**AP BIOLOGY COURSE AUDIT/SYLLABUS**

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**PHILOSOPHY**

It has been said that the 21st Century will be known as the age of biology. I have been teaching biological science for 16 years in varying situations Including primarily freshman and sophomore introductory Biology, high school special education integrated science, along with instruction in the physical sciences. The pace of biological discovery has outpaced the ability of textbook companies to keep up and waiting until it makes it into the book will put you behind. So I have tried very hard in the last 10 years to keep up through workshops, and reading professional journals and books. I incorporate these new ideas into my courses so the students can be as dazzled by these discoveries as I am. I want them to understand that we don’t have all the facts yet, that science is a process and the knowledge base changes all the time with new discoveries. Hopefully, they will see that there is still plenty to discover and that each is capable of making their own mark on the scientific world. I am concerned about the public’s general lack of knowledge of evolutionary theory (and the nature of science in general) and I try to incorporate it as an underlying theme in almost everything I teach; I am happy to see it included as one of the Big Ideas. I also want my students to see the value of biology in everyday life and even though they might not grow up to be scientists per se, everyone needs a working knowledge of biology as evidenced by news of global climate change and stem cell research and especially genetics just to name a few examples. Students should also be encouraged to discuss and debate the bioethics of these topics.

**COURSE OVERVIEW**

A.P. Biology is designed to be the equivalent of a typical two semester college introductory biology course, and is organized around 4 Big Ideas. The course follows the guidelines provided by The College Board, Inc. organization that polls 500+ colleges and universities as to their introductory course expectations. The focus of this course is designed to meet these requirements; supporting inquiry labs and other lab activities will be a focus of this course. Some will be performed at Sault high others will be performed at LSSU.

The prerequisites for this course are introductory Biology, and Chemistry. Physics or AP Physics, Honors Chemistry, AP Chemistry/Chem 115 are recommended.

The textbook is the focus of this course and students must study the text independently outside of class.

Time in class is spent on lab and reinforcement activities. Inquiry and argumentation are stressed.

The following 4 Big Ideas will serve as a focus with this course:

1. The process of evolution drives the diversity and unity of life.
2. Biological systems utilize energy and molecular building blocks to grow, reproduce and maintain homeostasis.
3. Living systems retrieve, transmit and respond to information essential to life processes.
4. Biological systems interact, and these interactions possess complex properties.bb

This course aims to provide students with the conceptual framework, factual knowledge, and analytical skills necessary to deal critically with the rapidly changing science of biology. Students are given opportunities to read journal articles on the most current aspects of the science and to conduct lab inquiries of their own design.

The class meets for **50 minutes 5 times per week**

**CURRICULAR MATERIALS**

The main instrument of study is the textbook:

**Biology in Focus - AP Biology Edition - Campbell**

**A book will be issued to each student.**

Chapter details are the student’s responsibility. Very little class time will be devoted to lecture, except as a review before each test.

**ASSESSMENT**

Tests parallel the A.P. exam in format and multiple choice questions are often taken from previous A.P. exams. A free response question is also included before each exam.

In addition to testing, students write a practice essay each week that are taken from previously released AP Biology exams. Most Biology labs require formal lab write-ups which are given high weight. Other assignments such as lab activities, webquests, current journal article summaries, etc. will also be counted for points.

The school grading policy counts each quarter as 40% of the semester grade and the final exam as 20% of the semester grade. Final exams are given both semesters, but AP students are exempt from second semester finals as long as they take the AP Exam.

**LABORATORY**

The lab portion is a fundamental part of the course. 2 AP Inquiry Labs per Big Idea will be performed. Other labs, as specified, will also be performed.Students will submit a formal lab report for each of the AP inquiry labs with hypothesis, materials and methods, results and analysis sections. We will take advantage of our local resources and attend 2 lab sessions at Lake Superior State University.

**AP Biology Big Ideas and Science Practices (http://advancesinap.collegeboard.org/science/biology)**

**AP Biology Big Ideas**

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

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

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

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

**Science Practices for AP Biology**

A practice is a way to coordinate knowledge and skills in order to accomplish a goal or task. The science practices enable students to establish lines of evidence and use them to develop and refine testable explanations and predictions of natural phenomena. These science practices capture important

aspects of the work that scientists engage in, at the level of competence expected of AP Biology students.

**Science Practice 1: The student can use representations and models to communicate scientific phenomena and solve scientific problems.**

**1.1** The student can *create representations and models* of natural or man-made phenomena and systems in the domain.

**1.2** The student can *describe representations and models* of natural or man-made phenomena and systems in the domain.

**1.3** The student can *refine representations and models* of natural or man-made phenomena and systems in the domain.

**1.4** The student can *use representations and models* to analyze situations or solve problems qualitatively and quantitatively.

