk, Harvey Fineberg “Are We Ready of Neo-evolution?” 2011
- Video: TED Talk, Savante Paabo “DNA Clues to Our Inner Neanderthal” 2011
- Video: TED Talk, Paul Bloom “The Origins of Pleasure” 2011
- Video: TED Talk, Juan Enriquez “Will Our Kids Be A Different Species?” 2012
- TED Talk, Juan Enriquez: We can reprogram life. How to do it wisely
- Video: HHMI Biointeractive, DVD “Your Inner Fish”
- Video: HHMI Biointeractive, “The Origin of Species”
    1. The Making of a Theory
    2. The Beak of a Finch
    3. Lizards in an Evolutionary Tree
- Video: HHMI Biointeractive, “The Making of the Fittest”
    1. Natural Selection in Mice
    2. Ice Fish, The Birth and Death of Genes
    3. Natural Selection in Humans, Sickle Cell Anemia
- Video: HHMI Biointeractive, “The Making of the Fittest” Part 2
    1. Evolving Switches, Evolving Bodies
    2. Got Lactose? The Co-evolution of Genes and Culture

Unit 12 --- Classification and Phylogeny of Living Organisms (1-2 week)
Text: Chapter 25 and 26

- Read Evolution: The Story of Life on Earth by Jay Hosler
- History of Life on Earth
- Classification (Domains and Kingdoms)
- Cladograms and Phylogenetic Trees
- Using Plant, Invertebrate and Vertebrate Clades/Trees as Examples
- **AP Lab: Comparing DNA Sequences to Understanding Evolutionary Relationships with BLAST**
- Video: TED Talk, Jessica Green “We're covered in germs. Let's design for that.”
- Video: David Attenborough “What a Wonderful World” on YouTube

Unit 13 --- Energy Flow in Ecosystems and Ecology (2-3 weeks)
Text: Chapter 52, 53, 54, 55 and 56

- Food Webs and Rule of 10 (Productivity) – Relate back to cell respiration/photosynthesis
- Population growth and carrying capacity
- Communities and succession
- Species interactions
- Nutrient cycles
- Discuss Current Environmental Issues
- **AP Lab: Energy Dynamics**
- Lab: Random Sampling Lab
- Lab: Mark and Recapture Lab
- Lab: Exponential Growth (Populations)

Unit 14 --- Review for AP Exam (1-2 weeks)

- Review major concepts and important diagrams
- Review Big Ideas with examples of how they relate to different units and Enduring Understandings.
- Review AP labs (objectives, concepts and science practices (SP) involved per lab)
- Review Formula Sheet and Grid-In Questions
- Practice Test (Released AP Exam)

After AP Exam --- Review of Scientific Journal Article

- Video: TED Talk, Marc Abrahams “A science award that makes you laugh, then think”
- Summarize a scientific journal article and present to the class