

**Course Name : AP Biology**

**Course Overview**

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**Course Materials/Resources/Technology**

“Principles of Life”, 3rd ed.  
Boundless digital textbook  
Chromebook/Canvas website

**UNIT 1: Chemistry of Life**

**Duration of Unit: 3 Weeks (15 days)**

**Description of Unit:** *We will compare and contrast the four basic classes of biological macromolecules, considering their structure and function, and end with a more focused look at DNA and RNA.*

**Essential Questions and/or Enduring Understandings:**

How do atoms bond together to form compounds?

What unique properties of water help it to support life on Earth?

What are the four major biological compounds and how do they differ in structure?

Describe how a protein’s structure affects its function (use enzymes as an example).

What is “denaturation”?

Use a model to show an enzyme functioning properly, then one that is inhibited.

What factors increase or decrease an enzyme’s effectiveness?

## **Academic Vocabulary:**

Electron

Bond

Atom

Molecule

Compound

Dehydration synthesis

Monomer

Polymer

Polar

Non-polar

Hydrophilic

Hydrophobic

Carbohydrate

Lipid

Protein

Nucleic acid

Amino acid

Nucleotide

Phosphate

Deoxyribose/ribose

Nitrogenous base

Enzyme

Substrate

Product(s)

Active site

Allosteric site

Inhibitor

Co-factor/coenzyme  
Denaturation

**Materials/Resources/Technology:**

**Biological Enzymes**  
**Data collection equipment (student-inquiry lab)**  
**Boundless online textbook**

<b>ESSENTIAL Standards</b>	<b>Learning Targets</b>
1.A: Describe biological concepts and/or processes.	<b>Demonstrate proficiency through completion of the following assignments:</b>  Biological Molecules - Multiple Features Map  Test One
1.B: Explain biological concepts and/or processes.	Biological Molecules modeling  Test One
2.A: Describe characteristics of a biological concept, process, or model represented visually.	Transcription and Translation Diagrams  Test One
3.B: State the null and alternative hypotheses,	Activity of Catalase - Enzyme Lab  Test One

or predict the results of an experiment.	
4.A: Construct a graph, plot, or chart.	Activity of Catalase - Enzyme Lab Test One
4.B: Describe data from a table or graph.	Activity of Catalase - Enzyme Lab Test One
5.A: Perform mathematical calculations.	Activity of Catalase - Enzyme Lab Test One
6.D: Explain the relationship between experimental results and larger biological concepts, processes, or theories.	Activity of Catalase - Enzyme Lab Test One
<b>NICE TO KNOW Standards</b>	<b>Learning Targets</b>
<b>Other AP Biology “<a href="#">Skills and Standards</a>”</b>	<b>Proficiency as demonstrated with the relevant assignment(s)</b>

<b>Common Formative and Summative Assessments</b>	
<ul style="list-style-type: none"><li>• N/A - currently only one section/one teacher</li></ul>	



<b>UNIT 2: Cell Structure and Function</b>	
<b>Duration of Unit: 5 weeks</b>	
<b>Description of Unit:</b> <i>We will review the functions of the smaller components that make up cells, explore different models of understanding those functions, and perform research about how cell size affects normal and abnormal cellular function. Finally, we will discuss the major competing scientific theories about the origin of cellular life.</i>	
<b>Essential Questions and/or Enduring Understandings:</b> What molecules make up the cell membrane? How does the cell membrane selectively allow materials in and out of the cell? How do the various cell organelles work together to perform cellular functions? Give examples. Calculate surface area:volume ratio. What is “efficiency”, and what makes a cell more efficient? (size/shape) Calculate water potential and predict direction of osmosis. How do cells differ between domains? How are they alike? How do animal and plant cells differ? How are they alike? What are the two main scientific theories of the formation of life on Earth?	
<b>Academic Vocabulary:</b>	

Biological membrane  
Phospholipid bilayer  
Semipermeable  
Organelle  
Mitochondria  
Ribosome  
Nucleus  
Nucleolus  
Endoplasmic reticulum  
Golgi apparatus  
Vesicle  
Cytoskeleton  
Vacuole  
Lysosome  
Diffusion  
Osmosis  
Passive transport  
Active transport  
Water potential  
Pressure potential  
Solute potential  
Ionization constant  
Prokaryote  
Eukaryote

