



# TAMALPAIS UNION HIGH SCHOOL DISTRICT

## Advanced Placement Biology

### Overview Information

Title of Course: Advanced Placement Biology	
Course Author(s): John Hayden, Amy Mastromonaco, Laura Valentine	Schools where the course will be taught: Redwood, Tamalpais, Archie Williams
Length of Course: 1 year	Subject Area and Discipline: Science
Grade Levels: 11th and 12th	Is this course an integrated course? No
Is this course being submitted for possible UC honors designation? No	Are you seeking UC approval? If so, in what area ( <a href="#">A-G</a> )?
Prerequisites (required or recommended): Living Earth (required), Physiology (recommended)	Co-requisites (required or recommended): Chemistry
Living Earth provides students with foundational knowledge about biology, which will be built upon in AP Biology. Chemistry also provides students with foundational knowledge about molecules, which is essential for fully understanding biology at the molecular/cellular level. Physiology is often useful for providing students with additional knowledge and context about living systems, which helps some students to be successful.	
Check all that apply: <input checked="" type="checkbox"/> UC A-G course <input type="checkbox"/> Graduation Requirement ( specify the requirement this course meets) <input checked="" type="checkbox"/> Elective <input checked="" type="checkbox"/> Honors/AP <input type="checkbox"/> CTE	

### Course Overview:

AP Biology is an introductory college-level biology course. Students cultivate their understanding of biology through inquiry-based investigations as they explore the following topics: evolution, cellular processes, energy and communication, genetic information transfer, ecology, and interactions. This course requires that 25 percent of the instructional time will be spent in hands-on laboratory work, with an emphasis on inquiry-based investigations that provide students with opportunities to apply the science practices. The course includes two essential components: the **science practices** and the **course content**. The **science practices** are central to the study and practice of biology. Students develop and apply the described practices on a regular basis over the span of the course.



AP BIOLOGY

# Science Practices

## Science Practice 1

### Concept Explanation 1

Explain biological concepts and processes presented in written format.

## Science Practice 2

### Visual Representations 2

Analyze visual representations of biological concepts and processes.

## Science Practice 3

### Questions and Methods 3

Determine scientific questions and methods.

#### SKILLS

**1.A** Describe biological concepts and processes.

**1.B** Explain biological concepts and processes.

**1.C** Explain biological concepts and processes in applied contexts.

**2.A** Describe characteristics of visual representations of biological concepts and processes.

**2.B** Explain relationships between characteristics of biological models in both theoretical and applied contexts.

**2.C** Explain how biological models relate to larger principles, concepts, processes, systems, or theories.

**2.D** Represent relationships within biological models, including mathematical models, diagrams, flowcharts, and systems.

**3.A** Identify or pose a testable question based on an observation, data, or a model.

**3.B** State the null hypothesis or predict the results of an experiment.

**3.C** Identify experimental procedures that align with the question, including:

- i. identifying dependent and independent variables
- ii. identifying appropriate controls
- iii. justifying appropriate controls

**3.D** Propose a new investigation based on an evaluation of the experimental design or evidence.

## Science Practice 4

### Representing and Describing Data 4

Represent and describe data.

## Science Practice 5

### Statistical Tests and Data Analysis 5

Perform statistical tests and mathematical calculations to analyze and interpret data.

## Science Practice 6

### Argumentation 6

Develop and justify scientific arguments using evidence.

#### SKILLS

**4.A** Construct a graph to represent the data, including: x-y graphs (bar, histogram, line, log scale, dual y), scatter plot, box and whisker plot, and pie chart. The graph should include the following components:

- i. type of graph appropriate for the data
- ii. axis labeling, including appropriate units and legend
- iii. scaling
- iv. accurately plotted data (including error bars when appropriate)
- v. trend line (when appropriate)

**4.B** Describe data from a table or graph, including:

- i. identifying specific data points
- ii. describing trends and patterns in the data
- iii. describing relationships between variables

**5.A** Perform mathematical calculations, including:

- i. mathematical equations in the curriculum
- ii. means
- iii. rates
- iv. ratios
- v. percentages and percent changes

**5.B** Use confidence intervals and error bars to estimate whether sample means are statistically different.

**5.C** Perform chi-square hypothesis testing.

**5.D** Use data to evaluate a hypothesis or prediction, including rejecting or failing to reject the null hypothesis.

**6.A** Make a scientific claim.

**6.B** Support a claim with evidence from biological principles, concepts, processes, and data.

**6.C** Provide reasoning to justify a claim by connecting evidence to biological theories.

**6.D** Explain the relationship between experimental results and larger biological concepts, processes, or theories.

**6.E** Predict the causes or effects of a change in, or disruption to, one or more components in a biological system.

The **course content** is organized into commonly taught units of study that provide a suggested sequence for the course. These units comprise the content and skills colleges and universities typically expect students to be proficient in to qualify for college credit and/or placement. This content is grounded in big ideas, which are crosscutting concepts that build conceptual understanding and spiral throughout the course.

