**AP Biology Course Syllabus**

Course Overview

The course is designed around the AP Biology Curriculum Framework that focuses on the four major concepts (Big Ideas) in biology. They include the following:

1. *The process of evolution drives the diversity and unity of life.*
2. *Biological systems utilize free energy and molecular building block to grow, reproduce and maintain dynamic homeostasis.*
3. *Living systems store, retrieve, transmit and respond to information essential to life processes.*
4. *Biological systems interact. These systems and their interactions possess complex properties.*

The big ideas are interconnected and cannot be taught in isolation. My students will create concept maps throughout the year that will connect the big ideas and enduring understanding with one another.

In order to investigate these four big ideas, the curriculum will focus on developing enduring understandings with identified essential knowledge. The essential knowledge in conjunction with the seven science practices are the foundation for the learning objectives for the course. The learning objectives for the course will be the basis for formative and summative assessments.

**Laboratory Component**

The source for many of the labs is *AP Biology Lab Manual*. Some of these laboratory investigations are modified to meet the time restrictions of the course. The course incorporates approximately 40% of the instructional time. The majority of the laboratory investigations are inquiry based at various levels. The labs range from guided inquiry to open inquiry investigations. In addition to the investigations found in the *AP Biology Lab Manual*, students will be engaged in a number of other investigations that supplements the curriculum.

There is an emphasis on the math component of the course. There are some basic statistical tools that are essential in the analysis of biological experiments. This curriculum includes that students are familiar with Chi-square, standard deviation, standard error and the T-test. In addition the students need to understand the importance of identifying mathematic trends. This includes generating a line of best fit for certain data.

Student presentation of the laboratory investigation includes mini-posters, PowerPoint’s, peer review, and laboratory reports. Full laboratory reports include introduction, hypothesis, procedure, data with statistical analysis, conclusion with limitations and recommendations.

The laboratory investigations are designed to incorporate the seven science practices with different investigations. These seven science practices include:

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 guide investigations within the context of the AP course*
4. *The student can plant 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.*

**Ethical Issues**

It is important that students are educated to make decisions that may affect society and the environment. This course will allow students to become familiar with many important biological issues in a variety of formats including peer discussion, role playing and poster displays. Below are some examples of issues. This list is not exhaustive and maybe modified as new research is published.

* Effects of using monoculture practices as an example of artificial selection (Big Idea 1)
* Herbicide resistant species such a pigweed emerging a threat to crops (Big Idea 1)
* Genetically modified food (Big Idea 3)
* Genetic screening and the impact on the insurance company (Big Idea 3)
* Global warming (Big Idea 4)

Teaching Strategies

AP Biology is structured around four Big ideas (Evolution, Energy Processes, Information, and Interactions). At least one of the Big ideas will be incorporated in every lesson throughout the course. Because evolution is the foundation upon which the entire course is based, it will be referenced throughout the entire course, and science as a process will be woven throughout both the investigations and the class activities outside of the investigations.

Students begin each unit with a list of enduring understandings and big ideas. Class

discussions may be based on animations from various sources (textbook, CDs, Internet, etc.) to help the students visualize what they have read. Quizzes are interspersed throughout the unit and inform how instruction may need to be adjusted to improve student learning. Students will need to be prepared to engage in monthly current event discussions informed by readings from recent scientific journals. Through these activities, students are given the opportunity to see that biology is in their everyday lives and is not just a chapter in a textbook.

**Textbooks/Resources**

1. Raven, Johnson, Mason, Losos, and Singer, *BIOLOGY,* 9th Edition (2011).
2. *AP Biology Investigative Labs: an Inquiry Based Approach*
3. Lewis and Ricki, *human Genetics: Concepts and Applications,* 8th Edition(2008)

**Student Evaluation and Assessment**

* Unit Assessments 50%
* Laboratory Work 25%
* Class work 25%

**Homework Reading Assignments-approximately 20 pages of reading per night!!!!!!**

**PACING GUIDE:**

* Unit 1-Water, Biochemistry, Cells, Photosynthesis, Respiration and Mitosis (Oh My!)-19 days
* Unit 2-Meiosis, Genetics, Replication to Translation, Biotechnology-13 days
* Unit 3-Population Genetics, Evolution, Geologic Time/Phylogeny-13 days
* Unit 4-Structure and Function of Animals-10 days
* Unit 5-Structure and Function of Plant-10 days
* Unit 6-Ecology-13 days

