

Unit	Lesson	Lesson Objectives
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**Biochemistry****Introduction to AP Biology**

Describe the components of the AP Biology course.

Describe the skills necessary to be successful in an AP Biology course.

**Reading Lesson - Chapter 2 (The Chemical Context of Life)****The Structure, Properties, and Bonding of Water**

Describe how the bonds between water molecules lead to the properties of water.

Describe the effect of buffers, acids, and bases on organisms and their environment.

Explain how the properties of water are important to life on Earth.

Relate the molecular structure of water to its polar nature.

**Reading Lesson - Chapter 3 (Carbon and the Molecular Diversity of Life)****The Elements of Life**

Construct an explanation as to how chemical bonds affect the formation and function of molecules.

Differentiate elements and compounds.

Explain how molecules are formed and broken down.

Explain why organisms need to exchange matter with the environment.

Relate the structure of the atoms of an element to the element's properties.

**An Introduction to Biological Macromolecules**

Characterize the type of bond that forms between monomers.

Compare the reactions involved in the formation and breakdown of polymers.

Describe the properties of monomers.

**The Properties of Biological Macromolecules**

Analyze how the characteristics of sugar monomers affect the properties and function of complex carbohydrates.

Describe the properties of nucleotides.

Explain how the amino acid sequence of proteins affects the protein's shape and function.

Relate the properties of lipids to its function.

**The Structure and Function of Biological Macromolecules**

Compare the types of protein structure.

Describe the structure and formation of nucleic acids.

Describe the structure of DNA.

Determine how the structure of a protein affects its function.

Differentiate linear and branched carbohydrate polymers.

**The Structure of Nucleic Acids**

Analyze how DNA and RNA are structurally similar.

Describe how the structural similarities and differences between DNA and RNA are related to their function.

Differentiate the structure of DNA and RNA.

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**Skills Lesson: Short Essay**

- Describe the skills necessary to be successful writing a short free response.
- Practice writing a short free response.

**Skills Lesson: Experimental Design**

- Design an inquiry investigation to answer a scientific question.
- Develop a refined scientific question that guides an investigation.
- Evaluate scientific questions.
- Justify the selection of data in an inquiry investigation.

**Skills Lesson: Displaying and Analyzing Data**

- Create charts using a spreadsheet application.
- Describe the different ways to display data.
- Justify the type of data and data analysis needed to answer a scientific question.
- Use charts to analyze data.

**Skills Lesson: Statistical Analysis of Data**

- Analyze data collected in an investigation.
- Apply statistical models to analyze data.
- Describe different types of data.
- Justify the type of data and data analysis needed to answer a scientific question.

**Unit 1 Test**
**Cells**
**Introduction to Unit 2**
**Reading Lesson - Chapter 4 (A Tour of the Cell)**
**Components of Cells**

- Compare plant and animal cells.
- Describe the function of the extracellular matrix.
- Distinguish prokaryotic and eukaryotic cells.
- Examine the structure and/or function of cell components and organelles.
- Explain how the structure of cells points to a common ancestor.

**Structure and Function of Cells**

- Examine how the cell's structures allow organisms to capture, store, and use energy.
- Explain how organelles and subcellular structures support the functions of the cell.

**Cell Size**

- Analyze the relationship between a cell's size and surface area-to-volume ratio.
- Describe the structures and strategies used by organisms to efficiently exchange materials with the environment.
- Explain how surface area-to-volume ratios affect cells, organisms, and biological systems.

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**Lab: Cell Size**

- Apply mathematical models involving surface area to volume ratios.
- Explain the effect of cell size and shape on a cell's ability to maintain homeostasis.
- Make predictions based upon the results of surface area to volume calculations.

**Reading Lesson - Chapter 5 (Membrane Transport and Cell Signaling)****Cell Membrane**

- Describe the structure of the cell membrane.
- Explain how the components of the cell membrane help maintain the internal environment of the cell.

**Cell Membrane Permeability**

- Describe the structure and function of cell walls.
- Explain how the permeability of the cell membrane affects the movement of materials across the membrane.
- Relate the structure of the cell membrane to its permeability.

**Transport across Membranes**

- Compare passive and active transport.
- Describe how organisms maintain water and solute balance.
- Distinguish between endocytosis and exocytosis.
- Explain how the permeability of membranes allows for the formation of concentration gradients.