The course content is focused on 4 Big Ideas

- **Big Idea 1: Evolution** The process of evolution drives the diversity and unity of life.
- **Big Idea 2: Energetics** Biological systems use energy and molecular building blocks to grow, reproduce, and maintain dynamic homeostasis
- **Big Idea 3: Information, Storage and Transmission** Living systems store, retrieve, transmit, and respond to information essential to life processes
- **Big Idea 4: Systems of Interactions** Biological systems interact, and these systems and their interactions exhibit complex properties.

## Unit 1: Chemistry of Life

### Unit Summary:

This first unit sets the foundation for students to understand the chemical basis of life, which is needed for mastery of future areas of focus and provides students with a survey of the elements necessary for carbon-based systems to function. Students learn that water and the properties of water play a vital role in the survival of individuals and biological systems. They also learn that living systems exist in a highly complex organization that requires input of energy and the exchange of macromolecules. This unit also addresses in detail how and in what conformations molecules called monomers bond together to form polymers. The structure of monomers and polymers determines their function. In the units that follow, students will need to understand and explain the interaction and bonding of atoms to form molecules.

### Essential Questions:

- What is the role of energy in the making and breaking of polymers?
- How do living systems transmit information in order to ensure their survival?
- How would living systems function without the polarity of the water molecule?

### Unit

### Outcomes:



## UNIT AT A GLANCE

Topic	Suggested Skill
<b>1.1 Structure of Water and Hydrogen Bonding</b>	<b>2.A</b> Describe characteristics of visual representations of biological concepts and processes.
<b>1.2 Elements of Life</b>	<b>2.A</b> Describe characteristics of visual representations of biological concepts and processes.
<b>1.3 Introduction to Macromolecules</b>	<b>2.A</b> Describe characteristics of visual representations of biological concepts and processes.
<b>1.4 Carbohydrates</b>	<b>1.A</b> Describe biological concepts and processes.
<b>1.5 Lipids</b>	<b>6.E</b> Predict the causes or effects of a change in, or disruption to, one or more components in a biological system.
<b>1.6 Nucleic Acids</b>	<b>2.A</b> Describe characteristics of visual representations of biological concepts and processes.
<b>1.7 Proteins</b>	<b>6.E</b> Predict the causes or effects of a change in, or disruption to, one or more components in a biological system.

### Sample Unit Assignments:

- Chapter reading guides: [Chapter 2 Reading guide \(BIF\)](#)
- [Macromolecules of Life KEY.pdf](#)
- [Protein Folding Model CLASS COPY](#) [Protein Folding Model STUDENT](#)

The above sample assignments in Unit 1 meet UC A-G requirements and College Board AP Biology standards by combining literacy, synthesis, and inquiry-based learning. Through **reading guides**, students build disciplinary literacy and analyze scientific texts; **macromolecule notes** help them organize and explain the structure-function relationships of key biomolecules; and the **protein modeling activity** provides a hands-on product that demonstrates how molecular interactions determine protein structure and function. Students demonstrate understanding through varied products—notes, written reflections, and models—ensuring access for diverse learners and reinforcing inclusive, college-level science practices.

### Sample Lab:

- [Properties of Water Lab CLASS COPY](#) [Properties of Water Lab STUDENT](#)

This lab aligns with AP Biology Science Practices such as **model development, concept explanation, and representation of data**. Students test water's cohesion, adhesion, surface tension, capillarity, heat capacity, and polarity through hands-on experiments. This lab supports the unit outcomes by helping students directly observe how molecular structure (i.e. polarity, hydrogen bonding) gives rise to emergent properties critical for life. The activity is structured to be inclusive, accessible, and collaborative—students work in mixed-ability groups, use multiple representation formats (data tables, graphs, verbal explanation, drawing molecular models), and discuss real-world relevance (e.g. water's role in climate, physiology, ecosystems).

### Sample unit Assessment:

- Almost each week, students have a **chapter quiz**. It is formative: open-notes and 5 multiple-choice questions to check their understanding and provide a platform for identifying areas of growth prior to the summative Unit Exam
- **Unit Exam** - The unit exam is formatted to mirror the College Board AP exam in May. There are multiple-choice questions (from a bank of AP questions), as well as Free Response Questions (either from previous AP exams or generated by the teacher).