**AP Equity and Access Policy and Discussion**

“The College Board strongly encourages educators to make equitable access a guiding principle for their AP programs by giving all **willing and academically prepared** student the opportunity to participate in AP. “

**Unit 1 – Water, Biochemistry, Cells, Photosynthesis Respiration, Mitosis**

Big Ideas 1, 2, 3, 4

Connected to Enduring Understandings-1.A, 1.B, 1.D, 2.A, 2.B, 2.C, 2.D, 2.E, 3.A, 3.B, 3.C, 3.D, 4.A, 4.B, 4.C

Reading-Chapters:

2-The Nature of Molecules and the Properties of Water (Pages 18-30)

3-The Chemical Building Blocks of Life (Pages 34-56)

4-Cell Structure (Pages 59-85)

5-Membranes (Pages 88-104)

6-Energy and Metabolism (Pages 108-119)

7-How Cells Harvest Energy (Pages 123-143)

8-Photosynthesis (Pages 147-165)

9-Cell Communication (Pages 168-183)

10-How Cells Divide (Pages 187-204)

19-Cellular Mechanisms of Development (Pages 373, 375-391)

Topics:

* Properties of water, water as a solvent, and pH (i.e. transpiration and blood)
* Macromolecules … monomers to polymers … carbohydrates, lipids, proteins, and nucleic acids.  Functional group review. Importance of carbon in organic molecules.
* Enzymes and the regulation of proteins … exergonic reactions, endergonic reactions, inhibitors, the effects of temperature and pH. (in relation to behavior and symbiosis to increase chances of survival)
* Connection of DNA and mRNA to protein construction and diversity … also, maintaining the continuity of life.
* Cell structure and organelles, structure and function of organelles. Comparison of animal versus plant cells … Cytoskeleton
* Cell membrane, structure and function.  All transport into and out of cells, active and passive transport as connected to homeostasis.
* Cell signaling (reception, transduction and response), G protein-coupled receptors, cascade effect and signaling pathways and apoptosis.
* Photosynthesis – Structure of chloroplasts, light reactions, Calvin cycle, ETC, chemiosmosis. (Examples and applications using local plants in the temperature biome). Energy transfer (Connected to food chains)
* Respiration – Structure of mitochondria, glycolysis, Kreb’s cycle, ETC and chemiosmosis.  Alcohol and lactic acid fermentation. (Examples- Athletic performance examples (second wind) of respiration and why we need oxygen. Energy transfer connected to food webs
* Cell division in somatic cells.  Phases of cell cycle and phases of mitosis.  Binary fission. Control of the cell cycle and cancer.  Continuity and regulation of species.

Labs:

Investigation 4 – Diffusion and Osmosis

Investigation 5 – Photosynthesis

Investigation 6 – Cellular Respiration

Investigation 13 – Enzyme Activity

**Unit 2 – Meiosis, Genetics, Replication to Translation, Biotechnology**

Big Ideas 1,2,3,4

Connected to Enduring Understanding-1.A, 1.B, 1.C, 1.D, 2.A, 2.B, 2.D, 2.E, 3.A, 3.B, 3.C, 3.D, 4.A, 4.B, 4.C

Reading-Chapters:

11-Sexual Reproduction and Meiosis (Pages 207-218)

12-Patterns of Inheritance (Pages 221-236)

13-Chromosomes, Mapping, and the Meiosis-Inheritance Connection (Pages 240-253)

14-DNA: The Genetic Material (Pages 256-275)

15-Genes and How They Work (Pages 278-301)

16-Control of Gene Expression (Pages 304-305, 308-313, 316-324)

17-Biotechnology (Pages 327-345)

18-Genomics (Pages 348-367)

 Topics:

* Mendelian Genetics and modes of inheritance and probability in the scope of meiosis
* Cell division of sex cells.  Meiosis in males and females and how it differs. Phases of Meiosis I and Meiosis II, crossing-over, non-disjunction.
* Chromosome structure and the discovery of the structure of DNA.  Eukaryotic chromosomes compared to prokaryotic chromosomes.
* Crick’s Central Dogma – Replication, Transcription, and Translation … proteins and structures.
* Pedigree analysis, sex-linked characteristics, linkage**.**
* Trp operon and lac operon – gene regulation
* Bacterial and viral reproduction.  HIV and reverse transcriptase.  Prions and kuru … why not to eat squirrel brains with your scrambled eggs!
* Biotechnology – bacterial transformations, restriction enzyme analysis and PCR.  Applications in agriculture, pharmaceutical products, environmental solutions and forensics.

