

Pequea Valley School District

Science

Unit 2: Evolution

Course: AP Biology

Grade: 11-12

Planning the Focus Based on the Desired Result
What do you want all students to know, understand and do by the end of the unit?

Unit Essential Question(s):

- How can you observe and see the process of evolution within the world we live in today?

Lesson Essential Questions:

- How is natural selection a major mechanism of evolution?
- How does microevolution occur within a population?
- Can you construct an argument for how species evolve?
- How are organisms linked by lines of descent from common ancestry?
- How is the origin of living systems explained by natural processes?

AP Enduring Understanding

- Enduring understanding 1.A: Change in the genetic makeup of a population over time is evolution.
- Enduring understanding 1.B: Organisms are linked by lines of descent from common ancestry.
- Enduring understanding 1.C: Life continues to evolve within a changing environment.
- Enduring understanding 1.D: The origin of living systems is explained by natural processes.

Pacing: Approximate number of class sessions per unit:

- 15

Tier 3 Vocabulary (Content specific vocabulary)

Natural Selection Evolution Coevolution Biogeography Fossil Record Comparative Anatomy Comparative Embryology Molecular Biology Microevolution Gene pool	Hardy-Weinberg Equilibrium Genetic Drift Gene Flow Mutation Nonrandom mating Directional Selection Diversifying Selection Stabilizing Selection Sexual Selection Macroevolution	Pre-zygotic barrier Post-zygotic barrier Speciation Allopatric Speciation Sympatric Speciation Gradualism Punctuated Equilibrium Phylogeny Clade
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Know - What do learners need to **know** in order to be able to do and understand? *List concepts, such as facts, formulas, key vocabulary and knowledge “nuggets”.*

The learners will understand:

- Essential knowledge **1.A.1**: Natural selection is a major mechanism of evolution.
- Essential knowledge **1.A.2**: Natural selection acts on phenotypic variations in populations.
- Essential knowledge **1.A.3**: Evolutionary change is also driven by random processes.
- Essential knowledge **1.A.4**: Biological evolution is supported by scientific evidence from many disciplines, including mathematics.
- Essential knowledge **1.B.1**: Organisms share many conserved core processes and features that evolved and are widely distributed among organisms today.
- Essential knowledge **1.B.2**: Phylogenetic trees and cladograms are graphical representations (models) of evolutionary history that can be tested.
- Essential knowledge **1.C.1**: Speciation and extinction have occurred throughout the Earth’s history.
- Essential knowledge **1.C.2**: Speciation may occur when two populations become reproductively isolated from each other.
- Essential knowledge **1.C.3**: Populations of organisms continue to evolve.
- Essential knowledge **1.D.1**: There are several hypotheses about the natural origin of life on Earth, each with supporting scientific evidence.
- Essential knowledge **1.D.2**: Scientific evidence from many different disciplines supports models of the origin of life.

Understand - What do learners need to **understand**? What is the **big idea**? *List broad concepts or “big ideas” in a statement of enduring understanding.*

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

The learners will know:

- Natural selection as a mechanism of evolution
- Microevolution and the 5 mechanisms that can change the allele frequency within a population
- Macroevolution and how speciation occurs
- What a phylogeny is and how to interpret what they mean
- About the origin of life

Learning Outcome - What do learners need to be able to **accomplish** by the unit’s end? *List skills and competencies.*

The learners will be able to:

- Conclude that the mechanisms of evolution we have learned about change the allele frequency of a population over time by performing a hardy-weinberg lab activity
- Analyze a phylogenetic tree and determine ancestry based on molecular data.
- Explain how life originated by natural processes.
- Complete a unit exam and demonstrate their understand of evolutionary theory.

Pequea Valley School District

Science

Unit 3: Matter

Course: AP Biology

Grade: 11-12

Planning the Focus Based on the Desired Result
What do you want all students to know, understand and do by the end of the unit?

Unit Essential Question(s):

- How are biological molecules relevant to your everyday life?
- How can you prove the processes that occur within a cell help you to maintain homeostasis?