**Facilitated Diffusion**

- Compare active transport and facilitated diffusion.
- Differentiate channel and carrier proteins.
- Examine how membrane proteins assist in the transport of molecules and ions across the cell membrane.
- Explain how ion pumps maintain membrane potential.
- Explain how the ability of a molecule to pass through the cell membrane is affected by the molecule's structure.

**Osmoregulation**

- Analyze the mechanisms that help organisms maintain internal environments.
- Calculate the solute and water potential of solutions.
- Describe how concentration gradients affect the transport of molecules across membranes.
- Differentiate the effect of hypotonic, hypertonic, and isotonic environments on cells.
- Examine the relationship between solute and water potential.

**Lab: Tonicity and Osmoregulation**

- Apply mathematical models involving water potential.
- Investigate whether homeostasis is maintained by the movement of particles across membranes.
- Predict the effect of cell size and shape on osmoregulation.

**Transport Mechanisms**

- Examine how the knowledge of transport mechanisms has impacted medicine and technology.
- Summarize the mechanisms involved in the movement of materials across the cell membrane.

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### Cell Compartmentalization

Describe cell compartmentalization.

Explain how cell compartmentalization allows the organelles of the cell to perform their functions efficiently.

### Evolution of Compartmentalization in Cells

Compare prokaryotic and eukaryotic cell compartmentalization.

Describe the origins of cell compartmentalization.

Relate the functions of mitochondria and chloroplasts to their ancestral counterparts.

### Unit 2 Test

## Enzymes and Metabolism

### Introduction to Unit 3

### Reading Lesson - Chapter 6 (An Introduction to Metabolism)

#### Structure of Enzymes

Describe the structure and properties of enzymes.

Examine the importance of enzyme active site and substrate specificity.

#### Function of Enzymes

Describe enzymes.

Explain how enzymes facilitate chemical reactions.

#### Enzyme Activity

Explain the causes and effects of changes in the structure of enzymes.

Explain the effects of environmental conditions on enzyme activity.

#### Lab: Enzyme Activity

Analyze data and identify how molecular interactions affect structure and function.

Design a plan for collecting data to show that all biological systems are affected by complex biotic and abiotic interactions.

Use models to predict and justify that changes in the subcomponents of a biological polymer affect the functionality of the molecule.

#### Energy and Life

Analyze how energy is efficiently transferred in metabolic pathways.

Describe the role of energy in living organisms.

Explain why highly ordered systems do not violate the second law of thermodynamics.

#### Photosynthesis

Describe the evolution of photosynthesis.

Describe the importance of photosynthesis.

Examine how light energy is absorbed and transformed to chemical energy during the light-dependent reactions of photosynthesis.

Explain how the chemical energy from the light-dependent reactions is used to produce sugars in the light-independent reactions (Calvin cycle).

Support the claim that cyanobacterial photosynthesis created an oxygenated atmosphere.

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**Lab: Photosynthesis**

Analyze data and identify how molecular interactions affect structure and function.

Apply mathematical routines to describe interactions among living systems.

Construct explanations based on scientific evidence as to how interactions of subcellular structures provide essential functions.

Justify the scientific claim that free energy is required for living systems.

Justify the scientific claim that organisms share many conserved core processes and features that evolved and are widely distributed among organisms today.

**Reading Lesson - Chapter 7 (Cellular Respiration and Fermentation)**

**Cellular Respiration**

Describe the stages of cellular respiration.

Examine alternative glucose breakdown pathways.

Explain the importance of cellular respiration.

**Variation and Fitness**

Account for the variation within and among cells.

Relate the variation of molecules within cells to the ability of organisms to survive and reproduce in different environments.

**Unit 3 Test**

**Cell Communication and Cell Cycle**

**Introduction to Unit 4**

**Communication between Cells**

Describe how cells communicate with one another over short and long distances.

Describe the importance of cell communication.

Explain how cells that are in direct contact or are adjacent communicate.

**Reading Lesson - Concept 5.6 (Cell Signaling)**

**Introduction to Signal Transduction**

Analyze how cells respond to signals.

Describe the role of the components of a signal transduction pathway in cell communication.

Explain the function of signal transduction pathways in cell communication.

**Signal Transduction**

Describe how signal transduction pathways impact how a cell responds to its environment.

Explain how signal transduction affects gene expression and cell function.