Labs:

Investigation 7-Cell Division: Mitosis and Meiosis

Investigation 8-Biotechnology: Bacterial Transformation

Investigation 9-Biotechnology: Restrictive Enzyme Analysis of DNA

**Unit 3 – Population Genetics, Evolution, Geologic Time/Phylogeny**

Big Ideas 1,2,3,4

Connected to Enduring Understandings-1.A, 1.B, 1.C. 1.D, 2.E, 3.A, 3.C, 3.D, 4.A, 4.C

Reading-Chapters:

20-Genes Within Populations (Pages 396-413)

21-The Evidence for Evolution (Pages 418-433)

22-The Origin of Species (Pages 437-452)

23-Systematics, Phylogenies and Comparative Biology (Pages 455-468)

24-Genome Evolution (Pages 473-485)

26-The Origin and Diversity of Life (Pages 511-513)

28-Prokaryotes (Pages 548-553 Prokaryotic Genetics)

 Topics:

* Darwin and Wallace – observations that led to the theory of evolution
* The theory of evolution…survival of the fittest, natural selection, isolation and geologic time. Evidence supporting evolution
* Population genetics: Hardy – Weinberg Equilibrium and the conditions for this equilibrium … allele frequencies, genetic drift, population bottlenecks and founder’s effect.
* Hardy – Weinberg problems and the frequency of disease alleles in human genetics and local wildlife/plant populations
* Speciation – allopatric and sympatric … barriers that led to speciation.
* Phylogeny – Fossil Record, Geologic Time, faunal succession.
* Taxonomy / Classification … The use of biotechnological tools to redefine taxonomy.
* Geologic time periods in context with the evolution of organisms.
* Prokaryotes: adapted to success-reproduction, adaptation and genetic diversity (linked to transformation and conjugation)

Labs:

Investigation 1-Artifical Selection

Investigation 2-Mathematical Modeling: Hardy-Weinberg

Investigation 3-Comparing DNA Sequence3s to Understand Evolutionary Relationships

 with BLAST

**Unit 4– Structure and Function of Animals**

Big Ideas 1,2,3,4

Connected to Enduring Understandings-1.A, 1.D, 2.A, 2.B, 2.C, 2.D, 2.E, 3.A, 3.B, 3.D, 4.A, 4.B, 4.C

Reading-Chapters:

42-The Animal Body and Principals of Regulation (Pages 863-882)

43-The Nervous System (Pages 887-900, 908-911)

44-Sensory Systems (Pages 915-918)

45-The Endocrine System (Pages 938-957)

51-The Immune System (Pages 1055-1080)

Topics

* The origins and evolution of eukaryotes / classification of eukaryotes … with an emphasis on animal evolution and diversity … deuterostomes, protosomes, symmetry, segmentation, specialization, amniote egg …
* Body plans and homeostasis as it relates to structure and function.
* Animal nutrition … especially the role of enzymes and adaptations to increase surface area
* Circulation and gas exchange – pH and buffers, double circulation, special adaptations for aquatic animals … relates to aerobic respiration and diffusion.
* Immune system – cell-mediated and humoral responses, antibodies as an example of the tertiary structure of proteins (disulfide bonding)
* Homeostasis – Kidneys – waste disposal and water regulation … regulation / ADH
* Endocrine System – Pituitary gland / Hormones … regulation of the menstrual cycle.
* Reproduction – oogenesis and spermatogenesis … two different approaches … structure and function of gametes.  Embryo development  … stages and tissue development …
* Nervous System – the anatomy of neurons and its signals, synaptic gaps / neurotransmitters.  Sense organs.
* Animal behavior – altruism, imprinting, conditioning, learning, social behaviors

Labs:

Protein Separation using Electrophoresis – This is an additional lab which is used as an independent study.  Students explore the change in a protein profile from different protein sources or a process over time. (as planarian regeneration at different stages)

**Unit 5 – Structure and Function of Plants**

Big Ideas 1,2,3,4

Connecting to Enduring Understandings-1.A, 1.B, 1.C, 1.D, 2.A, 2.C, 2.D, 2.E, 3.C, 3.D, 3.E, 4.A, 4.C

Reading Chapters:

36-Plant Form (Pages 731-752)

37-Transport in Plants (Pages 756-770)