Lesson Essential Questions:

- How do the sequence of monomers determine the properties of macromolecules?
- Can you compare prokaryotic cells and eukaryotic cells?
- How is a eukaryotic cell structured?
- How are substances passively and actively transported into and out of a cell?
- Can you connect how passive and active transport are used within biological systems?
- How can you apply the concept of passive and active transport to the processes you see occur within a neuron?

AP Enduring Understanding

- Enduring understanding 4.A: Interactions within biological systems lead to complex properties.
- Enduring understanding 4.B: Competition and cooperation are important aspects of biological systems.
- Enduring understanding 2.B: Growth, reproduction and dynamic homeostasis require that cells create and maintain internal environments that are different from their external environments.
- Enduring understanding 4.C: Naturally occurring diversity among and between components within biological systems affects interactions with the environment.

Pacing: Approximate number of class sessions per unit:

- 35

Tier 3 Vocabulary (Content specific vocabulary)

Acid	Lipid	Transpiration
Base	Saturated and Unsaturated Fat	Phoelm
pH	Phospholipid	Stomata
Carbon	Steroid	Xylem
Hydroxyl Group	Protein	Membrane potential

Carbonyl Group	Amino acids	Action potential
Carboxyl Group	Primary, secondary,	Osmoregulation
Amino Group	tertiary and quaternary structure	Osmolarity
Sulfhydryl Group	Nucleic acid	Nephron
Phosphate Group	DNA and RNA	Homeostasis
Methyl Group	Prokaryotic and Eukaryotic Cell	
Dehydration reaction	Cell Organelles (all)	
Hydrolysis reaction	Phospholipid bilayer	
Carbohydrate	Active and Passive Transport	
Mono, di, polysaccharides	Concentration Gradient	
	Water Potential	

Know - What do learners need to **know** in order to be able to do and understand? *List concepts, such as facts, formulas, key vocabulary and knowledge “nuggets”.*

The learners will know:

- Essential knowledge 2.B.1: Cell membranes are selectively permeable due to their structure.
- Essential knowledge 2.B.2: Growth and dynamic homeostasis are maintained by the constant movement of molecules across membranes.
- Essential knowledge 2.B.3: Eukaryotic cells maintain internal membranes that partition the cell into specialized regions.
- Essential knowledge 2.C.1: Organisms use feedback mechanisms to maintain their internal environments and respond to external environmental changes.
- Essential knowledge 2.C.2: Organisms respond to changes in their external environments.
- Essential knowledge 4.A.1: The subcomponents of biological molecules and their sequence determine the properties of that molecule.
- Essential knowledge 4.A.2: The structure and function of subcellular components, and their interactions, provide essential cellular processes.

Understand - What do learners need to **understand**? What is the **big idea**? *List broad concepts or “big ideas” in a statement of enduring understanding.*

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

The learners will understand:

- How the subcomponents of biological molecules and their sequence determine their function.
- How the subcellular components and their interactions provide essential cellular processes.
- How individual parts of a cell work together to make the cell function.
- How passive and active transport help a cell to maintain homeostasis.
- How systems within organisms work together to allow the organisms to maintain homeostasis.

Learning Outcome - What do learners need to be able to **accomplish** by the unit’s end? *List skills and competencies.*

The learners will be able to:

- Explain how the structure fits the function of a macromolecule.

- Determine how pH affects the activity of proteins like catalase through performing an inquiry lab.
- Create a model of a cell and explain how the subcomponents work together.
- Analyze how a cell maintains homeostasis by the regulation of water and other molecules through cell membranes.
- Complete a unit exam in which they will demonstrate what they have learned.

Pequea Valley School District

Science

Unit 4: Energy

Course: AP Biology

Grade: 11-12

Planning the Focus Based on the Desired Result
What do you want all students to know, understand and do by the end of the unit?

Unit Essential Question(s):

- How are enzymes an essential molecule that allow living organisms to maintain homeostasis?
- How can you analyze the role of enzymes within both cellular respiration and photosynthesis?

Lesson Essential Questions:

- How do living systems require an input of free energy?
- How do enzymes regulate metabolic activities?
- How does the process of photosynthesis harness light and convert it into chemical energy?
- How does the process of cellular respiration convert stored chemical energy in the form of glucose into ATP?
- How does what we have learned about cellular energy connect to larger/bigger ideas and concepts in Biology?
- How do cooperative interactions within organisms promote efficiency in the use of energy and matter?