**1.5** The student can *re-express key elements* of natural phenomena across multiple representations in the domain.

**Science Practice 2: The student can use mathematics appropriately.**

**2.1** The student can *justify the selection of a mathematical routine* to solve problems.

**2.2** The student can *apply mathematical routines* to quantities that describe natural phenomena.

**2.3** The student can *estimate numerically* quantities that describe natural phenomena.

**Science Practice 3: The student can engage in scientific questioning to extend thinking or to guide investigations within the context of the AP course.**

**3.1** The student can *pose scientific questions*.

**3.2** The student can *refine scientific questions*.

**3.3** The student can *evaluate scientific questions*.

**Science Practice 4: The student can plan and implement data collection strategies appropriate to a particular scientific question.**

**4.1** The student can *justify the selection of the kind of data* needed to answer a particular scientific question.

**4.2** The student can *design a plan* for collecting data to answer a particular scientific question.

**4.3** The student can *collect data* to answer a particular scientific question.

**4.4** The student can *evaluate sources of data* to answer a particular scientific question.

**Science Practice 5: The student can perform data analysis and evaluation of evidence.**

**5.1** The student can *analyze data* to identify patterns or relationships.

**5.2** The student can *refine observations and measurements* based on data analysis.

**5.3** The student can *evaluate the evidence provided by data sets* in relation to a particular scientific question

**Science Practice 6: The student can work with scientific explanations and theories.**

**6.1** The student can *justify claims with evidence*.

**6.2** The student can *construct explanations of phenomena based on evidence* produced through scientific practices.

**6.3** The student can *articulate the reasons that scientific explanations and theories are refined or replaced*.

**6.4** The student can *make claims and predictions about natural phenomena* based on scientific theories and models.

**6.5** The student can *evaluate alternative scientific explanations*.

**Science Practice 7: The student is able to connect and relate knowledge across various scales, concepts, and representations in and across domains.**

**7.1** The student can *connect phenomena and models* across spatial and temporal scales.

**7.2** The student can *connect concepts* in and across domain(s) to generalize or extrapolate in and/or across enduring understandings and/or big ideas.

**AP BIOLOGY COMPREHENSIVE SYLLABUS**

**The course has been arranged with a conceptual approach, and are aligned to the Big Ideas and Enduring Understandings.\*** The school year is broken into four 9 week quarters, for a total of 36 weeks. But, with school improvement days, shortened schedules, testing days, etc., this leaves approximately 30 weeks of instructional time. Time spent on each unit is approximate and subject to change with the school schedule.

\*The College Board requires all schools using the designation “AP Biology” to submit a syllabus for approval.

<http://www.collegeboard.com/student/testing/ap/sub_bio.html>

The first chapter and the last 5 chapters encompassing the Ecology unit are done as summer homework. A test over these chapters is given during the first weeks of school. The first **2 weeks** of class are spent doing enrichment activities for these chapters.

Listed Labs and enrichment activities are meant to provide possibilities for learning in each area. Because they are listed does not mean that that activity will be performed, or another substituted depending on available resources.

**1. Organisms and Populations-Part 1**

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

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

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

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

**Essential Questions:**

* How do organisms use free energy to maintain organization, growth, and reproduction?
* How do changes in free energy available to organisms result in changes in population size and disruptions to an ecosystem?
* How are biological systems from cells to organisms to populations, communities, and ecosystems affected by complex biotic and abiotic interactions involving exchange of matter and free energy?
* In what ways do communities interact within their environments that result in the movement of matter and energy?
* In what ways do interactions between and within populations influence patterns of species distribution and amount of local and global ecosystem changes over time?
* How does the diversity of a species within an ecosystem influence the stability of the ecosystem?

Readings:

Chapter 1: Evolution and the foundations of Biology

Chapter 40: Population Ecology and the Distribution of Organisms

Chapter 41: Species interactions

Chapter 42: Ecosystem and Energy

Chapter 43: Global Ecology and Conservation Biology

1. Laboratory Activities

a. **AP Lab 12 – Behavior**

**b. AP Lab 10-Energy Dynamics**

2. . Supplementary activities

a. Dissolved Oxygen Lab

b. Demo: Pasteur’s experiment

**LO 4.11** The student is able to justify the selection of the kind of data needed

to answer scientific questions about the interaction of populations within

communities. [See **SP 1.4, 4.1**]

**LO 4.12** The student is able to apply mathematical routines to quantities that

describe communities composed of populations of organisms that interact in

complex ways. [See **SP 2.2**]

**LO 4.13** The student is able to predict the effects of a change in the community’s

populations on the community. [See **SP 6.4**]

**LO 4.14** The student is able to apply mathematical routines to quantities that

describe interactions among living systems and their environment, which result

in the movement of matter and energy. [See **SP 2.2**]

**LO 4.15** The student is able to use visual representations to analyze situations or

solve problems qualitatively to illustrate how interactions among living systems and

with their environment result in the movement of matter and energy. [See **SP 1.4**]

**LO 4.16** The student is able to predict the effects of a change of matter or energy

availability on communities.[See **SP 6.4**]

**LO 4.17** The student is able to analyze data to identify how molecular

interactions affect structure and function. [See **SP 5.1**]

**LO 4.18** The student is able to use representations and models to analyze how

cooperative interactions within organisms promote efficiency in the use of energy

and matter. [See **SP 1.4**]

