Science Department
AP Biology

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Effective Date: September 2025

Scope and Sequence

Unit	Topic of Study	Duration (Weeks)
1	Ecology	5
2	Chemistry of Life	3
3	Cells	5
4	Cellular Energetics	5
5	Cell Communication and the Cell Cycle	5
6	Heredity	3
7	Gene Expression & Regulation	6
8	Natural Selection	6

Unit 1
Ecology
Summary and Rationale
The content in this unit 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 those systems. By this point in

the course, students should be able to accurately determine what happens within biological systems when disruptions occur.

Recommended Pacing

5 weeks (~19-21 class periods - per AP recommendations in the CED)
Exam weight: 10-15%

Standards

HS-LS2-2: Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.
HS-LS2-3: Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions.
HS-LS2-4: Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.
HS-LS2-5: Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.
HS-LS2-6: Evaluate the claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.
HS-LS2-7: Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.

Interdisciplinary Connections

9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a).

9.4.12.CI.3: Investigate new challenges and opportunities for personal growth, advancement, and transition (e.g., 2.1.12.PGD.1).

Instructional Focus

Unit Essential Questions:

- How does diversity among and between species in a biological system affect the evolution of species within an ecosystem?
- 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 and storage of transmission?
- How do organisms use energy or conserve energy to respond to environmental stimuli?
- How do species interactions affect the survival of an ecosystem?
- How do changes in matter and free energy available to organisms result in changes in population size and disruptions to an ecosystem?
- How are population dynamics affected by the level of variation in a population?
- How do adaptations in organisms relate to them obtaining and using energy and matter in a particular environment?
- In what ways do communities interact within their environments that result in the movement of matter and energy?

- How are biological systems from cells to organisms to populations, communities, and ecosystems affected by complex biotic and abiotic interactions involving exchange of matter and free energy?
- How do organisms use free energy to maintain organization, growth, and reproduction?
- How can changes in energy availability affect population size?
- How is matter (C, H, O, N, P) cycled through the living and nonliving components of the environment?
- How does the diversity of a species within an ecosystem influence the stability of the ecosystem?
- In what ways do interactions between and within populations influence patterns of species distribution and amount of local and global ecosystem changes over time?
- How do organisms communicate with one another, specifically, how can individuals act on information and communicate it to others?
- In what ways are timing and coordination of behavior important in natural selection?

Unit Enduring Understandings:

- Living systems are organized in a hierarchy of structural levels that interact.
- Communities and ecosystems change on the basis of interactions among populations and disruptions to the environment.
- The highly complex organization of living systems requires constant input of energy and the exchange of macromolecules.
- Naturally occurring diversity among and between components within biological systems affects interactions with the environment.
- Evolution is characterized by change in the genetic make-up of a population over time and is supported by multiple lines of evidence.
- Competition and cooperation are important aspects of biological systems.
- Timing and coordination of biological mechanisms involved in growth, reproduction, and homeostasis depend on organisms responding to environmental cues.
- Transmission of information results in changes within and between biological systems.
- Interactions between and within populations influence patterns of species distribution and abundance.
- Communities are composed of populations of organisms that interact in complex ways.
- Organisms must exchange matter with the environment to grow, reproduce and maintain organization.
- The diversity of species within an ecosystem may influence the stability of the ecosystem.
- Distribution of local and global ecosystems change over time.

Evidence of Learning (Assessments)

Assign the Progress Checks from AP Course and Exam Description Resource for each unit.
Each Personal Progress Check contains formative multiple-choice and free-response questions.
The feedback from the Personal Progress Checks shows students the areas where they need to focus.

Objectives (SLO)

Topic 8.1 – Responses to the Environment

- Explain how behavioral and physiological responses of organisms relate to changes in internal or external environments.
- Describe how organisms respond to environmental stimuli.
- Explain how behavioral responses affect an organism's fitness and contribute to population success.
- Describe how communication and cooperative behaviors influence survival and reproduction.

Topic 8.2 – Energy Flow Through Ecosystems

- Describe the strategies organisms use to acquire and use energy.
- Explain how energy flows and matter cycles through trophic levels.
- Describe the major biogeochemical cycles, including the water, carbon, nitrogen, and phosphorus cycles.
- Explain how changes in energy availability affect populations, communities, and ecosystems.
- Explain how autotrophs and heterotrophs contribute to energy flow within ecosystems.

Topic 8.3 – Population Ecology

- Describe factors that influence population growth dynamics.
- Explain how birth rates, death rates, and population size affect population growth.
- Compare exponential and logistic population growth.
- Interpret population growth models and graphs.

Topic 8.4 – Effect of Density on Populations

- Explain how population density affects and is determined by resource availability in the environment.
- Describe carrying capacity and limiting factors.
- Distinguish between density-dependent and density-independent factors.
- Explain how environmental conditions influence population growth.

Topic 8.5 – Community Ecology

- Describe the structure of a community according to its species composition and diversity.
- Explain how interactions within and among populations influence community structure.
- Describe competition, predation, mutualism, commensalism, and parasitism.
- Explain how interactions between species affect population dynamics and ecosystem stability.

Topic 8.6 – Biodiversity

- Describe the relationship between ecosystem diversity and its resilience to environmental changes.
- Explain how the addition or removal of ecosystem components affects short-term and long-term ecosystem structure.
- Describe the role of keystone species in maintaining ecosystem diversity.
- Explain how biodiversity contributes to ecosystem stability and resilience.

Topic 8.7 – Disruptions in Ecosystems

- Explain how the environment interacts with random or preexisting genetic variations in populations.
- Explain how invasive species affect ecosystem dynamics.
- Describe human activities that lead to changes in ecosystem structure and dynamics.
- Explain how geological and meteorological activity leads to changes in ecosystem structure and dynamics.
- Explain how environmental disruptions can affect biodiversity and cause population declines or extinctions.

Suggested Resources/Technology Tools

College Board AP Website

Modifications

Special Education-

Modifications and accommodations must be aligned to students' IEPs and uphold expectations of the plan lawfully.

- Allow additional time for skill mastery.
- Provide small group/ individualized instruction.

● Allow use of assistive technology.
● Anticipate needs; pre-teach if needed.
● Have student repeat directions to check for understanding.
● Highlight text/ visual presentation.
● Modify assessment/assignment content, format, length (benchmarks, tests and quizzes) .