AP Enduring Understanding

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

Pacing: Approximate number of class sessions per unit:

- 20

Tier 3 Vocabulary (Content specific vocabulary)

Free Energy	Competitive Inhibition	Glycolysis
Metabolism	Allosteric	Citric Acid Cycle
Catalysts	ATP	Electron Transport Chain
Exergonic	Photosynthesis	Fermentation
Endergonic	Light Reactions (and all vocab associated with light reactions)	Feedback- both positive and negative
Catabolism	Calvin cycle (and all vocab associated with calvin cycle)	Compartmentalization
Anabolism		System
Ectothermy		
Endothermy	Cellular Respiration	

Substrate
Active Site

Aerobic Respiration
Anaerobic Respiration

Know - What do learners need to know in order to be able to do and understand? *List concepts, such as facts, formulas, key vocabulary and knowledge “nuggets”.*

The learners will understand:

- Essential knowledge **2.A.1**: All living systems require constant input of free energy.
- Essential knowledge **2.A.2**: Organisms capture and store free energy for use in biological processes.
- Essential knowledge **2.A.3**: Organisms must exchange matter with the environment to grow, reproduce and maintain organization.
- Essential knowledge **2.C.1**: Organisms use feedback mechanisms to maintain their internal environments and respond to external environmental changes.

Understand - What do learners need to understand? What is the big idea? *List broad concepts or “big ideas” in a statement of enduring understanding.*

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

The learners will know:

- How to explain what free energy is.
- How to calculate free energy using the Gibbs free energy equation.
- How all living systems require an input of free energy.
- How enzymes are used within biological reactions to reduce the amount of free energy needed to run the reaction.
- How an enzyme works on its substrate and what factors can affect the rate at which the enzyme will work.
- How the process of photosynthesis takes solar energy and converts it into chemical energy.
- How the light and dark reactions must work together within the process of photosynthesis.
- How cellular respiration takes stored chemical energy and converts it into kinetic energy to drive the production of ATP.
- That there are variations of both cellular respiration and photosynthesis depending on selection pressures.
- How feedback regulates all of the processes that we have looked at within the unit.

Learning Outcome - What do learners need to be able to **accomplish** by the unit’s end? *List skills and competencies.*

The learners will be able to:

- Explain how enzymes work and what factors can affect their rate of reaction.
- Explain what free energy is and how it applies to both respiration and photosynthesis.
- Explain the process of photosynthesis.
- Explain the process of cellular respiration.
- Compare and contrast the processes of photosynthesis and cellular respiration.
- Connect how free energy, enzymes, photosynthesis and cellular respiration all fit together.

Pequea Valley School District

Science

Unit 5: Information

Course: AP Biology

Grade: 11-12

Planning the Focus Based on the Desired Result

What do you want all students to know, understand and do by the end of the unit?

Unit Essential Question(s):

- How is the study of the exchange and flow of genetic information relevant to you now as well as in the future?

Lesson Essential Questions:

- How does genetic information flow from DNA to RNA to Protein?
- How can you prove that genetic engineering is relevant to your everyday life?
- How do viruses transmit genetic information and how is this important to you?
- Can you compare how gamete and somatic cells divide?
- How is the expression of genes regulated and why is this so vitally important?

AP Enduring Understanding

- Enduring understanding 3.A: Heritable information provides for continuity of life.
- Enduring understanding 3.B: Expression of genetic information involves cellular and molecular mechanisms.
- Enduring understanding 3.C: The processing of genetic information is imperfect and is a source of genetic variation.