**Materials/Resources/Technology:**

**Microscopes**

**Data collection equipment (student-inquiry lab)**

**Boundless online textbook**

ESSENTIAL Standards	Learning Targets
1.A: Describe biological concepts and/or processes.	<p align="center"><b>Demonstrate proficiency through completion of the following assignments:</b></p> <p align="center">Organelle Structure and Function - Literacy Tools</p> <p align="center">Passive Transport - Comprehension Models</p> <p align="center">Quiz - Cellular Structure and Function</p> <p align="center">Test Two</p>
1.B: Explain biological concepts and/or processes.	<p align="center">Organelle Structure and Function - Literacy Tools</p> <p align="center">Passive Transport - Comprehension Models</p> <p align="center">Quiz - Cellular Structure and Function</p> <p align="center">Test Two</p>
2.B Explain relationships between different characteristics of biological concepts, processes, or models represented visually	<p align="center">Passive Transport - Comprehension Models</p> <p align="center">Test Two</p>
2.D Represent relationships within biological models,	<p align="center">Passive Transport - Comprehension Models</p> <p align="center">Water Potential - Inquiry Lab</p> <p align="center">Test Two</p>

including mathematical models.	
3.A Identify or pose a testable question based on an observation, data, or a model.	<p style="text-align: center;">Water Potential - Inquiry Lab</p> <p style="text-align: center;">Test Two</p>
<p>3.E Propose a new/next investigation based on</p> <p style="padding-left: 40px;">a. An evaluation of the evidence from an experiment.</p> <p style="padding-left: 40px;">b. An evaluation of the design/methods.</p>	<p style="text-align: center;">Water Potential - Inquiry Lab</p> <p style="text-align: center;">Test Two</p>
5.B Use confidence intervals and/ or error bars to determine whether sample means are statistically different.	<p style="text-align: center;">Quiz - Cellular Structure and Function</p> <p style="text-align: center;">Water Potential - Inquiry Lab</p> <p style="text-align: center;">Test Two</p>
5.D Use data to evaluate a hypothesis (rejecting	<p style="text-align: center;">Water Potential - Inquiry Lab</p> <p style="text-align: center;">Test Two</p>



or failing to reject the null hypothesis).	
6.A Make a scientific claim.	Water Potential - Inquiry Lab Test Two
<b>NICE TO KNOW Standards</b>	<b>Learning Targets</b>
<b>Other AP Biology “<a href="#">Skills and Standards</a>”</b>	<b>Proficiency as demonstrated with the relevant assignment(s)</b>
<b>Common Formative and Summative Assessments</b>	
<ul style="list-style-type: none"> <li>• N/A - currently only one section/one teacher</li> </ul>	

### Unit 3: Energy

**Duration of Unit: 4 weeks**

**Description of Unit:** *We will cover the basics of metabolism and cellular energetics in order to show similarities and differences in the pathways and the uses for energy that various organisms have.*

**Essential Questions and/or Enduring Understandings:**

How do the Laws of Thermodynamics relate to living systems?

How does ATP demonstrate relationships among living things?

Write a verbal description of the photosynthesis equation.

Write a verbal description of the cellular respiration equation.

Compare fermentation and chemosynthesis to both photosynthesis and cellular respiration.

How (from where) do different organisms obtain their energy?

What cellular reactions use energy?

What cellular reactions release energy?

Give several specific examples of using energy to maintain homeostasis within a cell and/or organism.

**Academic Vocabulary:**

Thermodynamics

Energy

Potential energy

Kinetic energy

Endergonic reactions

Exergonic reactions

Coupled reactions

ATP

Entropy

Enthalpy

Gibbs free energy

Metabolism

Catabolic reactions

Anabolic reactions

Cellular respiration

Photosynthesis

Fermentation  
 Chemosynthesis  
 Homeostasis  
 Thermoregulation  
 Ectotherm  
 Endotherm