39-Plant Defense Response (Pages 791-796)

41-Plant Reproduction (Pages 830-837)

Topics:

* Plant evolution – vascular plants, seeds, flowering plants.  Relate to artificial selection of plants for agriculture use … teosente to corn.
* Plant Structure and Growth – Plant organs and tissue.  Plant growth by meristematic tissue.
* Transport of Water (Transpiration - Xylem) and Sugars (Translocation – Phloem) … structure of vascular tissue.
* Plant Nutrition and how it relates to Photosynthesis and Protein Synthesis.
* Plant Reproduction – Asexual and Sexual.
* Plant Hormones
* Plant Responses to light, touch, hormones and flowering.
* The future of horticulture and agronomy to solve our energy needs.

Labs:

Investigation 11-Transpirations

**Unit 6-Ecology**

Big Ideas 1,2,3,4

Connected to Enduring Understandings-1.A, 1.B, 1.C, 2.A, 2.C, 2.D, 2.E, 4.A, 4.B, 4.C

Readings-Chapters:

54-Behavioral Biology (Pages 1133-1154)

55-Ecology of Individuals and Populations (Pages 1162-1174)

56-Community Ecology (Pages 1186-1204)

57-Dynamics of Ecosystems (Pages 1208-1223)

58-The Biosphere (Pages 1230-1253)

59-Conservation Biology (Pages 1256-1278)

Topics:

* Behavior and communication by animals are affected by natural selection and energy flow.
* Genetic diversity and phenotype variation is important to selection and survival. Altruistic behaviors develop through selection.
* Interactions of organisms with the environment…symbiosis, food chains, energy flow and population density.
* Populations and population growth curves/models … abiotic and biotic factors, carrying capacity, competitive exclusion principle, and competition.
* Terrestrial biomes, aquatic biomes (marine and freshwater)
* Biogeochemical cycles and their connection to organic molecules of importance.
* Environmental problems, pollution and conservation … global problems and solutions.

Labs:

Investigation 12 – Fruit Fly Behavior

Investigation 10-Energy Dynamics

**From the College Board:**

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

**Enduring understanding 1.A: Change in the genetic makeup of a population over time is evolution.**

Essential knowledge 1.A.1: Natural selection is a major mechanism of evolution.

Essential knowledge 1.A.2: Natural selection acts on phenotypic variations in populations.

Essential knowledge 1.A.3: Evolutionary change is also driven by random processes.

Essential knowledge 1.A.4: Biological evolution is supported by scientific evidence from many disciplines, including mathematics.

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

Essential knowledge 1.B.1: Organisms share many conserved core processes and features that evolved and are widely distributed among organisms today.

Essential knowledge 1.B.2: Phylogenetic trees and cladograms are graphical representations (models) of evolutionary history that can be tested.

**Enduring understanding 1.C: Life continues to evolve within a changing**

**environment.**

Essential knowledge 1.C.1: Speciation and extinction have occurred throughout the Earth’s history.

Essential knowledge 1.C.2: Speciation may occur when two populations become reproductively isolated from each other.

Essential knowledge 1.C.3: Populations of organisms continue to evolve.

**Enduring understanding 1.D: The origin of living systems is explained**

**by natural processes.**

Essential knowledge 1.D.1: There are several hypotheses about the natural origin of life on Earth, each with supporting scientific evidence.

Essential knowledge 1.D.2: Scientific evidence from many different disciplines supports models of the origin of life.

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

**Enduring understanding 2.A: Growth, reproduction and maintenance of the organization of living systems require free energy and matter.**

Essential knowledge 2.A.1: All living systems require constant input of free energy.

Essential knowledge 2.A.2: Organisms capture and store free energy for use in biological processes.

Essential knowledge 2.A.3: Organisms must exchange matter with the environment to grow, reproduce and maintain organization.

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

Essential knowledge 2.B.1: Cell membranes are selectively permeable due to their structure.

Essential knowledge 2.B.2: Growth and dynamic homeostasis are maintained by the constant movement of molecules across membranes.

Essential knowledge 2.B.3: Eukaryotic cells maintain internal membranes that partition the cell into specialized regions.

**Enduring understanding 2.C:**

**Organisms use feedback mechanisms to regulate growth and reproduction, and to maintain dynamic homeostasis.**

Essential knowledge 2.C.1: Organisms use feedback mechanisms to maintain their internal environments and respond to external environmental changes.