ML-

● Provide additional wait time for student responses to questions
● Provide simplification of sentence structure and repetition of questions/sentences exactly as stated before trying to rephrase.
● Speak clearly, using a normal tone and rate of speed, or slightly slower.
● Use directed reading activities. Ensure preview of text before assigned/read, provide pre-reading

Gifted and Talented-

● Advance, accelerate, or compact content
● Support abstract and advanced higher-level thinking through differentiated questioning
● Allowance for adapting of content for individual student interests
● Provide assignments geared to development in areas of affect, creativity, cognition, and research skills

504-

Modifications and accommodations must be aligned to the 504 plan and uphold expectations of the plan lawfully.

● Provide additional time for in-class assignments and assessments
● Allow for computer with voice output, spelling and grammar checker
● Offer individual help throughout the lesson
● Modify readings and primary source documents

At Risk-

● Provide small group instruction for identified areas for growth
● Allow for alternate pathways for completion of assignments.
● Provide additional wait time for student responses to questions
● Pair oral instruction with visuals
● Utilize manipulatives

For a full list of Accommodations and Modifications, please click here.

Career Readiness, Life Literacies, and Key Skills Practices (June 2020)

Please select all standards that apply to this unit of study:

- ☐ Act as a responsible and contributing citizen and employee.
- ☑ Apply appropriate academic and technical skills.
- ☐ Attend to personal health and financial well being.
- ☑ Communicate clearly and effectively and with reason.
- ☐ Consider the environmental, social and economics impacts of decisions.
- ☐ Demonstrate creativity and innovation.
- ☑ Employ valid and reliable research strategies.
- ☑ Utilize critical thinking to make sense of problems and persevere in solving them.
- ☐ Model integrity, ethical leadership, and effective management.
- ☐ Plan education and career paths aligned to personal goals.
- ☐ Use technology to enhance productivity.
- ☐ Work productively in teams while using cultural global competence.

Unit 2

Chemistry of Life

Summary and Rationale

This 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 energy input and the exchange of macromolecules. This unit also addresses in detail how molecules called monomers bond together in specific conformations 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 interactions and bonding of atoms to form molecules.

Recommended Pacing

3 weeks (~9-11 class periods - per AP recommendations in the CED)
Exam weight: 8-11%

Standards

HS-LS1-6: Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules.
HS-LS1-1: Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells.
HS-PS1-1: Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms.
HS-PS1-2: Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.
HS-PS1-3: Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles.
HS-PS1-4: Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy.

Interdisciplinary Connections

9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a).

9.4.12.CI.3: Investigate new challenges and opportunities for personal growth, advancement, and transition (e.g., 2.1.12.PGD.1).

Instructional Focus

Unit Essential Questions:

- What is the role of energy in the making and breaking of polymers? (ENE)
- How do living systems transmit information in order to ensure their survival? (IST)

- How would living systems function without the polarity of the water molecule? (SYI-1)
- In what ways does variation in molecular units provide cells with a wider range of functions?
- In what ways do the subcomponents of biological molecules and their sequence, determine the properties of that molecule?
- How is DNA, and in some cases RNA, the primary source of heritable information?
- How does scientific evidence support hypotheses about the origin of life on Earth? (SYI-3)
- How do media artists generate ideas and formulate artistic intent?
- How does collaboration expand and affect the creative process? How can creative risks be encouraged?

Unit Enduring Understandings:

- Living systems are organized in a hierarchy of structural levels that interact. (SYI-1)
- The highly complex organization of living systems requires constant input of energy and the exchange of macromolecules. (ENE-1)
- Heritable information provides for continuity of life. (IST-1)
- Organisms must exchange matter with the environment to grow, reproduce, and maintain organization.
- The subcomponents of biological molecules and their sequence determine the properties of that molecule.
- Naturally occurring diversity among and between components within biological systems affects interactions with the environment. (SYI-3)

Evidence of Learning (Assessments)

Assign the Progress Checks from AP Course and Exam Description Resource for each unit.
Each Personal Progress Check contains formative multiple-choice and free-response questions.
The feedback from the Personal Progress Checks shows students the areas where they need to focus.

Objectives (SLO)

Topic 1.1 – Structure of Water and Hydrogen Bonding

- Explain how water's polarity and hydrogen bonding contribute to its biological properties.
- Relate cohesion, adhesion, surface tension, specific heat, and heat of vaporization to the functions of water in living systems.

Topic 1.2 – Elements of Life

- Describe the composition of macromolecules required by living organisms.
- Identify the major elements (carbon, hydrogen, oxygen, nitrogen, phosphorus, and sulfur) found in biological molecules.

Topic 1.3 – Introduction to Macromolecules

- Describe the chemical reactions that build and break biological macromolecules.
- Explain dehydration synthesis and hydrolysis.

Topic 1.4 – Carbohydrates

- Describe the structure and function of carbohydrates.
- Explain how monosaccharides combine to form polysaccharides.

Topic 1.5 – Lipids

- Describe the structure and function of lipids.
- Distinguish between saturated and unsaturated fatty acids.
- Explain the roles of fats, steroids, cholesterol, and phospholipids in living organisms.

Topic 1.6 – Nucleic Acids

- Describe the structure and function of DNA and RNA.
- Compare the structural differences between DNA and RNA.
- Explain how nucleotide sequences store biological information.

Topic 1.7 – Proteins

- Describe the structure and function of proteins.
- Explain how amino acids form polypeptides through peptide bonds.
- Explain how the structure and shape of proteins relate to their functions.

Suggested Resources/Technology Tools

College Board AP Website

Modifications

Special Education-

Modifications and accommodations must be aligned to students' IEPs and uphold expectations of the plan lawfully.