**LO 4.19** The student is able to use data analysis to refine observations and

measurements regarding the effect of population interactions on patterns of

species distribution and abundance. [See **SP 5.2**]

**LO 4.20** The student is able to explain how the distribution of ecosystems changes

over time by identifying large-scale events that have resulted in these changes in

the past. [See **SP 6.3**]

**LO 4.21** The student is able to predict consequences of human actions on both

local and global ecosystems. [See **SP 6.4**]

**LO 4.22** The student is able to construct explanations based on evidence of how

variation in molecular units provides cells with a wider range of functions. [See **SP 6.2**]

**LO 4.23** The student is able to construct explanations of the influence of

environmental factors on the phenotype of an organism. [See **SP 6.2**]

**LO 4.24** The student is able to predict the effects of a change in an environmental

factor on the genotypic expression of the phenotype. [See **SP 6.4**]

**LO 4.25** The student is able to use evidence to justify a claim that a variety of

phenotypic responses to a single environmental factor can result from different

genotypes within the population. [See **SP 6.1**]

**LO 4.26** The student is able to use theories and models to make scientific claims

and/or predictions about the effects of variation within populations on survival

and fitness. [See **SP 6.4**]

**LO 4.27** The student is able to make scientific claims and predictions about how

species diversity within an ecosystem influences ecosystem stability. [See **SP 6.4**]

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

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

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

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

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

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

**II. Molecules and Cells**

**Essential Questions:**

* How do molecules and atoms from the environment build new molecules?
* In what ways do DNA and RNA molecules have similarities and differences that define their function?
* In what ways do the sub-components of biological molecules and their sequences determine the properties of those molecules?
* What interactions between molecules affect their structure and function?

**A. The Chemistry of Life**

Readings:

Chapter 2: The Chemical Context of Life

Chapter 3: Carbon and Molecular Diversity

1. Laboratory Activities

a. Polar vs. Non-Polar substances

b. **AP Lab 13: Enzyme Catalysis**

2. Enrichment Activities

a. Toothpickase activity-students model enzyme action

b. Demo: Amylase activity on starch agar: students “draw” on starch agar with swab wetted with saliva

c. Amino Acid starter kit; Protein Folding-model primary, secondary and tertiary structure using “toobers” (3D Molecular Designs) following the rules of chemistry

d. Molecular visualization-using JMol to model protein structure on the computer

**LO 4.1** The student is able to explain the connection between the sequence and

the subcomponents of a biological polymer and its properties. [See **SP 7.1**]

**LO 4.2** The student is able to refine representations and models to explain how

the subcomponents of a biological polymer and their sequence determine the

properties of that polymer. [See **SP 1.3**]

**LO 4.3** The student is able to use models to predict and justify that changes in the

subcomponents of a biological polymer affect the functionality of the molecule.

[See **SP 6.1, 6.4**]

**B. Exchanging Materials with the Environment**

**Essential Questions**

* How do surface-area-to-volume ratios affect the ability of biological systems to obtain necessary resources or eliminate waste products?
* How is growth and dynamic homeostasis maintained by the constant movement of molecules across membranes?
* In what ways do eukaryotic cells’ internal membranes and organelles contribute to cell functions?
* How do cells communicate, transmit, and receive chemical signals, and how does signal transmission within and between cells mediate gene expression and cell function?

Readings:

Chapter 4: A tour of the cell

Chapter 5 Membrane Transport and Cell signaling.

1. Laboratory Activities

a. **AP Lab 4 - Osmosis and Diffusion/Inquiry**

i. Osmosis and Confusion-students fill dialysis bags with solutions of their choice and place them in different solutions to predict which way water will move

b. Surface Area/Volume ratio:Cell size lab with agar blocks

c. Quorum Sensing in Bacteria

d. Modeling the Cell Membrane-3D Molecular designs kit for modeling the cell membrane-chemistry and different types of membrane proteins

e. read about Miller-Urey experiment and Oparin’s hypothesis, graph data about composition of atmosphere of earth and how it’s changed over time

**LO 4.4** The student is able to make a prediction about the interactions of subcellular organelles. [See **SP 6.4**]

**LO 4.5** The student is able to construct explanations based on scientific evidence as to

how interactions of subcellular structures provide essential functions. [See **SP 6.2**]

**LO 4.6** The student is able to use representations and models to analyze situations

qualitatively to describe how interactions of subcellular structures, which possess

specialized functions, provide essential functions. [See **SP 1.4**]

**LO 4.7** The student is able to refine representations to illustrate how interactions

between external stimuli and gene expression result in specialization of cells,

tissues and organs. [See **SP 1.3**]

**LO 4.8** The student is able to evaluate scientific questions concerning organisms

that exhibit complex properties due to the interaction of their constituent parts.