## Unit 2: Cells

### Unit Summary:

The cell is the basic unit of life. Cells contribute to the organization of life and provide the environment in which organelles function. Organelles in turn provide compartmentalization and organize cellular products for dispersal and waste for disposal. Cells have membranes that allow them to establish and maintain an internal environment. These membranes also control the exchange of material with the cell's external environment. The maintenance of the internal and external conditions of a cell is called homeostasis. Student understanding of these concepts will be necessary in later units when the focus of instruction shifts to cellular products and by-products and when students learn why cellular exchange of energy and materials matters.

### Essential Questions/Knowledge:

- Defend the origin of eukaryotic cells.
- How do the mechanisms for transport across membranes support energy conservation?
- What are the advantages and disadvantages of cellular compartmentalization?
- How are living systems affected by the presence or absence of subcellular components?

## Unit Outcomes:

UNIT  
2

Cells

## UNIT AT A GLANCE

Topic	Suggested Skills	Class Periods
		<b>~14–16</b> CLASS PERIODS
<b>2.1 Cell Structure and Function</b>	<b>1.A</b> Describe biological concepts and processes. <b>6.A</b> Make a scientific claim.	
<b>2.2 Cell Size</b>	<b>2.D</b> Represent relationships within biological models, including mathematical models, diagrams, flowcharts, and systems. <b>4.A</b> Perform mathematical calculations, including: i. mathematical equations in the curriculum ii. means iii. rates iv. ratios v. percentages and percent changes	
<b>2.3 Plasma Membrane</b>	<b>2.A</b> Describe characteristics of visual representations of biological concepts and processes.	
<b>2.4 Membrane Permeability</b>	<b>3.D</b> Use data to evaluate a hypothesis or prediction, including rejecting or failing to reject the null hypothesis.	
<b>2.5 Membrane Transport</b>	<b>3.D</b> Propose a new investigation based on an evaluation of the experimental design or evidence.	
<b>2.6 Facilitated Diffusion</b>	<b>6.E</b> Predict the causes or effects of a change in, or disruption to, one or more components in a biological system.	
<b>2.7 Tonicity and Osmoregulation</b>	<b>4.A</b> Construct a graph to represent the data, including: x-y graphs (bar, histogram, line, log scale, dual y), scatter plot, box and whisker plot, and pie chart. The graph should include the following components: i. type of graph appropriate for the data ii. axis labeling, including appropriate units and legend iii. scaling iv. accurately plotted data (including error bars when appropriate) v. trend line (when appropriate)	
<b>2.8 Mechanisms of Transport</b>	<b>1.B</b> Explain biological concepts and processes.	
<b>2.9 Cell Compartmentalization</b>	<b>6.E</b> Predict the causes or effects of a change in, or disruption to, one or more components in a biological system.	
<b>2.10 Origins of Cell Compartmentalization</b>	<b>6.B</b> Support a claim with evidence from biological principles, concepts, processes, and data.	



Go to [AP Classroom](#) to assign the **Progress Check** for Unit 2. Review the results in class to identify and address any student misunderstandings.

### Sample Unit Assignments:

- [Cell Parts Practice 2024](#)
- [Cell Membrane Bubble Model CLASS COPY](#) + [Cell Membrane Bubble Model Student Copy](#)
- [Endosymbiosis WebQuest](#)

In Unit 2, students engage in three key assignments that deepen their understanding of cellular structures and functions. The **Cell Parts Practice** assignment involves identifying and labeling organelles within eukaryotic cells, reinforcing knowledge of cellular components and their roles. The **Cell Membrane Bubble Model** requires students to create a physical model representing the fluid mosaic model of the plasma membrane, enhancing comprehension of membrane structure and function. Lastly, the **Endosymbiosis WebQuest** explores the endosymbiotic theory, prompting students to investigate the origins of mitochondria and chloroplasts through research and analysis.

These assignments align with the UC A-G laboratory science requirements by promoting scientific inquiry, critical thinking, and the application of biological concepts. They also meet College Board AP Biology standards by addressing key concepts such as cellular structure, membrane dynamics, and evolutionary theory. Through these activities, students develop skills in observation, modelling, and research, ensuring inclusive and affirming representation of scientific knowledge.

### Sample Lab:

- [Osmosis Labs CLASS COPY](#) + [Osmosis Labs Student](#)

In the Osmosis Labs, students explore the principles of osmosis first by using dialysis tubing in different tonicities of sucrose water solutions and determining the change in mass (due to osmosis). Next, students submerge potato slices into various sucrose solutions to again determine the change in mass, and this time determine the potato's water potential. Through careful observation and measurement, they analyze the movement of water to reinforce the selective permeability of the cell membrane and introduce the idea of cellular homeostasis. This lab aligns with the AP Biology curriculum by engaging students in scientific inquiry, data collection, analysis, and helping them foster a deeper understanding of cellular processes. It connects to the real world by discussing water potential - key to understanding the movement of water in plants (pretty important for most ecosystems and for all of us, to survive!)