**Materials/Resources/Technology:**

**Data collection equipment (student-inquiry lab)**  
**Boundless online textbook**

<b>ESSENTIAL Standards</b>	<b>Learning Targets</b>
1.A: Describe biological concepts and/or processes.	<p align="center"><b>Demonstrate proficiency through completion of the following assignments:</b></p> <p align="center">Boundless Ch. 8 - Reading Guide</p> <p align="center">Quiz - Energy</p> <p align="center">Test Three</p>
1.B: Explain biological concepts and/or processes.	<p align="center">Boundless Ch. 8 - Reading Guide</p> <p align="center">Quiz - Energy</p> <p align="center">Test Three</p>
2.B Explain relationships between different characteristics of biological concepts,	<p align="center">Free Energy - graphing exercises</p> <p align="center">Quiz - Energy</p> <p align="center">Test Three</p>

<p>processes, or models represented visually</p>	
<p>3.C Identify experimental procedures that are aligned to the question, including</p> <ul style="list-style-type: none"> <li>a. Identifying dependent and independent variables.</li> <li>b. Identifying appropriate controls.</li> <li>c. Justifying appropriate controls.</li> </ul>	<p style="text-align: center;">Photosynthesis/Cellular Respiration Lab</p> <p style="text-align: center;">Test Three</p>
<p>3.E Propose a new/next investigation based on</p> <ul style="list-style-type: none"> <li>a. An evaluation of the evidence from an experiment.</li> <li>b. An evaluation of the design/methods.</li> </ul>	<p style="text-align: center;">Photosynthesis/Cellular Respiration Lab</p> <p style="text-align: center;">Test Three</p>
<p>5.D Use data to evaluate a hypothesis (rejecting</p>	<p style="text-align: center;">Photosynthesis/Cellular Respiration Lab</p>

or failing to reject the null hypothesis).	Test Three
6.A Make a scientific claim.	Photosynthesis/Cellular Respiration Lab Test Three
6.B Support a claim with evidence from biological principles, concepts, processes, and/or data.	Photosynthesis/Cellular Respiration Lab Test Three
<b>NICE TO KNOW Standards</b>	<b>Learning Targets</b>
<b>Other AP Biology “<a href="#">Skills and Standards</a>”</b>	<b>Proficiency as demonstrated with the relevant assignment(s)</b>
<b>Common Formative and Summative Assessments</b>	
<ul style="list-style-type: none"> <li>● N/A - currently only one section/one teacher</li> </ul>	

## Unit 4: Cell Communication and Cell Cycle

**Duration of Unit: 6 weeks**

**Description of Unit:** *The cellular signaling process allows cells to communicate in many different ways, over both short and long distances. This communication is subsequently controlled by various negative and positive feedback mechanisms. We will look at several examples in detail, and also connect these concepts to the cell cycle - the series of events that cells will go through when growing and dividing. The application of these concepts to real-life diseases such as cancer is also explored through research.*

**Essential Questions and/or Enduring Understandings:**

Compare the three major types of indirect cellular signaling.

Describe a generalized cell signaling response.

What is the purpose of mitosis in cells?

What is the purpose of meiosis?

How are the processes of mitosis and meiosis similar and different?

What errors can occur during mitosis? What effects would these errors have on an organism?

What errors can occur during meiosis? What effects would these errors have on an organism?

How does the cell cycle progress?

Where are the “checkpoints” of the cell cycle and how are they controlled?

**Academic Vocabulary:**

Signal

Transduction

Response

Autocrine signaling

Paracrine signaling  
Endocrine signaling  
Direct signaling (“juxtacrine”)  
Ligand  
Receptor molecule  
Mitosis  
Meiosis  
Interphase  
DNA replication  
Sister chromatids  
Homologous chromosome pairs  
Spindle fibers  
Centriole  
Centrosome  
Centromere  
Kinetochore  
Diploid  
Haploid  
Crossing over  
Independent assortment  
 $G_0$   
S phase  
 $G_1$   
M phase  
Cyclin  
Cyclin-dependent kinase (CDK)  
Apoptosis

Negative feedback  
Positive feedback

**Materials/Resources/Technology:**

**Microscopes**  
**Data collection equipment (student-inquiry lab)**  
**Boundless online textbook**

<b>ESSENTIAL Standards</b>	<b>Learning Targets</b>
1.A: Describe biological concepts and/or processes.	<b>Demonstrate proficiency through completion of the following assignments:</b>  Signal Transduction Analogy video  Test Four
1.C: Explain biological concepts, processes, and/or models in applied contexts.	Signal Transduction Analogy video  Cell Signaling Case Study  Cancer Gene website  Test Four
3.A: Identify or pose a testable question based on an observation, data, or a model.	Meiosis - Evolution from Mitosis reading assignment  Test Four