[See **SP 3.3**]

**LO 4.9** The student is able to predict the effects of a change in a component(s) of

a biological system on the functionality of an organism(s). [See **SP 6.4**]

**LO 4.10** The student is able to refine representations and models to illustrate

biocomplexity due to interactions of the constituent parts.[See **SP 1.3**]

**LO 3.31** The student is able to describe basic chemical processes for cell

communication shared across evolutionary lines of descent. [See **SP 7.2**]

**LO 3.32** The student is able to generate scientific questions involving cell

communication as it relates to the process of evolution. [See **SP 3.1**]

**LO 3.33** The student is able to use representation(s) and appropriate models to

describe features of a cell signaling pathway. [See **SP 1.4**]

**LO 3.34** The student is able to construct explanations of cell communication

through cell-to-cell direct contact or through chemical signaling. [See **SP 6.2**]

**LO 3.35** The student is able to create representation(s) that depict how cell-to-cell

communication occurs by direct contact or from a distance through chemical signaling. [See **SP 1.1**]

**LO 3.36** The student is able to describe a model that expresses the key elements of

signal transduction pathways by which a signal is converted to a cellular response.

[See **SP 1.5**]

**LO 3.37** The student is able to justify claims based on scientific evidence that

changes in signal transduction pathways can alter cellular response. [See **SP 6.1**]

**LO 3.38** The student is able to describe a model that expresses key elements to

show how change in signal transduction can alter cellular response. [See **SP 1.5**]

**LO 3.39** The student is able to construct an explanation of how certain drugs affect

signal reception and, consequently, signal transduction pathways. [See **SP 6.2**]

**LO 1.27** The student is able to describe a scientific hypothesis about the origin of

life on Earth. [See **SP 1.2**]

**LO 1.28** The student is able to evaluate scientific questions based on hypotheses

about the origin of life on Earth. [See **SP 3.3**]

**LO 1.29** The student is able to describe the reasons for revisions of scientific

hypotheses of the origin of life on Earth. [See **SP 6.3**]

**LO 1.30** The student is able to evaluate scientific hypotheses about the origin of

life on Earth. [See **SP 6.5**]

**LO 1.31** The student is able to evaluate the accuracy and legitimacy of data to answer scientific questions about the origin of life on Earth. [See **SP 4.4**]

**LO 1.32** The student is able to justify the selection of geological, physical, and

chemical data that reveal early Earth conditions. [See **SP 4.1**]

**C. Metabolism**

**Essential Questions:**

* In what ways do all living systems require a constant input of free energy?
* How do organisms capture and store free energy for use in biological processes?
* How do interactions between molecules affect their structure and function?

**Energy Transformation**

Readings:

Chapter 6: An Introduction to Metabolism

Chapter 7: Cell Respiration and Fermentation

Chapter 8: Photosynthesis

Chapter 33 Animal Nutrition

1. . Laboratory Activities

a. **AP Lab 6 - Cell Respiration in Germinating Peas (or Sugar Metabolism in Yeast)**

b. **AP Lab 5 - Plant Pigments and Photosynthesis (Floating Disk Assay)**

c. Yeast Fermentation-students test the ability of yeast to break down various sugars, and add lactase drops to lactose to break down disaccharides into glucose, studying enzyme action

**LO 2.1** The student is able to explain how biological systems use free energy

based on empirical data that all organisms require constant energy input to

maintain organization, to grow and to reproduce. [See **SP 6.2**]

**LO 2.2** The student is able to justify a scientific claim that free energy is required

for living systems to maintain organization, to grow or to reproduce, but that

multiple strategies exist in different living systems. [See **SP 6.1**]

**LO 2.3** The student is able to predict how changes in free energy availability affect

organisms, populations and ecosystems. [See **SP 6.4**]

**LO 2.4** The student is able to use representations to pose scientific questions

about what mechanisms and structural features allow organisms to capture, store

and use free energy. [See **SP 1.4, 3.1**]

**LO 2.5** The student is able to construct explanations of the mechanisms and

structural features of cells that allow organisms to capture, store or use free energy.

[See **SP 6.2**]

**LO 2.6** The student is able to use calculated surface area-to-volume ratios to predict

which cell(s) might eliminate wastes or procure nutrients faster by diffusion.[See **SP 2.2**]

**LO 2.7** Students will be able to explain how cell size and shape affect the overall

rate of nutrient intake and the rate of waste elimination. [See **SP 6.2**]

**LO 2.8** The student is able to justify the selection of data regarding the types of

molecules that an animal, plant or bacterium will take up as necessary building

blocks and excrete as waste products. [See **SP 4.1**]

**LO 2.9** The student is able to represent graphically or model quantitatively

the exchange of molecules between an organism and its environment, and the

subsequent use of these molecules to build new molecules that facilitate dynamic

homeostasis, growth and reproduction. [See **SP 1.1, 1.4**]

**LO 2.10** The student is able to use representations and models to pose scientific

questions about the properties of cell membranes and selective permeability

based on molecular structure. [See **SP 1.4, 3.1**]

**LO 2.11** The student is able to construct models that connect the movement

of molecules across membranes with membrane structure and function.

[See **SP 1.1, 7.1, 7.2**]

**LO 2.12** The student is able to use representations and models to analyze

situations or solve problems qualitatively and quantitatively to investigate

whether dynamic homeostasis is maintained by the active movement of

molecules across membranes. [See **SP 1.4**]

**LO 2.15** The student can justify a claim made about the effect(s) on a biological

system at the molecular, physiological or organismal level when given a scenario

in which one or more components within a negative regulatory system is altered.