● Allow additional time for skill mastery.
● Provide small group/ individualized instruction.
● Allow use of assistive technology.
● Anticipate needs; pre-teach if needed.
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● Highlight text/ visual presentation.
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ML-

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Gifted and Talented-

● Advance, accelerate, or compact content
● Support abstract and advanced higher-level thinking through differentiated questioning
● Allowance for adapting of content for individual student interests
● Provide assignments geared to development in areas of affect, creativity, cognition, and research skills

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● Modify readings and primary source documents

At Risk-

● Provide small group instruction for identified areas for growth
● Allow for alternate pathways for completion of assignments.
● Provide additional wait time for student responses to questions
● Pair oral instruction with visuals
● Utilize manipulatives

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Career Readiness, Life Literacies, and Key Skills Practices (June 2020)

Please select all standards that apply to this unit of study:

- ☐ Act as a responsible and contributing citizen and employee.
- ☑ Apply appropriate academic and technical skills.
- ☐ Attend to personal health and financial well being.
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- ☐ Consider the environmental, social and economics impacts of decisions.
- ☐ Demonstrate creativity and innovation.
- ☑ Employ valid and reliable research strategies.
- ☑ Utilize critical thinking to make sense of problems and persevere in solving them.
- ☐ Model integrity, ethical leadership, and effective management.
- ☐ Plan education and career paths aligned to personal goals.
- ☐ Use technology to enhance productivity.
- ☐ Work productively in teams while using cultural global competence.

Unit 3

Cells

Summary and Rationale

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 materials with the cell's external environment, an important foundational concept.

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.

Recommended Pacing

5 weeks (~14-16 class periods - per AP recommendations in the CED)
Exam weight: 10-13%

Standards

HS-LS1-2: Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.
HS-LS1-1: Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells.
HS-PS2-6: Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.
HS-PS1-3: Plan and conduct an investigation to gather evidence to compare the structure of substances at the bulk scale to infer the strength of electrical forces between particles.
HS-LS1-3: Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.
HS-LS1-7: Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed, resulting in a net transfer of energy.

Interdisciplinary Connections

9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a).

9.4.12.CI.3: Investigate new challenges and opportunities for personal growth, advancement, and transition (e.g., 2.1.12.PGD.1).

Instructional Focus

Unit Essential Questions:

- What scientific evidence supports models of the origin of life? (The Origin of Life – Scientific Evidence)
- What hypotheses exist, with supporting scientific evidences, including mathematical models, about the natural origin of life on Earth? (Abiogenesis)
- In what ways does variation in molecular units provide cells with a wider range of functions? (Cell Structure: Subcellular Components- 2.1)
- How do the structure and function of subcellular components and their interactions provide essential cellular processes? (Cell Structure: Subcellular Components- 2.1)
- How does cell size affect the ability of biological systems to obtain necessary resources or eliminate waste products? (Cell Size, 2.3)
- In what ways do eukaryotic cells' internal membranes and organelles (structure) contribute to cell functions? (Cell Structure and Function, 2.2)
- How do cells create and maintain internal environments that are different from their external environments? (Plasma Membranes, 2.4)
- How is growth and dynamic homeostasis maintained by the constant movement of molecules across membranes? (Membrane Permeability, 2.5)

Unit Enduring Understandings:

- Scientific evidence from many different disciplines supports models of the origin of life. (The Origin of Life – Scientific Evidence - 1.D.2)
- The origin of life on Earth is explained by natural processes. (Abiogenesis - 1.D.1)
- Evolution is characterized by a change in the genetic makeup of a population over time and is supported by multiple lines of evidence. (EVO-1)
- Living Systems are organized in a hierarchy of structural levels that interact. (SYI-1)
- The highly complex organization of living systems requires constant input of energy and the exchange of macromolecules. (ENE-1)

- Cells have membranes that allow them to establish and maintain internal environments that are different from their external environments. (ENE-2)

Evidence of Learning (Assessments)

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Objectives (SLO)

Topic 2.1 – Cell Structure and Function

- Explain how the structure and function of subcellular components and organelles contribute to cell function.
- Compare the structures and functions of major cell organelles.
- Explain how organelles work together to maintain cellular processes.

Topic 2.2 – Cell Size

- Explain how surface area-to-volume ratios affect the exchange of materials between cells or organisms and the environment.
- Calculate and compare surface area-to-volume ratios.
- Explain how cell size influences the efficiency of material exchange.

Topic 2.3 – Plasma Membrane

- Describe the roles of cell membrane components in maintaining the internal environment of the cell.
- Describe the fluid mosaic model of cell membranes.
- Explain how phospholipids, proteins, and other membrane components contribute to membrane structure and function.

Topic 2.4 – Membrane Permeability

- Explain how the structure and properties of molecules affect their ability to cross the plasma membrane.
- Describe the selective permeability of the plasma membrane.

Topic 2.5 – Membrane Transport

- Describe the mechanisms organisms use to maintain solute and water balance.
- Explain the differences between passive and active transport.
- Describe how cells transport large molecules through endocytosis and exocytosis.

Topic 2.6 – Facilitated Diffusion

- Explain how the structure of a molecule affects its ability to pass through the plasma membrane.
- Describe how channel and carrier proteins facilitate the movement of substances across membranes.

Topic 2.7 – Tonicity and Osmoregulation

- Explain how concentration gradients affect the movement of molecules across membranes.
- Compare hypotonic, hypertonic, and isotonic solutions.
- Explain how osmoregulatory mechanisms contribute to the health and survival of organisms.
- Calculate and interpret water potential.

Topic 2.8 – Mechanisms of Transport

- Explain how active transport moves substances across cell membranes using energy.
- Describe the role of membrane proteins in establishing and maintaining electrochemical gradients.
- Explain how transport mechanisms help maintain cellular homeostasis.

Topic 2.9 – Cell Compartmentalization

- Describe the membrane-bound structures of eukaryotic cells.
- Explain how internal membranes and membrane-bound organelles contribute to the compartmentalization of cellular functions.

Suggested Resources/Technology Tools

College Board AP Website

Modifications

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- ☐ Consider the environmental, social and economics impacts of decisions.
- ☐ Demonstrate creativity and innovation.
- ☑ Employ valid and reliable research strategies.
- ☑ Utilize critical thinking to make sense of problems and persevere in solving them.
- ☐ Model integrity, ethical leadership, and effective management.
- ☐ Plan education and career paths aligned to personal goals.
- ☐ Use technology to enhance productivity.
- ☐ Work productively in teams while using cultural global competence.

Unit 4

Cellular Energetics

Summary and Rationale

In this unit, students build on knowledge gained in the Cells Unit 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 the Heredity Unit while studying how cells use energy to fuel life processes.

Recommended Pacing

5 weeks (~12-14 class periods - per AP recommendations in the CED)
Exam weight: 12-16%

Standards

HS-LS1-5: Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.
HS-LS1-7: Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed, resulting in a net transfer of energy.
HS-LS2-3: Construct and revise an explanation based on evidence for the cycling of matter and flow of energy in aerobic and anaerobic conditions.
HS-LS2-5: Develop a model to illustrate the role of photosynthesis and cellular respiration in the cycling of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.