**Alteration of Signal Transduction Pathways**

Analyze the effect of mutations on signal transduction.

Examine how chemicals interfere with signal transduction pathways.

**Feedback**

Compare negative and positive feedback mechanisms.

Explain the role of negative and positive feedbacks in organisms.

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		<b>Reading Lesson - Chapter 9 (The Cell Cycle)</b>
		<b>Cell Cycle and Mitosis</b> <ul style="list-style-type: none"><li>Describe the stages and events of the cell cycle.</li><li>Explain the role of mitosis in the transmission of genetic information from one generation to the next.</li></ul>
		<b>Cell Cycle Regulation and Disruptions</b> <ul style="list-style-type: none"><li>Describe the effect of disruptions in the cell cycle.</li><li>Examine the control system involved in the regulation of the cell cycle.</li><li>Explain the importance of cell cycle regulation.</li></ul>
		<b>Skills Lesson: Long Essay</b> <ul style="list-style-type: none"><li>Be able to plan and write a long free response answer.</li><li>Understand the long free response question section of the AP exam.</li></ul>
		<b>Skills Lesson: Data-Based Essay</b> <ul style="list-style-type: none"><li>Describe the skills necessary to be successful writing a data-based essay.</li><li>Practice writing a data-based essay.</li></ul>
		<b>Unit 4 Test</b>
		<b>Cumulative Exam I</b>
		<b>Heredity</b>
		<b>Introduction to Unit 5</b>
		<b>Reading Lesson - Chapter 10 (Meiosis and Sexual Life Cycles)</b>
		<b>Meiosis</b> <ul style="list-style-type: none"><li>Compare meiosis and mitosis.</li><li>Describe the phases and outcome of meiosis.</li><li>Explain the role of meiosis in heredity.</li></ul>
		<b>Meiosis and Genetic Diversity</b> <ul style="list-style-type: none"><li>Analyze the meiotic processes that result in genetic diversity.</li><li>Describe how fertilization contributes to genetic variation.</li><li>Explain how sexual reproduction in eukaryotes allows for genetic variation.</li></ul>
		<b>Lab: Mitosis and Meiosis</b> <ul style="list-style-type: none"><li>Construct a representation that connects the process of meiosis to the passage of traits from parent to offspring.</li><li>Construct an explanation about how DNA is transmitted to the next generation via mitosis or meiosis.</li><li>Evaluate evidence provided by data sets to support the claim that inheritable information is passed from one generation to the next.</li><li>Explain the connection between meiosis and how genetic variation.</li><li>Make predictions about natural phenomena occurring during the cell cycle.</li></ul>

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**Reading Lesson - Chapter 11 (Mendel and the Gene Idea)****Mendelian Inheritance**

- Analyze transmission of traits using probability rules.
- Describe features and processes that support the idea of common ancestry for all organisms.
- Examine Gregor Mendel's experiments.
- Explain Mendel's laws of inheritance.
- Use the  $\chi^2$  test to analyze data.

**Reading Lesson - Chapter 12 (The Chromosomal Basis of Inheritance)****Non-Mendelian Inheritance**

- Describe how non-nuclear genes are transmitted.
- Describe inheritance patterns that deviate from the Mendelian model of inheritance.
- Examine sex-linked inheritance.
- Use statistical analysis to show the trait ratios of non-Mendelian inheritance patterns.

**Effect of the Environment on Phenotype**

- Describe how environmental conditions affect gene expression.
- Examine examples of how the environment affects phenotype.

**Chromosomal Inheritance**

- Connect chromosomal behavior to the transmission pattern of genes.
- Examine the effect of changes in the structure and number of human chromosomes.
- Explain how chromosomal inheritance produces genetic variation in sexual reproduction.

**Unit 5 Test****Gene Expression****Introduction to Unit 6****DNA and RNA Structure**

- Compare the inheritance structures of prokaryotic and eukaryotic organisms.
- Describe how scientists identified the main molecules involved in the inheritance of genetic information.
- Relate the structure and characteristics of the inheritance molecules to their function.

**Reading Lesson - Chapter 13 (The Molecular Basis of Inheritance)****DNA Replication**

- Describe the mechanisms involved in DNA replication.
- Differentiate DNA replication models.
- Explain how errors in the DNA replication process are corrected.