[See **SP 6.1**]

**LO 2.16** The student is able to connect how organisms use negative feedback to

maintain their internal environments. [See **SP 7.2**]

**LO 2.17** The student is able to evaluate data that show the effect(s) of changes in

concentrations of key molecules on negative feedback mechanisms. [See **SP 5.3**]

**LO 2.18** The student can make predictions about how organisms use negative

feedback mechanisms to maintain their internal environments. [See **SP 6.4**]

**LO 2.19** The student is able to make predictions about how positive feedback

mechanisms amplify activities and processes in organisms based on scientific

theories and models. [See **SP 6.4**]

**LO 2.20** The student is able to justify that positive feedback mechanisms amplify

responses in organisms. [See **SP 6.1**]

**LO 2.21** The student is able to justify the selection of the kind of data needed to

answer scientific questions about the relevant mechanism that organisms use to

respond to changes in their external environment. [See **SP 4.1**]

**LO 2.22** The student is able to refine scientific models and questions about the

effect of complex biotic and abiotic interactions on all biological systems, from cells

and organisms to populations, communities and ecosystems. [See **SP 1.3, 3.2**]

**LO 2.23** The student is able to design a plan for collecting data to show that all

biological systems (cells, organisms, populations, communities and ecosystems)

are affected by complex biotic and abiotic interactions. [See **SP 4.2, 7.2**]

**LO 2.24** The student is able to analyze data to identify possible patterns and

relationships between a biotic or abiotic factor and a biological system (cells,

organisms, populations, communities or ecosystems). [See **SP 5.1**]

**LO 2.34** The student is able to describe the role of programmed cell death in

development and differentiation, the reuse of molecules, and the maintenance of

dynamic homeostasis. [See **SP 7.1**]

**LO 2.35** The student is able to design a plan for collecting data to support the

scientific claim that the timing and coordination of physiological events involve

regulation. [See **SP 4.2**]

**LO 2.36** The student is able to justify scientific claims with evidence to show how

timing and coordination of physiological events involve regulation. [See **SP 6.1**]

**LO 2.37** The student is able to connect concepts that describe mechanisms that

regulate the timing and coordination of physiological events. [See **SP 7.2**]

**LO 2.38** The student is able to analyze data to support the claim that responses to

information and communication of information affect natural selection. [See **SP 5.1**]

**LO 2.39** The student is able to justify scientific claims, using evidence, to describe

how timing and coordination of behavioral events in organisms are regulated by

several mechanisms. [See **SP 6.1**]

**LO 2.40** The student is able to connect concepts in and across domain(s) to predict

how environmental factors affect responses to information and change behavior.

[See **SP 7.2**]

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

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

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

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

**Enduring understanding 3.D**: Cells communicate by generating, transmitting and receiving chemical signals.

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

**Essential Questions:**

* How is heritable information passed to the next generation in eukaryotes, and how do changes in genotype result in changes in phenotype of an organism?
* In what ways does the chromosomal basis of inheritance provide an understanding of the patterns of transmission of genes from parent to offspring, and how are inheritance patterns of many traits explained other than through simple Mendelian genetics?
* What multiple processes increase genetic variation in biological systems, and how do environmental factors influence the expression of the genotype in an organism?
* In what ways does the diversity of a species within an ecosystem influence the stability of the ecosystem?
* How is DNA, and in some cases RNA, the primary source of heritable information?
* How does gene regulation result in differential gene expression, leading to cell specialization?
* In what ways do a variety of intercellular and intracellular signal transmissions mediate gene expression?
* How does viral replication result in genetic variation, and how can viral infection introduce genetic variation into the hosts?
* How do interactions between external stimuli and regulated gene expression result in specialization of cells, tissues, and organs?

**A. Heredity**

Readings:

Chapter 9: The Cell Cycle

Chapter 10: Meiosis and Sexual Life Cycles

Chapter 11: Mendel and the Gene Idea

Chapter 12: THe Chromosomal Basis of Inheritance

Chapter 14: Gene Expression-From Gene to Protein

Chapter 15: Regulation of Gene expression

supplement with (development, stem cells, and cancer)

1. Laboratory Activities

a. **AP Lab 7 – A. Mitosis-Growth of Onion Roots in Various Concentrations of Caffeine**

b. **AP Lab 7 -Chi Square Analysis of Root Tip Growth**

2. Enrichment Activities

a. Cancer genetics-students access a website tutorial about current knowledge of cancer and the role of cell signaling on cancer and the cell cycle

b. Yeast genetics-mating of a and α yeast haplotypes to demonstrate cell signaling and meiosis in the yeast life cycle

c. The Genetics of Eye Color in Fruit Flies-paper chromatography of eye pigments to follow a biosynthetic pathway and link it to phenotype

d. Genetics of Organisms-mating of *Drosophila melanogaster*-students choose strains of fruit flies to mate and determine the inheritance of the traits

e. M & M Statistics: A Chi Square Analysis

g. Bioinformatics of Insulin-students find the exons of a gene embedded within amino acid sequence in six reading frames, then build the tertiary structure of the molecule using “toobers”

h. Videos: “Life Story”, “Secret of Photo 51”