HS-LS1-6: Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules.
HS-PS1-2: Construct and revise an explanation for the outcome of a simple chemical reaction based on the outermost electron states of atoms, trends in the periodic table, and knowledge of the patterns of chemical properties.
HS-PS1-4: Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy.
HS-PS3-1: Create a computational model to calculate the change in the energy of one component in a system when the change in energy of the other component(s) and energy flows in and out of the system are known.

Interdisciplinary Connections

9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a).

9.4.12.CI.3: Investigate new challenges and opportunities for personal growth, advancement, and transition (e.g., 2.1.12.PGD.1).

Instructional Focus

Unit Essential Questions:

- How is energy captured and then used by a living system? (ENE)
- How do organisms use energy or conserve energy to respond to environmental stimuli? (SYI)
- In what ways do all living systems require a constant input of free energy? (Cellular Energy, 3.4)
- Why are enzymes necessary to sustain life and how do they work? (Enzymes, 3.1, 3.2)
- How do interactions between molecules affect their structure and function?
- How do organisms capture and store free energy for use in biological processes?
- How do organisms release stored free energy for use in biological processes? (Cellular Respiration, 3.6)

Unit Enduring Understandings:

- The highly complex organization of living systems requires constant input of energy and the exchange of macromolecules. (ENE-1) (Cellular Energy, 3.4)
- All living systems require constant input of free energy. (Cellular Energy, 3.4)
- Interactions between molecules affect their structure and function. (Enzyme Catalysis, 3.2)
- The structure and function of subcellular components, and their interactions, provide essential cellular processes.
- Organisms capture and store free energy for use in biological processes. (Cellular Respiration and Photosynthesis, 3.5, 3.6)
- Naturally occurring diversity among and between components within biological systems affects interactions with the environment. (SYI-3)

Evidence of Learning (Assessments)

Assign the Progress Checks from AP Course and Exam Description Resource for each unit.
Each Personal Progress Check contains formative multiple-choice and free-response questions.
The feedback from the Personal Progress Checks shows students the areas where they need to focus.

Objectives (SLO)

Topic 3.1 – Enzymes

- Explain how enzymes affect the rate of biological reactions.
- Describe how enzymes lower activation energy.
- Explain how enzyme-substrate interactions contribute to enzyme function.

Topic 3.2 – Environmental Impacts on Enzyme Function

- Explain how changes in environmental conditions affect enzyme activity.
- Describe how temperature, pH, and other environmental factors influence enzyme structure and function.
- Analyze data related to enzyme activity.

Topic 3.3 – Cellular Energy

- Explain how cells use energy to maintain biological processes.
- Describe the relationship between energy, free energy, and thermodynamics.
- Explain how energy-releasing and energy-requiring reactions are coupled.
- Explain how conserved metabolic pathways provide evidence of common ancestry.

Topic 3.4 – Photosynthesis

- Describe the processes and structural features of chloroplasts that allow organisms to capture and store energy.
- Explain how cells capture energy from light and transfer it to biological molecules.
- Describe the roles of the light-dependent reactions and the Calvin cycle.
- Explain how ATP and NADPH contribute to carbohydrate production.

Topic 3.5 – Cellular Respiration

- Describe the processes and structural features of mitochondria that allow organisms to use energy stored in biological macromolecules.
- Explain how cells obtain energy from biological macromolecules to power cellular functions.
- Describe the roles of glycolysis, the Krebs cycle, the electron transport chain, and chemiosmosis.
- Explain how ATP is produced during cellular respiration.
- Compare aerobic and anaerobic processes of energy production.

Suggested Resources/Technology Tools

College Board AP Website

Modifications

Special Education-

Modifications and accommodations must be aligned to students' IEPs and uphold expectations of the plan lawfully.

● Allow additional time for skill mastery.
● Provide small group/ individualized instruction.
● Allow use of assistive technology.
● Anticipate needs; pre-teach if needed.
● Have student repeat directions to check for understanding.
● Highlight text/ visual presentation.
● Modify assessment/assignment content, format, length (benchmarks, tests and quizzes) .

ML-

● Provide additional wait time for student responses to questions
● Provide simplification of sentence structure and repetition of questions/sentences exactly as stated before trying to rephrase.
● Speak clearly, using a normal tone and rate of speed, or slightly slower.

● Use directed reading activities. Ensure preview of text before assigned/read, provide pre-reading

Gifted and Talented-

● Advance, accelerate, or compact content
● Support abstract and advanced higher-level thinking through differentiated questioning
● Allowance for adapting of content for individual student interests
● Provide assignments geared to development in areas of affect, creativity, cognition, and research skills

504-

Modifications and accommodations must be aligned to the 504 plan and uphold expectations of the plan lawfully.

● Provide additional time for in-class assignments and assessments
● Allow for computer with voice output, spelling and grammar checker
● Offer individual help throughout the lesson
● Modify readings and primary source documents

At Risk-

● Provide small group instruction for identified areas for growth
● Allow for alternate pathways for completion of assignments.
● Provide additional wait time for student responses to questions
● Pair oral instruction with visuals
● Utilize manipulatives

For a full list of Accommodations and Modifications, please click here.

Career Readiness, Life Literacies, and Key Skills Practices (June 2020)

Please select all standards that apply to this unit of study:

- ☐ Act as a responsible and contributing citizen and employee.
- ☑ Apply appropriate academic and technical skills.
- ☐ Attend to personal health and financial well being.
- ☑ Communicate clearly and effectively and with reason.
- ☐ Consider the environmental, social and economics impacts of decisions.
- ☐ Demonstrate creativity and innovation.
- ☑ Employ valid and reliable research strategies.
- ☑ Utilize critical thinking to make sense of problems and persevere in solving them.
- ☐ Model integrity, ethical leadership, and effective management.
- ☐ Plan education and career paths aligned to personal goals.
- ☐ Use technology to enhance productivity.
- ☐ Work productively in teams while using cultural global competence.

Unit 5

Cell Communication & Cell Cycle

Summary and Rationale

In this unit, 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 that provides for the continuity of life. In Unit 6, students will move on to learn about heredity.