4.B: Describe data from a table or graph	Cancer Gene website Test Four
5.B: Use confidence intervals and/or error bars to determine whether sample means are statistically different.	Chi-squared problems - mitosis Test Four
5.C: Perform chi-square hypothesis testing.	Chi-squared problems - mitosis Test Four
<b>NICE TO KNOW Standards</b>	<b>Learning Targets</b>
Other AP Biology “ <a href="#">Skills and Standards</a> ”	<b>Proficiency as demonstrated with the relevant assignment(s)</b>
<b>Common Formative and Summative Assessments</b>	
<ul style="list-style-type: none"> <li>• N/A - currently only one section/one teacher</li> </ul>	

## Unit 5: Heredity

**Duration of Unit:** 4 weeks

**Description of Unit:** *By observing cells under the microscope, crossbreeding various model organisms, and utilizing cutting-edge visualization techniques, scientists were able to determine the structure and function of DNA. They identified chromosomes as the location of genes, and discovered that these genes could be manipulated to control the physical appearance of the organism.*

*We will learn more about how genetic variation is produced, how traits are passed through generations, and how the environment can both affect our physical characteristics AND change our DNA directly, through observation, digital simulations, and modeling.*

**Essential Questions and/or Enduring Understandings:**

What are the ways that meiosis and sexual reproduction create genetic diversity?

Describe the basic rules of heredity.

How do Mendel's Laws allow us to predict genetic outcomes? (AKA do your Punnett squares!)

How can chi-squared be used to determine genetic linkage?

How is genetic distance calculated?

What is genetic distance used for?

How can the environment affect an organism's phenotype?

**Academic Vocabulary:**

Chromosome

Gene

Allele

Locus  
Dominance  
Allele  
Incomplete dominance  
Co-dominance  
X-linkage  
Autosomes  
Pedigree  
Karyotype  
Gene linkage  
Genetic distance  
Genotype  
Phenotype  
Wild type  
Chi-squared  
Meiosis  
Interphase  
DNA replication  
Sister chromatids  
Homologous chromosome pairs  
Spindle fibers  
Centriole  
Centrosome  
Centromere  
Kinetochore  
Diploid  
Haploid

Crossing over  
Independent assortment

**Materials/Resources/Technology:**

**Microscopes**  
**Boundless online textbook**

<b>ESSENTIAL Standards</b>	<b>Learning Targets</b>
1.B: Explain biological concepts and/or processes.	<p><b>Demonstrate proficiency through completion of the following assignments:</b></p> <p>Gene Linkage simulation/distance calculations</p> <p>Virtual <i>Drosophila</i> genetics lab</p> <p>Quiz - Heredity</p> <p>Test Five</p>
2.A: Describe characteristics of a biological concept, process, or model represented visually.	<p>Gene Linkage simulation/distance calculations</p> <p>Virtual <i>Drosophila</i> genetics lab</p> <p>Test Five</p>
5.A: Perform mathematical equations.	<p>Gene Linkage simulation/distance calculations</p> <p>Mendelian genetics problems</p> <p>Quiz - Heredity</p>

	Test Five
5.C: Perform chi-square hypothesis testing.	Gene Linkage simulation/distance calculations Mendelian genetics problems Chi-squared sample problems Quiz - Heredity Test Five
6.D: Explain the relationship between experimental results and larger biological concepts, processes, or theories.	Gene Linkage simulation/distance calculations Virtual <i>Drosophila</i> genetics lab Test Five
<b>NICE TO KNOW Standards</b>	<b>Learning Targets</b>
<b>Other AP Biology “<a href="#">Skills and Standards</a>”</b>	<b>Proficiency as demonstrated with the relevant assignment(s)</b>

## Common Formative and Summative Assessments

- N/A - currently only one section/one teacher

## Unit 6: Gene Expression and Regulation

**Duration of Unit:** 4 weeks

**Description of Unit:**

*We have learned about the regulation of gene expression, allowing us to predict and even control when genes are turned on or off. Active genes will produce their proteins, whereas inactive genes will not. This can have major effects on the observed phenotype.*

*Hands-on technological applications also allow us to manipulate DNA, RNA, and proteins in order to investigate their properties, create more copies for our use, or even use nucleic acids to affect our natural world.*

**Essential Questions and/or Enduring Understandings:**

Draw and label the structure of the DNA molecule.