**B. Reproduction and Development**

Readings:

Chapter 30: Plant Reproduction

Chapter 36 Animal Reproduction and Development

1. . Laboratory Activities

a. Zebrafish embryology-mating of zebrafish and observation of early embryogenesis

b. Conjugation in Bacteria

**C. Molecular Genetics**

Readins:

Chapter 16: Develpment, stem cells, cancer

Chapter 17: Viruses

Chapter 18: Genomes and their evolution

1. Laboratory Activities

a. **AP Lab 8 - Molecular Biology**

b. Transformation-BioRad pGlo Transformation with Inquiry extension.

c. DNA extraction and PCR for ALU

d. Electrophoresis of ALU PCR product

2. Enrichment Activities

a. Restriction enzyme simulation, restriction mapping

b. Recombinant DNA Modeling-Paper Plasmid Lab

c. Restriction Analysis simulation

**LO 3.1** The student is able to construct scientific explanations that use the structures

and mechanisms of DNA and RNA to support the claim that DNA and, in some

cases, that RNA are the primary sources of heritable information. [See **SP 6.5**]

**LO 3.2** The student is able to justify the selection of data from historical investigations

that support the claim that DNA is the source of heritable information. [See **SP 4.1**]

**LO 3.3** The student is able to describe representations and models that illustrate

how genetic information is copied for transmission between generations.

[See **SP 1.2**]

**LO 3.4** The student is able to describe representations and models illustrating

how genetic information is translated into polypeptides. [See **SP 1.2**]

**LO 3.5** The student can justify the claim that humans can manipulate heritable

information by identifying *at least two* commonly used technologies. [See **SP 6.4**]

**LO 3.6** The student can predict how a change in a specific DNA or RNA sequence

can result in changes in gene expression. [See **SP 6.4**]

**LO 3.7** The student can make predictions about natural phenomena occurring

during the cell cycle. [See **SP 6.4**]

**LO 3.8** The student can describe the events that occur in the cell cycle. [See **SP 1.2**]

**LO 3.9** The student is able to construct an explanation, using visual representations

or narratives, as to how DNA in chromosomes is transmitted to the next

generation via mitosis, or meiosis followed by fertilization. [See **SP 6.2**]

**LO 3.10** The student is able to represent the connection between meiosis and

increased genetic diversity necessary for evolution. [See **SP 7.1**]

**LO 3.11** The student is able to evaluate evidence provided by data sets to support

the claim that heritable information is passed from one generation to another

generation through mitosis, or meiosis followed by fertilization. [See **SP 5.3**]

**LO 3.15** The student is able to explain deviations from Mendel’s model of the

inheritance of traits. [See **SP 6.5**]

**LO 3.16** The student is able to explain how the inheritance patterns of many traits

cannot be accounted for by Mendelian genetics. [See **SP 6.3**]

**LO 3.17** The student is able to describe representations of an appropriate example

of inheritance patterns that cannot be explained by Mendel’s model of the

inheritance of traits. [See **SP 1.2**]

**LO 3.18** The student is able to describe the connection between the regulation of

gene expression and observed differences between different kinds of organisms.

[See **SP 7.1**]

**LO 3.19** The student is able to describe the connection between the regulation of gene

expression and observed differences between individuals in a population.

[See **SP 7.1**]

**LO 3.20** The student is able to explain how the regulation of gene expression is

essential for the processes and structures that support efficient cell function.

[See **SP 6.2**]

**LO 3.21** The student can use representations to describe how gene regulation

influences cell products and function. [See **SP 1.4**]

**LO 3.22** The student is able to explain how signal pathways mediate gene

expression, including how this process can affect protein production. [See **SP 6.2**]

**LO 3.23** The student can use representations to describe mechanisms of the

regulation of gene expression. [See **SP 1.4**]

**LO 3.24** The student is able to predict how a change in genotype, when expressed as a phenotype, provides a variation that can be subject to natural selection. [See **SP 6.4, 7.2**]

**LO 3.25** The student can create a visual representation to illustrate how changes in a DNA nucleotide sequence can result in a change in the polypeptide produced. [See **SP 1.1**]

**LO 3.26** The student is able to explain the connection between genetic variations in organisms and phenotypic variations in populations. [See **SP 7.2**]

**LO 3.27** The student is able to compare and contrast processes by which genetic

variation is produced and maintained in organisms from multiple domains.