Pacing:

- 40

Tier 3 Vocabulary (Content specific vocabulary)

DNA, RNA, mRNA, tRNA, rRNA	Intron/Exon	Microarray
Nucleic Acid (all parts)	Mutation (all types of mutation)	Cell cycle
Central Dogma	Promotor	Mitosis
DNA replication (all enzymes associated with process)	Enhancer	Meiosis
Leading and lagging strand	Transcription Factors	Independent Assortment
Protein Synthesis	Operons	Genotype/Phenotype
Transcription	Genetic Engineering	Allele
Translation	Restriction Enzymes	Complex patterns of inheritance (all)
Codon	Polymerase Chain Reaction	Gamete
	Gel Electrophoresis	Epigenetics

Know - What do learners need to **know** in order to be able to do and understand? *List concepts, such as facts, formulas, key vocabulary and knowledge “nuggets”.*

The learners will understand:

- Essential knowledge **3.A.1**: DNA, and in some cases RNA, is the primary source of heritable information.
- Essential knowledge **3.A.2**: In eukaryotes, heritable information is passed to the next generation via processes that include the cell cycle and mitosis or meiosis plus fertilization.
- Essential knowledge **3.A.3**: The chromosomal basis of inheritance provides an understanding of the pattern of passage (transmission) of genes from parent to offspring.
- Essential knowledge **3.A.4**: The inheritance pattern of many traits cannot be explained by simple Mendelian genetics.
- Essential knowledge **3.B.1**: Gene regulation results in differential gene expression, leading to cell specialization.
- Essential knowledge **3.B.2**: A variety of intercellular and intracellular signal transmissions mediate gene expression.
- Essential knowledge **3.C.1**: Changes in genotype can result in changes in phenotype.
- Essential knowledge **3.C.2**: Biological systems have multiple processes that increase genetic variation.
- Essential knowledge **3.C.3**: Viral replication results in genetic variation, and viral infection can introduce genetic variation into the hosts.

Understand - What do learners need to **understand**? What is the **big idea**? *List broad concepts or “big ideas” in a statement of enduring understanding.*

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

The learners will know:

- The structure of DNA as well as how the molecule replicates.
- How the information contained in DNA is first transcribed and then translated into a protein.
- How mutations in the genetic code can change the structure and function of a protein.
- The structure of a virus and how they transmit information.
- How the cell cycle maintains control of cellular reproduction.
- The process of mitosis and meiosis. They will also be able to compare and contrast the two.
- How genetic information is inherited from parents to offspring through both simple Mendelian genetics and complex patterns of heredity.
- How the expression of genes are regulated and multiple levels of biological organization.

Learning Outcome - What do learners need to be able to **accomplish** by the unit’s end? *List skills and competencies.*

The learners will be able to:

- Explain the process of DNA replication and how due to this process genetic information can be transmitted from generation to generation.
- Explain how the information in DNA is transcribed and translated into a functional protein.
- Interpret how genetic engineering techniques are useful to understand the genetic code within DNA.
- Explain how a virus is structured and transmits genetic information.
- Explain how the cell cycle controls cellular reproduction.
- Compare and contrast the process of mitosis and meiosis.

- Explain how genes are regulated at multiple levels of biological organization.

Pequea Valley School District

Science

Unit 6: Regulation

Course: AP Biology

Grade: 11-12

Planning the Focus Based on the Desired Result
What do you want all students to know, understand and do by the end of the unit?

Unit Essential Question(s):

- How is feedback (both positive and negative) used to maintain homeostasis within living organisms such as yourself?

Lesson Essential Questions:

- How is the process of development regulated by both internal and external signals?
- How do organisms maintain homeostasis through feedback?
- How does your body respond to a disruption such as an infection by harnessing the power of the immune system?
- How do organisms respond to disruptions through various mechanisms?

AP Enduring Understanding

- Enduring understanding 2.C: Organisms use feedback mechanisms to regulate growth and reproduction, and to maintain dynamic homeostasis.
- Enduring understanding 2.D: Growth and dynamic homeostasis of a biological system are influenced by changes in the system's environment.
- Enduring understanding 2.E: Many biological processes involved in growth, reproduction and dynamic homeostasis include temporal regulation and coordination.