Essential knowledge 2.C.2: Organisms respond to changes in their external environments.

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

Essential knowledge 2.D.1: All biological systems from cells and organisms to populations, communities and ecosystems are affected by complex biotic and abiotic interactions involving exchange of matter and free energy.

Essential knowledge 2.D.2: Homeostatic mechanisms reflect both common ancestry and divergence due to adaptation in different environments.

Essential knowledge 2.D.3: Biological systems are affected by disruptions to their dynamic homeostasis.

Essential knowledge 2.D.4: Plants and animals have a variety

of chemical defenses against infections that affect dynamic

homeostasis.

**Enduring understanding 2.E: Many biological processes involved in**

**growth, reproduction and dynamic homeostasis include temporal**

**regulation and coordination.**

Essential knowledge 2.E.1: Timing and coordination of specific events are necessary for the normal development

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

**Enduring understanding 3.A: Heritable information provides for continuity of life.**

Essential knowledge 3.A.1: DNA, and in some cases RNA, is the primary source of heritable information.

Essential knowledge 3.A.2: In eukaryotes, heritable information is passed to the next generation via processes that include the cell cycle and mitosis or meiosis plus fertilization.

Essential knowledge 3.A.3: The chromosomal basis of inheritance provides an understanding of the pattern of passage (transmission) of genes from parent to offspring.

Essential knowledge 3.A.4: The inheritance pattern of many traits cannot be explained by simple Mendelian genetics.

**Enduring understanding 3.B: Expression of genetic information**

**involves cellular and molecular mechanisms.**

Essential knowledge 3.B.1: Gene regulation results in differential gene expression, leading to cell specialization.

Essential knowledge 3.B.2: A variety of intercellular and intracellular signal transmissions mediate gene expression.

**Enduring understanding 3.C: The processing of genetic information is**

**imperfect and is a source of genetic variation.**

Essential knowledge 3.C.1: Changes in genotype can result in changes in phenotype.

Essential knowledge 3.C.2: Biological systems have multiple processes that increase genetic variation.

Essential knowledge 3.C.3: Viral replication results in genetic variation, and viral infection can introduce genetic variation into the hosts.

**Enduring understanding 3.D: Cells communicate by generating,**

**transmitting and receiving chemical signals.**

Essential knowledge 3.D.1: Cell communication processes share common features that reflect a shared evolutionary history.

Essential knowledge 3.D.2: Cells communicate with each other through direct contact with other cells or from a distance via chemical signaling.

Essential knowledge 3.D.3: Signal transduction pathways link signal reception with cellular response.

Essential knowledge 3.D.4: Changes in signal transduction pathways can alter cellular response.

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

Essential knowledge 3.E.1: Individuals can act on information and communicate it to others.

Essential knowledge 3.E.2: Animals have nervous systems that detect external and internal signals, transmit and integrate information, and produce responses.

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

**Enduring understanding 4.A: Interactions within biological systems**

**lead to complex properties.**

Essential knowledge 4.A.1: The subcomponents of biological molecules and their sequence determine the properties of that molecule.

Essential knowledge 4.A.2: The structure and function of subcellular components, and their interactions, provide essential cellular processes.

Essential knowledge 4.A.3: Interactions between external stimuli and regulated gene expression result in specialization of cells, tissues and organs.

Essential knowledge 4.A.4: Organisms exhibit complex properties due to interactions between their constituent parts.

Essential knowledge 4.A.5: Communities are composed of populations of organisms that interact in complex ways.

Essential knowledge 4.A.6: Interactions among living systems and with their environment result in the movement of matter and energy.

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

Essential knowledge 4.B.1: Interactions between molecules affect their structure and function.

Essential knowledge 4.B.2: Cooperative interactions within organisms promote efficiency in the use of energy and matter.

Essential knowledge 4.B.3: Interactions between and within populations influence patterns of species distribution and abundance.

Essential knowledge 4.B.4: Distribution of local and global ecosystems changes over time.

**Enduring understanding 4.C: Naturally occurring diversity among and**

**between components within biological systems affects interactions with the environment.**

Essential knowledge 4.C.1: Variation in molecular units provides cells with a wider range of functions.

Essential knowledge 4.C.2: Environmental factors influence the expression of the genotype in an organism.

Essential knowledge 4.C.3: The level of variation in a population affects population dynamics.

Essential knowledge 4.C.4: The diversity of species within an ecosystem may influence the stability of the ecosystem.