### Sample unit Assessment:

- Almost each week, students have a **chapter quiz**. It is formative: open-notes and 5 multiple-choice questions to check their understanding and provide a platform for identifying areas of growth prior to the summative Unit Exam
- **Unit Exam** - The unit exam is formatted to mirror the College Board AP exam in May. There are multiple-choice questions (from a bank of AP questions), as well as Free Response Questions (either from previous AP exams or generated by the teacher).

## Unit 3: Cellular Energetics

### Unit Summary:

In Unit 3, students build on knowledge gained in Unit 2 about the structure and function of cells, focusing on cellular energetics. Living systems are complex in their organization and require constant energy input. This unit provides students with the knowledge necessary to master the concepts of energy capture and usage. Students work through enzyme structure and function, learning the ways in which the environment plays a role in how enzymes perform their function(s). Students gain a deeper understanding of the processes of photosynthesis and cellular respiration, which is knowledge they will use in Unit 6 while studying how cells use energy to fuel life processes.

### Essential Questions/Knowledge:

- How do different environmental factors affect enzyme structure and function?
- How do cells capture and store energy?
- How do structures in the mitochondria work together to generate ATP during aerobic cellular respiration?

### Unit Outcomes:



## Cellular Energetics

### UNIT AT A GLANCE

Topic	Suggested Skills	Class Periods
<b>3.1 Enzymes</b>	<b>1.B</b> Explain biological concepts and processes. <b>3.C</b> Identify experimental procedures that align with the question, including: <ul style="list-style-type: none"><li>i. identifying dependent and independent variables</li><li>ii. identifying appropriate controls</li><li>iii. justifying appropriate controls</li></ul>	~12-14 CLASS PERIODS
<b>3.2 Environmental Impacts on Enzyme Function</b>	<b>6.E</b> Predict the causes or effects of a change in, or disruption to, one or more components in a biological system.	
<b>3.3 Cellular Energy</b>	<b>6.C</b> Provide reasoning to justify a claim by connecting evidence to biological theories.	
<b>3.4 Photosynthesis</b>	<b>6.B</b> Support a claim with evidence from biological principles, concepts, processes, and data.	
<b>3.5 Cellular Respiration</b>	<b>4.A</b> Construct a graph to represent the data, including: x-y graphs (bar, histogram, line, log scale, dual y), scatter plot, box and whisker plot, and pie chart. The graph should include the following components: <ul style="list-style-type: none"><li>i. the type of graph appropriate for the data</li><li>ii. axis labeling, including appropriate units and legend</li><li>iii. scaling</li><li>iv. accurately plotted data (including error bars when appropriate)</li><li>v. trend line (when appropriate)</li></ul>	

### Sample Unit Assignments:

Chapter Reading Guides: Chapter 6, Chapter 7, [Chapter 8](#) from Biology in Focus OR textbook notes

POGILs: [Enzymes](#)

[Modeling Photosynthesis](#)/Respiration

AP Classroom Videos

Students will access and learn information about Cellular Energetics in a variety of ways. Students will continue to practice reading college-levels texts by completing reading guides about each topic. Students will also have access to videos that cover each learning standard on AP Classroom. In class, students will work collaboratively to make meaning of information by working through activities such as POGILs or production of models. These in class activities allow students to receive timely feedback on their understanding of complex processes.

**Sample Lab:**

Photosynthesis and Respiration Lab - [BioRad Algae Beads](#)

In Unit 3 students will continue to develop their understanding of experimental design, including testing identifying different variables and appropriate controls for an experiment. They will also continue to refine their graphing skills in both of the sample labs/activities included here. The Algae Beads lab should help students to understand how environmental variables affect rates of photosynthesis and respiration, processes that are fundamental to life on Earth.

**Sample unit Assessment:**

AP Classroom Topic questions ([example](#)) are assigned for self-paced formative assessments. Chapter vocabulary quizzes are assessments which allow students to practice answering test questions and check their understanding prior to the summative Unit Exam

**Unit Exam** - The unit exam is formatted to mirror the College Board AP exam in May. There are multiple-choice questions (from a bank of AP questions), as well as Free Response Questions ([example of released AP question](#))

**Unit 4: Cell Communication and Cell Cycle****Unit Summary:**

In Unit 4, students continue to learn about the role of cells, focusing on how cells use energy and information transmission to communicate and replicate. Through systems of complex transduction pathways, cells can communicate with one another. Cells can also generate and receive signals, coordinate mechanisms for growth, and respond to environmental cues. To maintain homeostasis, cells respond to their environment. They can also replicate and regulate replication as part of the cell cycle which provides for the continuity of life. In Unit 5, students will move on to learn about heredity

**Essential Questions/Knowledge:**

- How do cells communicate with one another?
- Explain how a change in the structure of any signaling molecule affects the activity of the signaling pathway
- What are the consequences of disruption to the cell cycle/cell cycle checkpoints?