Pacing:

- 14

Tier 3 Vocabulary (Content specific vocabulary)

Development
 Differentiation
 Gene Expression
 Transcription Factors
 Feedback loops
 Immune System

Pathogen
 Innate Immunity
 Adaptive Immunity
 Positive Feedback
 Negative Feedback
 Operons
 Homeostasis

Barrier Defenses
 T and B cells
 Antibody
 Primary/Secondary Immune Response
 Antigen
 Active/Passive Immunity
 Proximate/Ultimate Explanations

Know - What do learners need to **know** in order to be able to do and understand? *List concepts, such as facts, formulas, key vocabulary and knowledge “nuggets”.*

The learners will understand:

- Essential knowledge **2.C.1**: Organisms use feedback mechanisms to maintain their internal environments and respond to external environmental changes.
- Essential knowledge **2.C.2**: Organisms respond to changes in their external environments.
- Essential knowledge **2.D.3**: Biological systems are affected by disruptions to their dynamic homeostasis.
- Essential knowledge **2.D.4**: Plants and animals have a variety of chemical defenses against infections that affect dynamic homeostasis.
- Essential knowledge **2.E.1**: 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.
- Essential knowledge **2.E.2**: Timing and coordination of physiological events are regulated by multiple mechanisms.
- Essential knowledge **2.E.3**: Timing and coordination of behavior are regulated by various mechanisms and are important in natural selection.

Understand - What do learners need to **understand**? What is the **big idea**? *List broad concepts or “big ideas” in a statement of enduring understanding.*

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

The learners will know:

- How timing and coordination of specific events are necessary for the normal development of organisms.
- How transcription factors are essential to the regulation of development.
- What a feedback loop is and how they regulate many of the biological processes within organisms.
- How biological systems respond to disruptions.
- How the immune system defends against foreign invaders and protects the organism from harm.
- How behavior is also regulated through various feedback mechanisms.

Learning Outcome - What do learners need to be able to **accomplish** by the unit’s end? *List skills and competencies.*

The learners will be able to:

- Explain how development is regulated through various embryological mechanisms.
- Describe and give various examples of both positive and negative feedback.
- Make connections among various areas of biology to see both positive and negative feedback.
- Explain the role of the immune system within both plants and animals as well as how it works.
- Provide various examples of how biological organisms respond to their environment through various means.

Pequea Valley School District Science

Unit 7: Communication

Course: AP Biology

Grade: 11-12

Planning the Focus Based on the Desired Result
What do you want all students to know, understand and do by the end of the unit?

Unit Essential Question(s):

- How do biological organisms have to communicate at many levels to maintain homeostasis?

Lesson Essential Questions:

- How do cells communicate with one another through signal transduction pathways?
- How do alterations in signaling pathways affect cellular responses?
- Why is cellular communication between living organisms so important?
- How do animal nervous systems detect external and internal signals to produce responses?
- How do animal endocrine systems detect external and internal signals to produce responses?
- How do plants use hormones to regulate cellular processes?

AP Enduring Understanding

- Enduring understanding 3.D: Cells communicate by generating, transmitting and receiving chemical signals.
- Enduring understanding 3.E: Transmission of information results in changes within and between biological systems.

Pacing:

- 11-12

Tier 3 Vocabulary (Content specific vocabulary)

Signal Transduction Pathway	Reception	Threshold
Ligands	Transduction	Synapses
Paracrine signaling	Response	Nervous System
Synaptic Signaling	Neuron	Central and Peripheral Nervous System
Endocrine signaling	Action Potential	Feedback
Hormones		

Know - What do learners need to **know** in order to be able to do and understand? *List concepts, such as facts, formulas, key vocabulary and knowledge “nuggets”.*

The learners will know:

- Essential knowledge **3.D.1**: Cell communication processes share common features that reflect a shared evolutionary history.
- Essential knowledge **3.D.2**: Cells communicate with each other through direct contact with other cells or from a distance via chemical signaling.
- Essential knowledge **3.D.3**: Signal transduction pathways link signal reception with cellular response.
- Essential knowledge **3.D.4**: Changes in signal transduction pathways can alter cellular response.
- Essential knowledge **3.E.1**: Individuals can act on information and communicate it to others.
- Essential knowledge **3.E.2**: Animals have nervous systems that detect external and internal signals, transmit and integrate information, and produce responses.

Understand - What do learners need to understand? What is the big idea? *List broad concepts or “big ideas” in a statement of enduring understanding.*

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

The learners will understand:

- How a signal transduction pathway conducts a signal.
- Why communication is so important between living organisms.
- How a neuron conducts an action potential.
- How both the central and peripheral nervous system work together.
- How the endocrine system regulates various processes through feedback.