Recommended Pacing

5 weeks (~12-14 class periods - per AP recommendations in the CED)
Exam weight: 10-15%

Standards

HS-LS1-3: Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.
HS-LS1-4: Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.
HS-LS1-2: Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.
HS-LS1-1: Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells.
HS-LS1-7: Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed, resulting in a net transfer of energy.
HS-PS2-6: Communicate scientific and technical information about why the molecular-level structure is important in the functioning of designed materials.

Interdisciplinary Connections

9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a).

9.4.12.CI.3: Investigate new challenges and opportunities for personal growth, advancement, and transition (e.g., 2.1.12.PGD.1).

Instructional Focus

Unit Essential Questions:

- How do cells communicate, transmit, and receive chemical signals? (Cell Communication, 4.1)
- How do conserved cellular processes support the idea that all organisms are linked by lines of descent from common ancestry? (Cell Communication, 4.1)
- How does signal transmission within and between cells mediate gene expression and cell function? (Signal Transduction Pathway, 4.3)
- How are external signals converted into cellular responses? (Signal Transduction Pathway, 4.3)
- How is heritable information passed to the next generation in eukaryotes? (Cell Cycle, Mitosis)

Unit Enduring Understandings:

- Cells communicate by generating, transmitting, receiving, and responding to chemical signals. (IST-3)
- Cells communicate with each other through direct contact with other cells or from a distance via chemical signaling. (Cell Communication)
- Cells communication processes share common features that reflect a shared evolutionary history.
- Signal transduction pathways link signal reception with cellular response. (Signal Transduction Pathway)
- Changes in signal transduction pathways can alter cellular response. (Effects of Changes in Pathways)
- Heritable information provides for continuity of life. (IST-1)
- In eukaryotes, heritable information is passed to the next generation via processes that include the cell cycle and mitosis or meiosis plus fertilization. (Cell Cycle, Mitosis)

Evidence of Learning (Assessments)

Assign the Progress Checks from AP Course and Exam Description Resource for each unit.
Each Personal Progress Check contains formative multiple-choice and free-response questions.
The feedback from the Personal Progress Checks shows students the areas where they need to focus.

Objectives (SLO)

Topic 4.1 – Cell Communication

- Describe the ways that cells communicate with one another.
- Explain how cells communicate over short and long distances.
- Distinguish between direct cell-to-cell communication and chemical signaling.

Topic 4.2 – Introduction to Signal Transduction

- Describe the components of a signal transduction pathway.
- Explain the role of receptors and signaling molecules in cellular communication.
- Describe how cells receive and transmit signals.

Topic 4.3 – Signal Transduction Pathways

- Describe the different types of cellular responses elicited by a signal transduction pathway.
- Explain how changes in the structure of signaling molecules affect pathway activity.
- Explain how signaling pathways influence gene expression and cellular responses.

Topic 4.4 – Feedback

- Explain how positive and negative feedback help maintain homeostasis.
- Compare positive and negative feedback mechanisms.
- Explain how feedback mechanisms respond to changes in internal and external conditions.

Topic 4.5 – Cell Cycle

- Describe the events that occur during the cell cycle.
- Explain the stages of interphase and mitosis.
- Describe how mitosis produces genetically identical daughter cells.
- Explain the role of cell division in growth, repair, and reproduction.

Topic 4.6 – Regulation of Cell Cycle

- Describe the role of checkpoints in regulating the cell cycle.
- Explain how cyclins and cyclin-dependent kinases regulate cell cycle progression.
- Explain how disruptions in cell cycle regulation can lead to uncontrolled cell division.

Suggested Resources/Technology Tools

College Board AP Website

Modifications

Special Education-

Modifications and accommodations must be aligned to students' IEPs and uphold expectations of the plan lawfully.

- Allow additional time for skill mastery.
- Provide small group/ individualized instruction.
- Allow use of assistive technology.
- Anticipate needs; pre-teach if needed.
- Have student repeat directions to check for understanding.
- Highlight text/ visual presentation.
- Modify assessment/assignment content, format, length (benchmarks, tests and quizzes) .

ML-

- Provide additional wait time for student responses to questions
- Provide simplification of sentence structure and repetition of questions/sentences exactly as stated before trying to rephrase.
- Speak clearly, using a normal tone and rate of speed, or slightly slower.
- Use directed reading activities. Ensure preview of text before assigned/read, provide pre-reading

Gifted and Talented-

- Advance, accelerate, or compact content
- Support abstract and advanced higher-level thinking through differentiated questioning
- Allowance for adapting of content for individual student interests
- Provide assignments geared to development in areas of affect, creativity, cognition, and research skills

504-

Modifications and accommodations must be aligned to the 504 plan and uphold expectations of the plan lawfully.

- Provide additional time for in-class assignments and assessments
- Allow for computer with voice output, spelling and grammar checker
- Offer individual help throughout the lesson
- Modify readings and primary source documents

At Risk-

- Provide small group instruction for identified areas for growth
- Allow for alternate pathways for completion of assignments.
- Provide additional wait time for student responses to questions
- Pair oral instruction with visuals
- Utilize manipulatives

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Career Readiness, Life Literacies, and Key Skills Practices (June 2020)

Please select all standards that apply to this unit of study:

- ☐ Act as a responsible and contributing citizen and employee.
- ☑ Apply appropriate academic and technical skills.
- ☐ Attend to personal health and financial well being.
- ☑ Communicate clearly and effectively and with reason.
- ☐ Consider the environmental, social and economics impacts of decisions.

- ☐ Demonstrate creativity and innovation.
- ☑ Employ valid and reliable research strategies.
- ☑ Utilize critical thinking to make sense of problems and persevere in solving them.
- ☐ Model integrity, ethical leadership, and effective management.
- ☐ Plan education and career paths aligned to personal goals.
- ☐ Use technology to enhance productivity.
- ☐ Work productively in teams while using cultural global competence.

Unit 6

Heredity

Summary and Rationale

This unit 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.

Recommended Pacing

3 weeks (~8-10 class periods - per AP recommendations in the CED)
Exam weight: 8-11%

Standards

HS-LS3-1: Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.
HS-LS3-2: Make and defend a claim based on evidence that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors.
HS-LS3-3: Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.
HS-LS1-1: Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells.
HS-LS1-4: Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.

Interdisciplinary Connections

9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a).

9.4.12.CI.3: Investigate new challenges and opportunities for personal growth, advancement, and transition (e.g., 2.1.12.PGD.1).