Explain how the DNA structure allows it to store information.

Briefly describe the connection between DNA, RNA, and protein.

How are genes regulated? What would activate a gene vs. turning it off?

How can we use biotechnology to manipulate or analyze molecules?

**Academic Vocabulary:**

Nucleotide  
Codon  
Complementary bases  
Transcription  
Translation  
DNA replication  
Helicase  
RNA polymerase  
Promoter sequence  
TATA box  
mRNA  
tRNA  
Amino acids  
Polypeptides  
Proteins  
Nucleosomes  
Histones  
Phosphorylation  
Kinase  
Methylation  
Methyltransferase  
Operon

**Materials/Resources/Technology:**

**Gel electrophoresis apparatus**  
**Visualization technology (UV detection)**  
**Boundless online textbook**

ESSENTIAL Standards	Learning Targets
1.A: Describe biological concepts and/or processes.	<p align="center"><b>Demonstrate proficiency through completion of the following assignments:</b></p> <p align="center">Boundless Ch. 14 - reading guide</p> <p align="center">Stickleback gene modeling</p> <p align="center">Test Six</p>
1.B: Explain biological concepts and/or processes.	<p align="center">Stickleback gene modeling</p> <p align="center">Test Six</p>
3.A: Identify or pose a testable question based on an observation, data, or a model.	<p align="center">Inquiry lab extension (student choice)</p> <p align="center">Test Six</p>
6.C: Provide reasoning to justify a claim by connecting evidence to biological theories.	<p align="center">Boundless Ch. 14 - reading guide</p> <p align="center">Test Six</p>
6.E: Predict the causes or effects of a change in, or disruption to, one or more components in a biological system	<p align="center">Stickleback gene modeling</p> <p align="center">Test Six</p>



<b>NICE TO KNOW Standards</b>	<b>Learning Targets</b>
Other AP Biology “ <a href="#">Skills and Standards</a> ”	<b>Proficiency as demonstrated with the relevant assignment(s)</b>
<b>Common Formative and Summative Assessments</b>	
<ul style="list-style-type: none"> <li>● N/A - currently only one section/one teacher</li> </ul>	

## Unit 7: Evolution

**Duration of Unit: 4 weeks**

**Description of Unit:** *The basic principles of survival and natural selection have driven the change in populations that has led to the variety we see today. This unit will explore the evidence, mechanisms, and outcomes of evolutionary change.*

**Essential Questions and/or Enduring Understandings:**

What evidence is there that all living things are related?

What is the “Most Recent Common Ancestor”?

Describe natural selection, and give an example of how it can cause change in a population.

How are other causes of evolution similar to and different from natural selection? (genetic drift, artificial selection)

Compare sympatric and allopatric speciation.

How do ring species demonstrate evolutionary change?

How does extinction relate to evolutionary processes?

What are some common misconceptions around evolution? How would you address these areas of misunderstanding?

**Academic Vocabulary:**

Evolution

Natural selection

Artificial selection

Sexual selection

Genetic drift

Founder effect

Bottleneck effect

Most recent common ancestor

Phylogenetic tree

Cladogram

Node

Taxon

Clade

Monophyletic group

Paraphyletic group

Polyphyletic group

Synapomorphy

Plesiomorphy

Primitive characters

Derived characters

Ingroup/outgroup  
 Speciation  
 Sympatric speciation  
 Allopatric speciation  
 Ring species  
 Homologous characters  
 Analogous characters  
 Convergent evolution  
 Divergent evolution