Learning Outcome - What do learners need to be able to accomplish by the unit’s end? *List skills and competencies.*

The learners will be able to:

- Explain how a signal transduction pathway works.
- Explain how organisms communicate with one another.
- Explain how a neuron conducts and action potential.
- Distinguish between the central and peripheral nervous system work.
- Explain how the endocrine system regulated cellular processes.

Pequea Valley School District
Science

Unit 8: Interactions

Course: AP Biology

Grade: 11-12

Planning the Focus Based on the Desired Result
What do you want all students to know, understand and do by the end of the unit?

Unit Essential Question(s):

- How do biological systems interact within the world we live in today?

Lesson Essential Questions:

- Can you construct an argument for how and why life is organized the way it is?
- How do interactions among living systems and their environment result in the movement of matter and energy?
- How are all biological systems affected by complex biotic and abiotic interactions?
- How does variation within a population affect population dynamics?
- How do communities interact in complex ways?
- How does biodiversity influence the stability of the ecosystem?

AP Enduring Understanding

- Enduring understanding **4.A**: Interactions within biological systems lead to complex properties.
- Enduring understanding **4.B**: Competition and cooperation are important aspects of biological systems.
- Enduring understanding **4.C**: Naturally occurring diversity among and between components within biological systems affects interactions with the environment.

Pacing:

- 11-12

Tier 3 Vocabulary (Content specific vocabulary)

Hierarchy	Productivity	Keystone Species
Energy flow	Limiting Factors	Species Richness and Diversity
Matter cycles	Population	Survivorship
Biomass	Community	Biodiversity
Food chains	Trophic level	Food web
	Human impact	Pyramids

Know - What do learners need to **know** in order to be able to do and understand? *List concepts, such as facts, formulas, key vocabulary and knowledge “nuggets”.*

The learners will understand:

- Essential knowledge **4.A.1**: The subcomponents of biological molecules and their sequence determine the properties of that molecule.
- Essential knowledge **4.A.2**: The structure and function of subcellular components, and their interactions, provide essential cellular processes.
- Essential knowledge **4.A.3**: Interactions between external stimuli and regulated gene expression result in specialization of cells, tissues and organs.
- Essential knowledge **4.A.4**: Organisms exhibit complex properties due to interactions between their constituent parts.
- Essential knowledge **4.A.5**: Communities are composed of populations of organisms that interact in complex ways.
- Essential knowledge **4.A.6**: Interactions among living systems and with their environment result in the movement of matter and energy.
- Essential knowledge **4.B.1**: Interactions between molecules affect their structure and function.
- Essential knowledge **4.B.2**: Cooperative interactions within organisms promote efficiency in the use of energy and matter.
- Essential knowledge **4.B.3**: Interactions between and within populations influence patterns of species distribution and abundance.
- Essential knowledge **4.B.4**: Distribution of local and global ecosystems changes over time.
- Essential knowledge **4.C.3**: The level of variation in a population affects population dynamics.
- Essential knowledge **4.C.4**: The diversity of species within an ecosystem may influence the stability of the ecosystem.

Understand - What do learners need to **understand**? What is the **big idea**? *List broad concepts or “big ideas” in a statement of enduring understanding.*

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

The learners will understand:

- How life is organized into a hierarchy.
- How interactions among living systems and their environment will result in the movement of matter and energy.
- How the level of variation in a population affects population dynamics.
- How communities are composed of populations or organisms that interact in complex ways.
- How the diversity of species within an ecosystem may influence the stability of the ecosystem.

Learning Outcome - What do learners need to be able to **accomplish** by the unit’s end? *List skills and competencies.*

The learners will be able to:

- Explain how life is organized into a hierarchy.
- Interpret how interactions among living systems and their environment result in the movement of matter and energy.
- Demonstrate how the level of variation in a population affects population dynamics.
- Explain how communities are composed of populations or organisms that interact in complex ways.
- Show how the diversity of species within an ecosystem may influence the stability of the ecosystem.