**Unit Outcomes:**

## Cell Communication and Cell Cycle

**UNIT AT A GLANCE**

Topic	Suggested Skills	Class Periods
4.1 Cell Communication	1.B Explain biological concepts and processes.	~12-14 CLASS PERIODS

#### 4.2 Introduction to Signal Transduction

**1.A** Describe biological concepts and processes.

#### 4.3 Signal Transduction Pathways

**6.C** Provide reasoning to justify a claim by connecting evidence to biological theories.

#### 4.4 Feedback

**6.E** Predict the causes or effects of a change in, or disruption to, one or more components in a biological system.

#### 4.5 Cell Cycle

**4.B** Describe data from a table or graph, including:

- i. identifying specific data points
- ii. describing trends and patterns in the data
- iii. describing relationships between variables

**5.A** Perform mathematical calculations, including:

- i. mathematical equations in the curriculum
- ii. means
- iii. rates
- iv. ratios
- v. percentages and percent changes

#### 4.6 Regulation of Cell Cycle

**6.E** Predict the causes or effects of a change in, or disruption to, one or more components in a biological system.



Go to [AP Classroom](#) to assign the **Progress Check** for Unit 4. Review the results in class to identify and address any student misunderstandings.

#### Sample Unit Assignments:

Textbook Reading Guides/Notes  
Modelling Mitosis/Meiosis with Pop Beads  
Signaling Lecture

#### Sample Lab: [Adventitious Root Development](#)

In Unit 4, students will continue to develop their experimental design and data analysis skills. They will investigate real-world applications of understanding cell signaling and mitosis by testing how different variables affect root growth from basil cuttings.

#### Sample unit Assessment:

AP Classroom Topic questions ([example](#)) are assigned for self-paced formative assessments. Chapter vocabulary quizzes are assessments which allow students to practice answering test questions and check their understanding prior to the summative Unit Exam

**Unit Exam** - The unit exam is formatted to mirror the College Board AP exam in May. There are multiple-choice questions (from a bank of AP questions), as well as Free Response Questions ([example of released AP question](#))

### Unit 5: Heredity

**Unit Summary:** Unit 5 focuses on heredity and the biological concepts and processes involved in ensuring the continuity of life. Students learn that the storage and transmission of genetic information via chromosomes from one generation to the next occur through meiosis. Meiotic division ensures genetic diversity, which is crucial to the survival of a species. In this unit, students gain a


deeper understanding of Mendelian genetics and learn how non-Mendelian genetics describes patterns of inheritance that seem to violate Mendel's laws. This unit also covers the roles played by chromosomal inheritance, environmental factors, and nondisjunction on an individual's phenotype. In Unit 6, students move on to learn about gene expression and regulation.

## Unit Outcomes:

# UNIT 5

## Heredity

### UNIT AT A GLANCE

Topic	Suggested Skills	Class Periods
		~8–10 CLASS PERIODS
<b>5.1 Meiosis</b>	<b>1.B</b> Explain biological concepts and processes.	
<b>5.2 Meiosis and Genetic Diversity</b>	<b>3.A</b> Identify or pose a testable question based on an observation, data, or a model.	
<b>5.3 Mendelian Genetics</b>	<b>5.C</b> Perform chi-square hypothesis testing. <b>6.E</b> Predict the causes or effects of a change in, or disruption to, one or more components in a biological system.	
<b>5.4 Non-Mendelian Genetics</b>	<b>5.A</b> Perform mathematical calculations, including: i. mathematical equations in the curriculum ii. means iii. rates iv. ratios v. percentages and percent changes <b>5.C</b> Perform chi-square hypothesis testing.	
<b>5.5 Environmental Effects on Phenotype</b>	<b>1.C</b> Explain biological concepts and processes in applied contexts.	
 Go to <a href="#">AP Classroom</a> to assign the <b>Progress Check</b> for Unit 5. Review the results in class to identify and address any student misunderstandings.		

#### Sample Unit Assignments: [Genetics Practice Problems](#)

Students practice making genotype and phenotype predictions based on Mendelian and non-Mendelian patterns of inheritance.