Instructional Focus

Unit Essential Questions:

- How is heritable information passed to the next generation in eukaryotes? (Cell Cycle, Mitosis and Meiosis)
- What multiple processes increase genetic variation in biological systems? (Increasing Genetic Variation)
- In what ways does the diversity of a species within an ecosystem influence the stability of the ecosystem?
- In what ways does the chromosomal basis of inheritance provide an understanding of the patterns of transmission of genes from parent to offspring? (Mendelian Genetics)
- How are inheritance patterns of many traits explained, other than through simple Mendelian genetics? (Advanced Genetics)
- How do changes in genotype result in changes in phenotype of an organism? (Mendelian Genetics)

Unit Enduring Understandings:

- Heritable information provides for continuity of life. (IST-1)
- In eukaryotes, heritable information is passed to the next generation via processes that include the cell cycle and mitosis or meiosis plus fertilization. (Cell Cycle, Mitosis and Meiosis)
- Organisms are linked by lines of descent from common ancestry. (EVO-2)
- Biological systems have multiple processes that increase genetic variation. (Increasing Genetic Variation)
- Naturally occurring diversity among and between components within biological systems affects interactions with the environment. (SYI-3)
- The chromosomal basis of inheritance provides an understanding of the pattern of passage (transmission) of genes from parent to offspring. (Mendelian Genetics)
- The inheritance patterns of many traits cannot be explained by simple Mendelian genetics. (Advanced Genetics)
- Changes in genotypes can result in changes in phenotypes. (Genotypes and Phenotypes)

Evidence of Learning (Assessments)

Assign the Progress Checks from AP Course and Exam Description Resource for each unit.
Each Personal Progress Check contains formative multiple-choice and free-response questions.
The feedback from the Personal Progress Checks shows students the areas where they need to focus.

Objectives (SLO)

Topic 5.1 – Meiosis

- Explain how meiosis results in the transmission of chromosomes from one generation to the next.
- Describe the stages of meiosis I and meiosis II.
- Compare the similarities and differences between mitosis and meiosis.
- Explain how meiosis produces haploid gametes.

Topic 5.2 – Meiosis and Genetic Diversity

- Explain how meiosis generates genetic diversity.

- Describe how crossing over and independent assortment contribute to genetic variation.
- Explain how random fertilization increases genetic diversity.
- Describe how nondisjunction affects chromosome number.

Topic 5.3 – Mendelian Genetics

- Explain how the inheritance of genes follows patterns described by Mendel.
- Apply probability rules to predict the inheritance of traits.
- Use monohybrid and dihybrid crosses to predict offspring genotypes and phenotypes.
- Interpret genetic crosses and inheritance patterns.

Topic 5.4 – Non-Mendelian Genetics

- Explain deviations from Mendel's model of inheritance.
- Describe incomplete dominance, codominance, and multiple alleles.
- Explain sex-linked inheritance patterns.
- Describe pleiotropy and non-nuclear inheritance.
- Interpret pedigrees to determine inheritance patterns.

Topic 5.5 – Environmental Effects on Phenotype

- Explain how the same genotype can result in multiple phenotypes under different environmental conditions.
- Describe how environmental factors influence gene expression and phenotypic variation.
- Explain phenotypic plasticity and its effects on organisms.

Suggested Resources/Technology Tools

College Board AP Website

Modifications

Special Education-

Modifications and accommodations must be aligned to students' IEPs and uphold expectations of the plan lawfully.

- Allow additional time for skill mastery.
- Provide small group/ individualized instruction.
- Allow use of assistive technology.
- Anticipate needs; pre-teach if needed.
- Have student repeat directions to check for understanding.
- Highlight text/ visual presentation.
- Modify assessment/assignment content, format, length (benchmarks, tests and quizzes) .

ML-

- Provide additional wait time for student responses to questions
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- Speak clearly, using a normal tone and rate of speed, or slightly slower.
- Use directed reading activities. Ensure preview of text before assigned/read, provide pre-reading

Gifted and Talented-

- Advance, accelerate, or compact content
- Support abstract and advanced higher-level thinking through differentiated questioning
- Allowance for adapting of content for individual student interests
- Provide assignments geared to development in areas of affect, creativity, cognition, and research skills

504-

Modifications and accommodations must be aligned to the 504 plan and uphold expectations of the plan lawfully.

● Provide additional time for in-class assignments and assessments
● Allow for computer with voice output, spelling and grammar checker
● Offer individual help throughout the lesson
● Modify readings and primary source documents

At Risk-

● Provide small group instruction for identified areas for growth
● Allow for alternate pathways for completion of assignments.
● Provide additional wait time for student responses to questions
● Pair oral instruction with visuals
● Utilize manipulatives

For a full list of Accommodations and Modifications, please click here.

Career Readiness, Life Literacies, and Key Skills Practices (June 2020)

Please select all standards that apply to this unit of study:

- ☐ Act as a responsible and contributing citizen and employee.
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- ☐ Attend to personal health and financial well being.
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- ☑ Employ valid and reliable research strategies.
- ☑ Utilize critical thinking to make sense of problems and persevere in solving them.
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- ☑ Use technology to enhance productivity.
- ☑ Work productively in teams while using cultural global competence.

Unit 7

Gene Expression & Regulation

Summary and Rationale

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. The next unit moves on to cover natural selection.

Recommended Pacing

6 weeks (~18-20 class periods - per AP recommendations in the CED)
Exam weight: 12-16%

Standards

HS-LS1-1: Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells.
HS-LS1-4: Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.
HS-LS3-1: Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.
HS-LS3-2: Make and defend a claim based on evidence that inheritable genetic variations may result from new genetic combinations through meiosis, replication errors, and/or mutations caused by environmental factors.

Interdisciplinary Connections

9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a).

9.4.12.CI.3: Investigate new challenges and opportunities for personal growth, advancement, and transition (e.g., 2.1.12.PGD.1).