**Materials/Resources/Technology:**

**Boundless online textbook**

<b>ESSENTIAL Standards</b>	<b>Learning Targets</b>
1.C: Explain biological concepts, processes, and/or models in applied contexts.	<p align="center"><b>Demonstrate proficiency through completion of the following assignments:</b></p> <p align="center">Natural selection - description paragraphs</p> <p align="center">Test Seven</p>
2.A: Describe characteristics of a biological concept, process, or model represented visually.	<p align="center">Selection “types” and graphs</p> <p align="center">Test Seven</p>
2.B: Explain relationships between different characteristics of biological	<p align="center">Selection “types” and graphs</p> <p align="center">Test Seven</p>

concepts, processes, or models.	
2.D: Represent relationships within biological models.	Hardy-Weinberg simulation/lab Evolutionary “Crystal Ball” predictions Test Seven
4.B: Describe data from a table or graph.	Hardy-Weinberg simulation/lab Test Seven
5.A: Perform mathematical calculations.	Hardy-Weinberg simulation/lab Test Seven
6.E: Predict the causes or effects of a change in, or disruption to, one or more components in a biological system.	Evolutionary “Crystal Ball” predictions Test Seven
<b>NICE TO KNOW Standards</b>	<b>Learning Targets</b>
<b>Other AP Biology “<a href="#">Skills and Standards</a>”</b>	<b>Proficiency as demonstrated with the relevant assignment(s)</b>

## Common Formative and Summative Assessments

- N/A - currently only one section/one teacher

## Unit 8: Ecology

**Duration of Unit: 3 weeks**

**Description of Unit:**

*Ecology focuses on studying the interconnected webs of relationships all organisms need in order to survive. A change in any one population can have far-reaching effects throughout the ecosystem. Competition to obtain resources leads to a wide variety of ways of life, from photosynthetic bacteria to the blue whale.*

*Although humans are not exempt from these relationships, we do have a disproportionate effect on the natural environment. The last section of this unit will explore some of those effects, both positive and negative.*

**Essential Questions and/or Enduring Understandings:**

How does Lindeman's Rule control trophic level numbers?

Draw a basic diagram, including the sun, showing energy transfer through a community. Be sure to indicate relative energy availability at each trophic level.

How does competition for resources lead to niche development?

Give an evolutionary explanation for mutualism.

Use evidence to form an argument for or against this statement: "Humans have had a negative effect on the natural environment."

What realistic steps could be taken in the future to minimize or reverse negative human effects on the planet?

**Academic Vocabulary:**

Competition  
Predation  
Symbiosis  
Mutualism  
Commensalism  
Parasitism  
Niche  
Competitive exclusion  
Keystone species  
Population  
Community  
Ecosystem  
Biodiversity  
Succession  
Trophic level  
Producer  
Primary consumer  
Secondary consumer  
Tertiary consumer  
Lindeman’s Rule  
Efficiency  
Gross primary productivity  
Net primary productivity  
Biomass

**Materials/Resources/Technology:**

**Microscopes**  
**Random population sampling tools**  
**Data collection equipment (student-inquiry lab)**  
**Boundless online textbook**

**ESSENTIAL Standards**

**Learning Targets**

<p>1.C: Explain biological concepts, processes, and/or models in applied contexts.</p>	<p style="text-align: center;"><b>Demonstrate proficiency through completion of the following assignments:</b></p> <p style="text-align: center;">Quiz - Ecology</p> <p style="text-align: center;">Human Impact Research Paper</p>
<p>2.D: Represent relationships within biological models, including mathematical models, diagrams, or flow charts.</p>	<p style="text-align: center;">Energy Pyramids</p>
<p>4.B: Describe data from a table or graph.</p>	<p style="text-align: center;">Quiz - Ecology</p> <p style="text-align: center;">Human Impact Research Paper</p>
<p>6.D: Explain the relationship between experimental results and larger biological concepts, processes, or theories.</p>	<p style="text-align: center;">Quiz - Ecology</p> <p style="text-align: center;">Human Impact Research Paper</p>
<p>6.E: Predict the causes or effects of a change in, or disruption to, one or more components in a biological system.</p>	<p style="text-align: center;">Quiz - Ecology</p> <p style="text-align: center;">Human Impact Research Paper</p>
<p style="text-align: center;"><b>NICE TO KNOW Standards</b></p>	<p style="text-align: center;"><b>Learning Targets</b></p>

Other AP Biology “ <a href="#">Skills and Standards</a> ”	Proficiency as demonstrated with the relevant assignment(s)
<b>Common Formative and Summative Assessments</b>	
<ul style="list-style-type: none"> <li>● N/A - currently only one section/one teacher</li> </ul>	