#### Sample Lab: Genetics of *Drosophila* [Part 1](#) and [Part 2](#)

Students breed fruit flies and study phenotypes across three generations to determine the genetic pattern of inheritance.

**Sample Unit Assessment:** [Heredity Assessment](#)

This test is typical of the course. It involves both multiple choice and free-response items, similar to the College Board test.

**Unit 6: Gene Expression and Regulation****Unit Summary:**

Progressing from the continuity of life to gene expression, students gain in-depth knowledge about nucleic acids and their role in gene expression in this unit. There is also a finer focus on the comparison between the structures of DNA and RNA. This unit highlights how an individual's genotype is physically expressed through their phenotype, thus emphasizing the importance of protein synthesis (transcription and translation) in Gene expression. Regulation of gene expression and cell specialization are instrumental in ensuring survival within an individual and across populations. Unit 7 moves on to cover natural selection.

**Essential Questions:**

- How does gene regulation relate to the continuity of life?
- How is the genetic information of a species diversified from generation to generation?

**Unit Outcomes:****Gene Expression and Regulation****UNIT AT A GLANCE**

		<b>Class Periods</b>
<b>Topic</b>	<b>Suggested Skills</b>	<b>~18-20 CLASS PERIODS</b>
<b>6.1 DNA and RNA Structure</b>	<b>1.C</b> Explain biological concepts and processes in applied contexts.	
<b>6.2 DNA Replication</b>	<b>2.B</b> Explain relationships between characteristics of biological models in both theoretical and applied contexts.	
<b>6.3 Transcription and RNA Processing</b>	<b>2.B</b> Explain relationships between characteristics of biological models in both theoretical and applied contexts.	
<b>6.4 Translation</b>	<b>2.D</b> Represent relationships within biological models, including mathematical models, diagrams, flowcharts, and systems. <b>6.E</b> Predict the causes or effects of a change in, or disruption to, one or more components in a biological system.	
<b>6.5 Regulation of Gene Expression</b>	<b>6.A</b> Make a scientific claim.	
<b>6.6 Gene Expression and Cell Specialization</b>	<b>6.B</b> Support a claim with evidence from biological principles, concepts, processes, and data.	
<b>6.7 Mutations</b>	<b>2.C</b> Explain how biological models relate to larger principles, concepts, processes, systems, or theories.	
<b>6.8 Biotechnology</b>	<b>6.D</b> Explain the relationship between experimental results	

**Sample Unit Assignments:** [DNA Replication Checkpoint](#)

Students demonstrate they understand the main ideas of the process of DNA replication.

**Sample Lab:** [Bacterial Transformation](#)

Students genetically alter bacteria to fluoresce like a jellyfish. This is a College Board lab.

**Sample Unit Assessment:** [Gene Regulation Checkpoint](#)

Students demonstrate that they understand the main ideas about how genes are regulated (turned on and off) in prokaryotes and eukaryotes.

**Unit 7: Natural Selection****Unit Summary:**

The concepts in Unit 7 build on foundational content from previous units as students discover natural selection—a mechanism of evolution. Natural selection is the theory that populations that are better adapted to their environment will survive and reproduce. Thus, the evolution of a species involves a change in its genetic makeup over time. In this unit, students study the evidence for and mechanisms of evolutionary change. Students also learn what happens when a species does not adapt to a changing or volatile environment and about the Hardy–Weinberg equilibrium as a model for describing and predicting allele frequencies in non-evolving populations. Students will learn to calculate and draw conclusions about the evolution, or lack thereof, of a population from data related to allele frequencies. The biological principles studied here and in previous units will carry over into Unit 8, which focuses on ecology.

**Essential Questions:**

- What conditions in a population make it more or less likely to evolve?
- Can we scientifically defend the theory of evolution?
- How does species interaction encourage or slow changes in species?

**Unit Outcomes:****Natural Selection****UNIT AT A GLANCE**

Topic	Suggested Skills	Class Periods
		<b>~19–21 CLASS PERIODS</b>
<b>7.1 Introduction to Natural Selection</b>	<b>2.A</b> Describe characteristics of visual representations of biological concepts and processes.	
<b>7.2 Natural Selection</b>	<b>1.B</b> Explain biological concepts and processes.	
<b>7.3 Artificial Selection</b>	<b>4.B</b> Describe data from a table or graph, including: i. identifying specific data points ii. describing trends and patterns in the data iii. describing relationships between variables	

#### 7.4 Population Genetics

**3.B** State the null hypothesis or predict the results of an experiment.

#### 7.5 Hardy-Weinberg Equilibrium

**1.C** Explain biological concepts and processes in applied contexts.

**8.A** Perform mathematical calculations, including:

- i. mathematical equations in the curriculum
- ii. means
- iii. rates
- iv. ratios
- v. percentages and percent changes

#### 7.6 Evidence of Evolution

**4.B** Describe data from a table or graph, including:

- i. identifying specific data points
- ii. describing trends and patterns in the data
- iii. describing relationships between variables

#### 7.7 Common Ancestry

**6.E** Predict the causes or effects of a change in, or disruption to, one or more components in a biological system.

#### 7.8 Continuing Evolution

**3.D** Propose a new investigation based on an evaluation of the experimental design or evidence.

#### 7.9 Phylogeny

**2.D** Represent relationships within biological models, including mathematical models, diagrams, flowcharts, and systems.