Instructional Focus

Unit Essential Questions:

- In what ways do the subcomponents of biological molecules and their sequence, determine the properties of that molecule? (Biological Molecules)
- How is DNA, and in some cases RNA, the primary source of heritable information? (DNA and RNA)
- In what ways are timing and coordination of specific events necessary for the normal development of an organism, and how are these events regulated? (Gene Expression and Cell Specialization, 6.6)
- How does gene regulation result in differential gene expression, leading to cell specialization? (Gene Expression and Cell Specialization, 6.6)
- In what ways do a variety of intercellular and intracellular signal transmissions mediate gene expression? (Gene Expression)

Unit Enduring Understandings:

- Heritable information provides for continuity of life. (IST-1)
- Differences in the expression of genes account for some of the phenotypic differences between organisms. (IST-2)
- The processing of genetic information is imperfect and is a source of genetic variation. (IST-4)
- The subcomponents of biological molecules and their sequence determine the properties of that molecule. (Biological Molecules)
- DNA, and in some cases RNA, is the primary source of heritable information. (DNA and RNA)
- Gene regulation results in differential gene expression, leading to cell specialization. (Gene Regulation)
- A variety of intercellular and intracellular signal transmissions mediate gene expression. (Gene Expression)
- Timing and coordination of specific events are necessary for the normal development of an organism, and these events are regulated by a variety of mechanisms. (Development)

Evidence of Learning (Assessments)

Assign the Progress Checks from AP Course and Exam Description Resource for each unit.
Each Personal Progress Check contains formative multiple-choice and free-response questions.
The feedback from the Personal Progress Checks shows students the areas where they need to focus.

Objectives (SLO)

Topic 6.1 – DNA and RNA Structure

- Describe the structures involved in passing hereditary information from one generation to the next.
- Describe the characteristics of DNA that allow it to function as hereditary material.
- Compare the structure and organization of genetic material in prokaryotic and eukaryotic cells.

Topic 6.2 – DNA Replication

- Describe the mechanisms involved in DNA replication.
- Explain how complementary base pairing allows DNA to be accurately replicated.
- Explain how DNA replication ensures the transmission of genetic information.

Topic 6.3 – Transcription and RNA Processing

- Describe the mechanisms by which genetic information flows from DNA to RNA to protein.
- Explain how RNA polymerase uses a DNA template to produce RNA.
- Describe the processing of eukaryotic RNA, including the addition of a 5′ cap, poly-A tail, and removal of introns.
- Explain how alternative RNA splicing can produce different proteins.

Topic 6.4 – Translation

- Explain how the phenotype of an organism is determined by its genotype.
- Describe how ribosomes translate mRNA into polypeptides.
- Explain the roles of mRNA, tRNA, and rRNA during translation.
- Describe initiation, elongation, and termination during protein synthesis.
- Explain how codons determine the amino acid sequence of a protein.

Topic 6.5 – Regulation of Gene Expression

- Describe the types of interactions that regulate gene expression.
- Explain how regulatory sequences and proteins control transcription.
- Describe how epigenetic changes influence gene expression.
- Explain how operons regulate gene expression in prokaryotes.
- Describe how gene expression can be coordinated in eukaryotic cells.

Topic 6.6 – Gene Expression and Cell Specialization

- Explain how the binding of transcription factors to promoter regions affects gene expression and phenotype.
- Explain the connection between gene regulation and phenotypic differences in cells and organisms.
- Describe how differential gene expression leads to cell specialization.

Topic 6.7 – Mutations

- Describe the various types of mutations.
- Explain how changes in DNA sequences can affect protein structure and function.
- Distinguish between beneficial, harmful, and neutral mutations.
- Explain how mutations can contribute to genetic variation.

Topic 6.8 – Biotechnology

- Explain the use of genetic engineering techniques in analyzing or manipulating DNA.

- Describe how biotechnology tools are used to study and modify genetic material.
- Explain how techniques such as PCR, gel electrophoresis, and genetic engineering are used in biological research.

Suggested Resources/Technology Tools

College Board AP Website

Modifications

Special Education-
Modifications and accommodations must be aligned to students' IEPs and uphold expectations of the plan lawfully.
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● Allow use of assistive technology.
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● Have student repeat directions to check for understanding.
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● Modify assessment/assignment content, format, length (benchmarks, tests and quizzes) .
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● Speak clearly, using a normal tone and rate of speed, or slightly slower.
● Use directed reading activities. Ensure preview of text before assigned/read, provide pre-reading
Gifted and Talented-
● Advance, accelerate, or compact content
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● Allowance for adapting of content for individual student interests
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504-
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At Risk-
● Provide small group instruction for identified areas for growth
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Career Readiness, Life Literacies, and Key Skills Practices (June 2020)

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- ☑ Apply appropriate academic and technical skills.
- ☐ Attend to personal health and financial well being.
- ☑ Communicate clearly and effectively and with reason.
- ☑ Consider the environmental, social and economics impacts of decisions.
- ☐ Demonstrate creativity and innovation.
- ☑ Employ valid and reliable research strategies.
- ☑ Utilize critical thinking to make sense of problems and persevere in solving them.
- ☐ Model integrity, ethical leadership, and effective management.
- ☑ Plan education and career paths aligned to personal goals.
- ☑ Use technology to enhance productivity.
- ☑ Work productively in teams while using cultural global competence.

Unit 8

Natural Selection

Summary and Rationale

The concepts in the Natural Selection Unit will 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 nonevolving 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 can be applied to all the units covered in this course.

Recommended Pacing

6 weeks (~19-21 class periods - per AP recommendations in the CED)
Exam weight: 13-20%

Standards

HS-LS4-2: Construct an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) heritable genetic variation, (3) competition for limited resources, and (4) the proliferation of organisms better able to survive and reproduce in the environment.
HS-LS4-3: Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking that trait.

HS-LS4-4: Construct an explanation based on evidence for how natural selection leads to adaptation of populations.
HS-LS4-5: Evaluate the evidence supporting claims that changes in environmental conditions may result in: (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species.
HS-LS4-6: Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.
HS-LS4-1: Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.

Interdisciplinary Connections

9.4.12.CI.1: Demonstrate the ability to reflect, analyze, and use creative skills and ideas (e.g., 1.1.12prof.CR3a).

9.4.12.CI.3: Investigate new challenges and opportunities for personal growth, advancement, and transition (e.g., 2.1.12.PGD.1).