[See **SP 7.2**]

**LO 3.28** The student is able to construct an explanation of the multiple processes

that increase variation within a population. [See **SP 6.2**]

**Big Idea I:** 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

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

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

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

**A. Evolution**

Readings:

Chapter 19: Descent with Modification

Chapter 20: Phylogeny

Chapter 21 The evolution of Populations

Chapter 22: The origin of Species

Chapter 23: Broad Patterns of Evolution

1. Laboratory Activities

a. **AP Lab 2 - Hardy-Weinberg Lab-** ALU Electrophoresis/PCR-students amplify a region of their own DNA to identify the presence or absence of an ALU element, use Hardy-Weinberg to see if our populationis in equilibrium, and compare our frequencies to the world population.

b. **AP lab 3**: Comparative Genomics-Bioinformatics-a comparison of Cytochrome C gene of various members of each domain using Biology Workbench Drawgram tool

2. . Enrichment Activities

a. Phylogenetic analysis of Whale Evolution -ie BLAST lab

b. Gene Regulation /Evolution in Stickleback Fish-HHMI

c. Classification of the Animalia (“Dead Things in Jars”)

d. Tree Thinking-build their own phylogenetic tree of animals

**LO 1.1** The student is able to convert a data set from a table of numbers that

reflect a change in the genetic makeup of a population over time and to apply

mathematical methods and conceptual understandings to investigate the cause(s)

and effect(s) of this change. [See **SP 1.5, 2.2**]

**LO 1.2** The student is able to evaluate evidence provided by data to qualitatively and

quantitatively investigate the role of natural selection in evolution. [See **SP 2.2, 5.3**]

**LO 1.3** The student is able to apply mathematical methods to data from a real or

simulated population to predict what will happen to the population in the future.

[See **SP 2.2**]

**LO 1.4** The student is able to evaluate data-based evidence that describes

evolutionary changes in the genetic makeup of a population over time. [See **SP 5.3**]

**LO 1.5** The student is able to connect evolutionary changes in a population over

time to a change in the environment.[See **SP 7.1**]

**LO 1.6** The student is able to use data from mathematical models based on the

Hardy-Weinberg equilibrium to analyze genetic drift and effects of selection in

the evolution of specific populations. [See **SP 1.4, 2.1**]

**LO 1.7** The student is able to justify data from mathematical models based on the

Hardy-Weinberg equilibrium to analyze genetic drift and the effects of selection

in the evolution of specific populations. [See **SP 2.1**]

**LO 1.8** The student is able to make predictions about the effects of genetic drift,

migration and artificial selection on the genetic makeup of a population. [See **SP 6.4**]

**LO 1.9** The student is able to evaluate evidence provided by data from many

scientific disciplines that support biological evolution. [See **SP 5.3**]

**LO 1.10** The student is able to refine evidence based on data from many scientific

disciplines that support biological evolution. [See **SP 5.2**]

**LO 1.11** The student is able to design a plan to answer scientific questions

regarding how organisms have changed over time using information from

morphology, biochemistry and geology. [See **SP 4.2**]

**LO 1.12** The student is able to connect scientific evidence from many scientific

disciplines to support the modern concept of evolution. [See **SP 7.1**]

**LO 1.13** The student is able to construct and/or justify mathematical models,

diagrams or simulations that represent processes of biological evolution. [See **SP 1.1, 2.1**]

**LO 1.14** The student is able to pose scientific questions that correctly identify

essential properties of shared, core life processes that provide insights into the

history of life on Earth. [See **SP 3.1**]

**LO 1.15** The student is able to describe specific examples of conserved core

biological processes and features shared by all domains or within one domain

of life, and how these shared, conserved core processes and features support the

concept of common ancestry for all organisms. [See **SP 7.2**]

**LO 1.16** The student is able to justify the scientific claim that organisms share

many conserved core processes and features that evolved and are widely

distributed among organisms today. [See **SP 6.1**]

**LO 1.17** The student is able to pose scientific questions about a group of

organisms whose relatedness is described by a phylogenetic tree or cladogram

in order to (1) identify shared characteristics, (2) make inferences about the

evolutionary history of the group, and (3) identify character data that could

extend or improve the phylogenetic tree. [See **SP 3.1**]

**LO 1.18** The student is able to evaluate evidence provided by a data set in

conjunction with a phylogenetic tree or a simple cladogram to determine

evolutionary history and speciation. [See **SP 5.3**]

**LO 1.19** The student is able create a phylogenetic tree or simple cladogram that

correctly represents evolutionary history and speciation from a provided data set.

[See **SP 1.1**]

**LO 1.20** The student is able to analyze data related to questions of speciation and

extinction throughout the Earth’s history. [See **SP 5.1**]

**LO 1.21** The student is able to design a plan for collecting data to investigate

the scientific claim that speciation and extinction have occurred throughout the

Earth’s history. [See **SP 4.2**]

**LO 1.20** The student is able to analyze data related to questions of speciation and

extinction throughout the Earth’s history. [See **SP 5.1**]

**LO 1.21** The student is able to design a plan for collecting data to investigate

the scientific claim that speciation and extinction have occurred throughout the

Earth’s history. [See **SP 4.2**]

**LO 1.22** The student is able to use data from a real or simulated population(s),

based on graphs or models of types of selection, to predict what will happen to

the population in the future. [See **SP 6.4**]

**LO 1.23** The student is able to justify the selection of data that address questions

related to reproductive isolation and speciation. [See **SP 4.1**]

**LO 1.24** The student is able to describe speciation in an isolated population and

connect it to change in gene frequency, change in environment, natural selection

and/or genetic drift. [See **SP 7.2**]

**LO 1.25** The student is able to describe a model that represents evolution within

a population. [See **SP 1.2**]

**LO 1.26** The student is able to evaluate given data sets that illustrate evolution as

an ongoing process. [See **SP 5.3**]

**III. Organisms and Populations-Part 2**

**Essential Questions:**

* In what ways are timing and coordination of specific events necessary for the normal development of an organism, and how are these events regulated?
* In what ways are timing and coordination of behavior regulated by various mechanisms, and how are they important in natural selection?
* How do organisms use feedback mechanisms to regulate growth and reproduction, and maintain dynamic homeostasis?
* What types of chemical defenses do plants and animals have against infections that affect their homeostasis?
* In what ways do the nervous systems of animals detect external and internal signals, transmit and integrate information, and produce responses?