#### 7.10 Speciation

**2.A** Explain relationships between characteristics of biological models in both theoretical and applied contexts.

**6.E** Predict the causes or effects of a change in, or disruption to, one or more components in a biological system.

#### 7.11 Variations in Populations

**6.C** Provide reasoning to justify a claim by connecting evidence to biological theories.

#### 7.12 Origins of Life on Earth

**3.B** State the null hypothesis or predict the results of an experiment.



Go to [AP Classroom](#) to assign the **Progress Check** for Unit 7. Review the results in class to identify and address any student misunderstandings.

#### Sample Unit Assignments:

- Chapter reading guides: [Ch. 19 reading Guide](#)
- [Artificial Selection](#)
- [Gizmos Natural Selection 2022](#)
- [Fishy Frequencies](#)

The above sample assignments in Unit 1 meet UC A-G requirements and College Board AP Biology standards by combining literacy, synthesis, and inquiry-based learning. Through **reading guides**, students build disciplinary literacy and analyze scientific texts; **the Gizmos** allows students to collect data through an online model to analyze directional natural selection. **Fishy frequencies** allows them to use authentic data to apply mathematical formulas to analyze a shift in allele frequency to determine if evolution has occurred. Students demonstrate understanding through varied products—notes, written reflections, and graphs—ensuring access for diverse learners and reinforcing inclusive, college-level science practices.

### Sample Lab:

- Bioinformatics lab: [Murder by HIV?](#) : Students use a real-life sequence-alignment tool (the BLAST platform) to compare DNA or protein sequences, construct phylogenetic trees, and interpret evolutionary relationships among organisms. This lab supports unit outcomes by having students practise data analysis, model building, and drawing evidence-based conclusions — aligning with science practices of inquiry, representation, and explanation. It also meets instructional standards by introducing students to computational biology, linking molecular structure to evolutionary patterns, and allowing diverse access (since all students can use online tools regardless of prior lab skill). The inclusive design ensures multiple perspectives by inviting comparisons across different species and evolutionary lineages.
- [Brine Shrimp Investigation CLASS COPY](#) [Brine Shrimp Investigation STUDENT](#) : Students manipulate environmental salinity conditions and observe the hatching success or survival of Brine shrimp populations to model how environmental pressures select for certain traits. This activity addresses unit outcomes by demonstrating natural selection in action, how variation and environment interact, and how populations adapt over time. It aligns with instructional standards by emphasizing student-driven experimentation, data interpretation, and drawing connections between an observable model system and broader evolutionary concepts. The lab is designed for inclusive access—students of varying lab experience can contribute, data can be collected in several ways, and the model system is relevant and accessible to all learners, drawing from multiple ecological and evolutionary perspectives.

### Sample unit Assessment:

- Almost each week, students have a **chapter quiz**. It is formative: open-notes and 5 multiple-choice questions to check their understanding and provide a platform for identifying areas of growth prior to the summative Unit Exam
- **Unit Exam** - The unit exam is formatted to mirror the College Board AP exam in May. There are multiple-choice questions (from a bank of AP questions), as well as Free Response Questions (either from previous AP exams or generated by the teacher).

## Unit 8: Ecology

### Unit Summary:

The content in Unit 8 brings together student learning from all previous units as it shows how a system's interactions are directly related to the system's available energy and its ability to evolve and respond to changes in its environment. When highly complex living systems interact, communities and ecosystems change based on those interactions. The more biodiversity present in a system, the more likely that system is to maintain its health and success in the face of disruption. Energy flows through systems; the rate of flow determines the success of the species within the systems. By this point in the course, a student should be able to accurately determine what happens within biological systems when disruptions occur.

### Essential Questions:





- How does diversity among and between species in a biological system affect the evolution of species within the system?
- How does the acquisition of energy relate to the health of a biological system?
- How do communities and ecosystems change, for better or worse, due to biological disruption?
- How does a disruption of a biological system affect genetic information storage and transmission?
- How do organisms use energy or conserve energy to respond to environmental stimuli?