Instructional Focus

Unit Essential Questions:

- What conditions in a population make it more or less likely to evolve? (EVO-1)
- How does species interaction encourage or slow changes in species? (SYI-4)
- How is natural selection a major mechanism of evolution? (Natural Selection)
- In what ways do organisms share many conserved core processes and features? What do these shared features mean? (Evidence for Evolution)
- How do phylogenetic trees and cladograms graphically represent or model evolutionary history? (Phylogenetics)
- Does evolution continue to occur in all species? Explain. (Evolution Continues)
- In what ways does natural selection act on phenotypic variations in a population? (Examples of Natural Selection)
- What is genetic drift and how does it drive evolution? (Genetic Drift)
- What is reproductive isolation and in what way does it lead to speciation? (Speciation)
- What is necessary for speciation and extinction to occur and when do they typically occur? (Speciation and Extinction)
- What are some of the major core processes and features shared by organisms, and what evidence do they provide? (Essential Characteristics of Life)

Unit Enduring Understandings:

- Evolution is characterized by a change in the genetic makeup of a population over time and is supported by multiple lines of evidence. (EVO-1)
- Life continues to evolve within a changing environment. (EVO-3)
- Natural selection is a major mechanism of evolution, which is the change in the genetic makeup of a population over time. (Natural Selection)
- Biological evolution is supported by scientific evidence from many disciplines, including mathematics. (Evidence for Evolution)
- Organisms are linked by lines of descent from common ancestry. (EVO-2)
- Naturally occurring diversity among and between components within biological systems affects interactions with the environment. (SYI-3)

- Phylogenetic trees and cladograms are graphical representations (models) of evolutionary history that can be tested. (Phylogenetics)
- Populations of organisms continue to evolve. (Evolution Continues)
- Natural selection acts on phenotypic variations in populations. (Examples of Natural Selection)
- Evolutionary change is also driven by random processes. (Genetic Drift)
- Speciation may occur when two populations have become reproductively isolated from each other. (Speciation)
- Speciation and extinction have occurred throughout the Earth's history. (Speciation and Extinction)
- Organisms are linked by lines of descent from common ancestry. (Essential Characteristics of Life)

Evidence of Learning (Assessments)

Assign the Progress Checks from AP Course and Exam Description Resource for each unit.
Each Personal Progress Check contains formative multiple-choice and free-response questions.
The feedback from the Personal Progress Checks shows students the areas where they need to focus.

Objectives (SLO)

Topic 7.1 – Introduction to Natural Selection

- Describe the causes of natural selection.
- Explain how natural selection affects populations.
- Explain how differences in reproductive success contribute to evolutionary change.
- Describe how environmental pressures influence survival and reproduction.

Topic 7.2 – Natural Selection

- Explain how natural selection acts on phenotypic variation within populations.
- Explain how molecular variation within cells can influence an organism's fitness.
- Describe how adaptations increase survival and reproductive success.

Topic 7.3 – Artificial Selection

- Explain how artificial selection affects the genetic makeup of a population.
- Describe how humans selectively breed organisms for desired traits.
- Compare artificial selection and natural selection.

Topic 7.4 – Population Genetics

- Explain how random occurrences affect the genetic makeup of a population.
- Describe how mutation, genetic drift, and gene flow affect allele frequencies.
- Explain how changes in allele frequencies provide evidence of evolution.

Topic 7.5 – Hardy-Weinberg Equilibrium

- Describe the conditions necessary for Hardy-Weinberg equilibrium.
- Explain how allele and genotype frequencies are calculated in a population.
- Apply the Hardy-Weinberg equations to analyze population genetics data.
- Determine whether a population is evolving based on changes in allele frequencies.

Topic 7.6 – Evidence of Evolution

- Describe the types of data that provide evidence for evolution.
- Explain how morphological, biochemical, and geological data provide evidence that organisms have changed over time.

- Interpret fossil, anatomical, and molecular evidence supporting evolution.

Topic 7.7 – Common Ancestry

- Explain how similarities in DNA, proteins, and anatomical structures provide evidence of common ancestry.
- Interpret phylogenetic trees and diagrams to identify evolutionary relationships.
- Explain how shared derived characteristics provide evidence of evolutionary relationships.

Topic 7.8 – Continuing Evolution

- Explain how evolution is an ongoing process in all living organisms.
- Describe how evolutionary processes continue to affect populations over time.
- Explain how environmental changes and genetic variation contribute to ongoing evolution.

Suggested Resources/Technology Tools

College Board AP Website

Modifications

Special Education-

Modifications and accommodations must be aligned to students' IEPs and uphold expectations of the plan lawfully.

● Allow additional time for skill mastery.
● Provide small group/ individualized instruction.
● Allow use of assistive technology.
● Anticipate needs; pre-teach if needed.
● Have student repeat directions to check for understanding.
● Highlight text/ visual presentation.
● Modify assessment/assignment content, format, length (benchmarks, tests and quizzes) .

ML-

● Provide additional wait time for student responses to questions
● Provide simplification of sentence structure and repetition of questions/sentences exactly as stated before trying to rephrase.
● Speak clearly, using a normal tone and rate of speed, or slightly slower.
● Use directed reading activities. Ensure preview of text before assigned/read, provide pre-reading

Gifted and Talented-

● Advance, accelerate, or compact content
● Support abstract and advanced higher-level thinking through differentiated questioning
● Allowance for adapting of content for individual student interests
● Provide assignments geared to development in areas of affect, creativity, cognition, and research skills

504-

Modifications and accommodations must be aligned to the 504 plan and uphold expectations of the plan lawfully.

● Provide additional time for in-class assignments and assessments
● Allow for computer with voice output, spelling and grammar checker
● Offer individual help throughout the lesson
● Modify readings and primary source documents

At Risk-

● Provide small group instruction for identified areas for growth
● Allow for alternate pathways for completion of assignments.
● Provide additional wait time for student responses to questions
● Pair oral instruction with visuals
● Utilize manipulatives

For a full list of Accommodations and Modifications, please click here.

Career Readiness, Life Literacies, and Key Skills Practices (June 2020)

Please select all standards that apply to this unit of study:

- ☐ Act as a responsible and contributing citizen and employee.
- ☑ Apply appropriate academic and technical skills.
- ☐ Attend to personal health and financial well being.
- ☑ Communicate clearly and effectively and with reason.
- ☑ Consider the environmental, social and economics impacts of decisions.
- ☐ Demonstrate creativity and innovation.
- ☑ Employ valid and reliable research strategies.
- ☑ Utilize critical thinking to make sense of problems and persevere in solving them.
- ☐ Model integrity, ethical leadership, and effective management.
- ☑ Plan education and career paths aligned to personal goals.
- ☑ Use technology to enhance productivity.
- ☑ Work productively in teams while using cultural global competence.