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		<b>Transcription and RNA Processing</b> <ul style="list-style-type: none"><li>Describe the steps involved in transcription.</li><li>Describe the structures of DNA and RNA.</li><li>Distinguish the three types of RNA in protein synthesis.</li><li>Explain how mRNA is processed in eukaryotic cells.</li><li>Outline the flow of genetic information in protein synthesis.</li></ul>
		<b>Reading Lesson - Chapter 14 (Gene Expression from Gene to Protein)</b>
		<b>Translation</b> <ul style="list-style-type: none"><li>Compare prokaryotic and eukaryotic translation.</li><li>Describe the features and steps of translation.</li><li>Explain how genetic information flows in retroviruses.</li></ul>
		<b>Reading Lesson - Chapter 15 (Regulation of Gene Expression)</b>
		<b>Gene Expression Regulation</b> <ul style="list-style-type: none"><li>Describe prokaryotic and eukaryotic gene expression regulation.</li><li>Explain the interactions involved in gene expression regulation.</li></ul>
		<b>Cell Specialization</b> <ul style="list-style-type: none"><li>Describe how transcription factors and promoters affect gene expression and the phenotype of an organism.</li><li>Relate gene expression regulation to phenotypic differences in cells and organisms.</li></ul>
		<b>Mutations</b> <ul style="list-style-type: none"><li>Analyze how mutations influence an organism's ability to survive and reproduce.</li><li>Describe how mutations affect the phenotypes of organisms.</li><li>Differentiate the types of mutations.</li><li>Explain how mutations occur.</li></ul>
		<b>Biotechnology</b> <ul style="list-style-type: none"><li>Describe the importance of biotechnology.</li><li>Explain how common genetic engineering techniques are used.</li></ul>
		<b>Lab: Biotechnology</b> <ul style="list-style-type: none"><li>Apply mathematical processes to solve a problem.</li><li>Explain how heritable information can be manipulated using common genetic engineering techniques.</li><li>Identify and question ethical, social, or medical issues surrounding human genetic disorders.</li><li>Justify the claim that heritable information can be manipulated.</li><li>Use genetic engineering techniques to analyze genetic fingerprints.</li></ul>
		<b>Unit 6 Test</b>

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**Evolution and Genetic Diversity****Introduction to Unit 7****Introduction to Natural Selection**

Analyze how populations are affected by natural selection.

Characterize evolution.

Describe the conditions necessary for natural selection to occur.

**Natural Selection**

Describe how environmental changes apply selective pressures on populations.

Explain how natural selection acts on phenotypic variations in populations.

Explain how phenotypic variations affect the fitness of organisms in particular environments.

**Artificial Selection**

Connect environmental changes to evolutionary changes in populations.

Describe how humans change the diversity within populations.

**Virtual Lab: Artificial Selection**

Analyze how natural selection affects populations.

Apply mathematical methods and conceptual knowledge to investigate the cause and effect of natural and artificial selection.

Describe how humans can affect diversity within a population.

Model natural and artificial selection.

Relate evolutionary changes to changes in the environment.

Use data to support the claim that natural and artificial selection are mechanisms of evolution.

**Reading Lesson - Chapter 21 (The Evolution of Populations)****Evolution of Populations**

Analyze how random occurrences cause the evolution of populations.

Describe how changes in genetic variation affect populations.

**Hardy-Weinberg Equilibrium**

Characterize a population in Hardy-Weinberg equilibrium.

Describe the effects of disturbing a population in Hardy-Weinberg equilibrium.

Use the Hardy Weinberg equation to calculate allele frequencies.

**Virtual Lab: Hardy-Weinberg**

Analyze the mechanisms that disrupt a population in Hardy-Weinberg equilibrium.

Model a population in Hardy-Weinberg equilibrium.

Use data as evidence to justify that natural selection, migration, and genetic drift are mechanisms of evolution.

Use data from a simulation to analyze how natural selection, migration, and genetic drift affect allele and genotype frequencies.