### Unit Outcomes:

## UNIT AT A GLANCE

		Class Periods
Topic	Suggested Skill	~19–21 CLASS PERIODS
<b>8.1 Responses to the Environment</b>	<b>3.C</b> Identify experimental procedures that align with the question, including: <ol style="list-style-type: none"> <li>identifying dependent and independent variables</li> <li>identifying appropriate controls</li> <li>justifying appropriate controls</li> </ol>	
<b>8.2 Energy Flow Through Ecosystems</b>	<b>6.D</b> Explain the relationship between experimental results and larger biological concepts, processes, or theories.	
<b>8.3 Population Ecology</b>	<b>4.A</b> Construct a graph to represent the data, including: x-y graphs (bar, histogram, line, log scale, dual y), scatter plot, box and whisker plot, and pie chart. The graph should include the following components: <ol style="list-style-type: none"> <li>type of graph appropriate for the data</li> <li>axis labeling, including appropriate units and legend</li> <li>scaling</li> <li>accurately plotted data (including error bars when appropriate)</li> <li>trend line (when appropriate)</li> </ol>	
<b>8.4 Effect of Density on Populations</b>	<b>5.A</b> Perform mathematical calculations, including: <ol style="list-style-type: none"> <li>mathematical equations in the curriculum</li> <li>means</li> <li>rates</li> <li>ratios</li> <li>percentages and percent changes</li> </ol>	
<b>8.5 Community Ecology</b>	<b>5.B</b> Use confidence intervals and error bars to estimate whether sample means are statistically different.	
<b>8.6 Biodiversity</b>	<b>6.E</b> Predict the causes or effects of a change in, or disruption to, one or more components in a biological system.	
<b>8.7 Disruptions in Ecosystems</b>	<b>5.D</b> Use data to evaluate a hypothesis or prediction, including rejecting or failing to reject the null hypothesis.	

### Sample Unit Assignments:

-  Ch. 40 Reading Guide
-  HHMI Pop Dynamics
-  Simpson Diversity Index
-  HHMI Nutrient Cycling in the Serengeti

In this unit, students explore ecosystem interactions and biodiversity through quantitative data analysis, modeling, and scientific reading. A key assignment, the **Population Dynamics and Simpson's Diversity Index Investigation**, requires students to collect and analyze population data, calculate diversity indices, and model ecological relationships—producing a **data report and graph-based analysis** that illustrate how population size, species diversity, and resource availability affect ecosystem stability. The **HHMI Nutrient Cycling in the Serengeti** activity extends this learning by modeling real-world systems, allowing students to see how matter cycles through ecosystems, and how different elements can be limiting factors. The **reading guide** builds scientific literacy and reinforces key concepts through structured reflection and comprehension. Together, these assignments meet the UC A–G criteria by integrating inquiry, data interpretation, and critical thinking while emphasizing inclusive access and relevance—highlighting global ecological issues and multiple scientific perspectives on conservation and sustainability.

#### Sample Lab:

- **Transpiration Investigation** : In this lab, students sample different microhabitats to determine the impact on transpiration, the movement of water through plants over time.
- **AP Bio Ladybug Behavior Lab** : In this lab, students explore how environmental stimuli influence the movement and choice behavior of ladybugs using a dual-chamber choice apparatus. They collect quantitative data on distribution under varying light and temperature conditions and then use statistical tools (e.g., chi-square or simple proportions) to determine whether their results reflect random distribution or directed behavior. This directly aligns with the unit outcomes by requiring students to (a) design or interpret controlled experiments, (b) analyze data in biological context, and (c) communicate evidence-based conclusions about behavior and adaptation. The activity supports the standards of instruction by engaging students in scientific practices of hypothesis formulation, data collection, model interpretation, and evaluation of error or alternative explanations. To promote inclusive access and representation, the procedure is designed so that students with different strengths (quantitative analysis, visual modeling, writing) can contribute meaningfully, and the findings connect to broader themes—such as how organisms respond to environmental change—which ensures the work remains relevant across cultural and ecological contexts.

#### Sample unit Assessment:

- Almost each week, students have a **chapter quiz**. It is formative: open-notes and 5 multiple-choice questions to check their understanding and provide a platform for identifying areas of growth prior to the summative Unit Exam
- **Unit Exam** - The unit exam is formatted to mirror the College Board AP exam in May. There are multiple-choice questions (from a bank of AP questions), as well as Free Response Questions (either from previous AP exams or generated by the teacher).

#### Recommended Texts and Resources:

Pilot: *Biology for the AP Course*, James Morris; Domenic Castignetti; John Lepri; Rick Relyea, 1st Edition, 2022

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**UC “D” Approved**