**A. Transporting Substances, Response**

Readings:

Various Readings selected from Unit 5 Plant Form and Function

Various Readings from unit 6 Animal Form and Function, along with Viruses

1. Laboratory activities

a. **AP Lab 11 – Transpiration in Plants**

b**.** Physiology of the Circulatory System

**B. Responding to the Environment**

Readings:

Neurons Synapses and Signaling

Nervous and Sensory Systems

The Immune System

1. Enrichment Activities

a. Disease Detectives-students use phenolphthalein in water to show the spread of a disease through “bodily fluids”

b. Bioinformatics-Evolution of AIDS-comparison of HIV-1 and HIV-2 to various SIV’s to determine their evolutionary origin

c. Fetal Pig dissection

**LO 2.25** The student can construct explanations based on scientific evidence

that homeostatic mechanisms reflect continuity due to common ancestry and/or

divergence due to adaptation in different environments. [See **SP 6.2**]

**LO 2.26** The student is able to analyze data to identify phylogenetic patterns or

relationships, showing that homeostatic mechanisms reflect both continuity due

to common ancestry and change due to evolution in different environments.

[See **SP 5.1**]

**LO 2.27** The student is able to connect differences in the environment with the

evolution of homeostatic mechanisms. [See **SP 7.1**]

**LO 2.28** The student is able to use representations or models to analyze

quantitatively and qualitatively the effects of disruptions to dynamic homeostasis

in biological systems. [See **SP 1.4**]

**LO 2.29** The student can create representations and models to describe immune

responses. [See **SP 1.1, 1.2**]

**LO 2.30** The student can create representations or models to describe nonspecific

immune defenses in plants and animals.[See **SP 1.1, 1.2**]

**LO 2.31** The student can connect concepts in and across domains to show that

timing and coordination of specific events are necessary for normal development

in an organism and that these events are regulated by multiple mechanisms.

[See **SP 7.2**]

**LO 2.32** The student is able to use a graph or diagram to analyze situations or solve

problems (quantitatively or qualitatively) that involve timing and coordination of

events necessary for normal development in an organism. [See **SP 1.4**]

**LO 2.33** The student is able to justify scientific claims with scientific evidence

to show that timing and coordination of several events are necessary for normal

development in an organism and that these events are regulated by multiple

mechanisms. [See **SP 6.1**]

**LO 3.29** The student is able to construct an explanation of how viruses introduce

genetic variation in host organisms. [See **SP 6.2**]

**LO 3.30** The student is able to use representations and appropriate models to

describe how viral replication introduces genetic variation in the viral population.

[See **SP 1.4**]

**LO 3.40** The student is able to analyze data that indicate how organisms exchange

information in response to internal changes and external cues, and which can

change behavior. [See **SP 5.1**]

**LO 3.41** The student is able to create a representation that describes how

organisms exchange information in response to internal changes and external

cues, and which can result in changes in behavior. [See **SP 1.1**]

**LO 3.42** The student is able to describe how organisms exchange information in

response to internal changes or environmental cues. [See **SP 7.1**]

**LO 3.43** The student is able to construct an explanation, based on scientific theories

and models, about how nervous systems detect external and internal signals,

transmit and integrate information, and produce responses. [See **SP 6.2, 7.1**]

**LO 3.44** The student is able to describe how nervous systems detect external and

internal signals. [See **SP 1.2**]

**LO 3.45** The student is able to describe how nervous systems transmit information.

[See **SP 1.2**]

**LO 3.46** The student is able to describe how the vertebrate brain integrates

information to produce a response. [See **SP 1.2**]

**LO 3.47** The student is able to create a visual representation of complex nervous

systems to describe/explain how these systems detect external and internal

signals, transmit and integrate information, and produce responses. [See **SP 1.1**]

**LO 3.48** The student is able to create a visual representation to describe how

nervous systems detect external and internal signals. [See **SP 1.1**]

**LO 3.49** The student is able to create a visual representation to describe how

nervous systems transmit information. [See **SP 1.1**]

**LO 3.50** The student is able to create a visual representation to describe how the

vertebrate brain integrates information to produce a response. [See **SP 1.1**]

**IV. Exam Review (2-3 weeks)**

a. Review Chapter Summaries and Study Guides

b. Review PowerPoint lectures

c. Review AP Lab Objectives

d. Take AP practice tests

e. Develop standards for sample essays

f. Review Special Topics