Unit	Lesson	Lesson Objectives
		<p><b>Evidence for Evolution</b></p> <ul style="list-style-type: none"> <li>Analyze how data serves as evidence that evolution has occurred.</li> <li>Describe the types of data used to support evolution.</li> <li>Relate the shared features of the domains of life to common ancestry.</li> </ul> <p><b>Reading Lesson-Chapter 23 (Broad Patterns of Evolution)</b></p> <p><b>Common Ancestry</b></p> <ul style="list-style-type: none"> <li>Differentiate the domains of life.</li> <li>Provide evidence for common ancestry in eukaryotes.</li> </ul> <p><b>Continuing Evolution</b></p> <ul style="list-style-type: none"> <li>Analyze evidence that shows that life on Earth continues to evolve.</li> <li>Create a timeline to represent evolutionary history.</li> </ul> <p><b>Reading Lesson - Chapter 20 (Phylogeny)</b></p> <p><b>Phylogeny</b></p> <ul style="list-style-type: none"> <li>Analyze phylogenetic trees and cladograms.</li> <li>Create phylogenetic trees and cladograms.</li> <li>Describe phylogenetic trees and cladograms.</li> </ul> <p><b>Reading Lesson - Chapter 22 (The Origin of Species)</b></p> <p><b>Speciation</b></p> <ul style="list-style-type: none"> <li>Define species and speciation.</li> <li>Describe conditions that lead to the appearance of new species.</li> <li>Describe the mechanisms involved in speciation.</li> <li>Examine the effect of ecological conditions on evolution and speciation.</li> </ul> <p><b>Extinction</b></p> <ul style="list-style-type: none"> <li>Analyze how extinction affects species diversity.</li> <li>Examine the causes and effects of extinctions.</li> </ul> <p><b>Variations in Populations</b></p> <ul style="list-style-type: none"> <li>Analyze the role genetic diversity plays in a population's ability to survive environmental changes.</li> <li>Explain how different selective pressures affect populations in varying environmental conditions.</li> </ul> <p><b>Origin of Life on Earth</b></p> <ul style="list-style-type: none"> <li>Analyze the scientific evidence that supports the origin of life models.</li> <li>Describe the models used to explain the origin of life on Earth.</li> </ul> <p><b>Unit 7 Test</b></p>

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**Ecology****Introduction to Unit 8****Responses**

Describe ways organisms respond to stimuli, and how specific responses increase fitness.

Explain the ways that organisms learn and cooperate, and how these behaviors increase fitness.

**Lab: Response to the Environment**

Describe how the behavioral and physiological responses of an organism affect its overall fitness.

Design a controlled experiment to determine how an organism responds to environmental changes.

Investigate the relationship between the behavior of an organism and its environment.

**Reading Lesson - Chapter 42 (Ecosystems and Energy)****Energy Flow**

Analyze how changes in energy availability affect organisms, populations, and ecosystems.

Describe the role of autotrophs and heterotrophs in the flow of energy within an ecosystem.

Explain the strategies used by organisms to obtain and use energy.

**Lab: Energy Flow through Ecosystems**

Analyze energy flow using mathematical models.

Design and conduct an experiment to investigate energy flow through ecosystems.

Explain energy dynamics including productivity and community interactions.

**Reading Lesson - Chapter 40 (Population Ecology and the Distribution of Organisms)****Population Ecology**

Examine the factors that influence population growth dynamics.

Use mathematical and graphical models to analyze population growth.

**Density of Populations**

Examine the relationship between the density of a population and resource availability.

Use a mathematical model to show a change in a population size over time.

**Reading Lesson - Chapter 41 (Ecological Communities)****Community Ecology**

Analyze how interactions within and between populations affect community structure.

Describe the structure of a community based on its species composition and diversity.

Explain the relationship between community structure and energy availability.

**Reading Lesson-Chapter 43 (Conservation Biology and Global Change)****Biodiversity**

Describe factors that help maintain diversity in an ecosystem.

Explain how a change in a component of an ecosystem affects the structure of the ecosystem.

Relate the diversity of an ecosystem to its ability to withstand environmental changes.

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**Changes in Ecosystems**

Analyze how human activities affect ecosystems.

Describe the interaction between the environment and variations in populations.

Examine the effect of invasive species on ecosystems.

Explain how ecosystems change as a result of geological and meteorological events.

**Unit 8 Test****Cumulative Exam II****Review****Taking the AP Exam**

Analyze exam questions.

Describe how to prepare for the AP Biology exam.

List the components of the AP Biology exam.

**Review Units 1–2****Review Units 3–4****Review Units 5–6****Review Units 7–8****AP Biology Practice Exam I****AP Biology Practice Exam II**