Southern York County School District Instructional Plan

Name:	**Dates: Summer Assignment and August**
Course/Subject: AP Biology	**Unit 1: Biochemistry of Life**

Stage 1 – Desired Results

PA Standards Addressed: Biology Assessment Anchors: Pennsylvania Biology Keystone Standards and Eligible Content

Biology Assessment Anchors: Pennsylvania Biology Keystone Standards and Eligible Content
BIO.A.2.1 Describe how the unique properties of water support life on earth.
BIO.A.2.2 Describe and interpret relationships between structure and function at various levels of biochemical organization; such as atoms, molecules and macromolecules.
BIO.A.2.2.1 Explain how carbon is uniquely suited to form biological macromolecules.

AP Biology Big Ideas, Enduring Understandings and Essential Knowledge:
Big Ideas:

Big Idea 2: Biological systems utilize free energy and molecular building blocks to grow, to reproduce and to maintain dynamic homeostasis.
Big Idea 4: Biological systems interact, and these systems and their interactions possess complex properties.

Enduring Understandings:
2.A Growth, reproduction and maintenance of the organization of living systems require free energy and matter.
4.A Interactions within biological systems lead to complex properties.
4.B Competition and cooperation are important aspects of biological systems.
4.C Naturally occurring diversity amount and between components within abiological systems affects interactions with the environment.

Essential Knowledge:
2.A.3 Organisms must exchange matter with the environment to grow, reproduce and maintain organization. (mastered)
4.A.1 The subcomponents of biological molecules and their sequence determine the properties of that molecule. (mastered)
4.B.1 The subcomponents of biological molecules and their sequence determine the properties of that molecule. (mastered)
4.C.1 Variations in molecular units provides cells with a wider range of functions. (introduced)

Understanding(s): ***Students will understand . . .***	**Unit Essential Question(s):**
1. Biological systems utilize free energy and molecular building blocks to grow, to reproduce and to maintain dynamic homeostasis. 2. Biological systems interact, and these systems and their interactions possess complex properties.	▪ To what extent can chemical properties and interactions affect a biological system?
Learning Objectives: ***Students will know . . .*** *Essential Knowledge:* ▪ Organic molecules are carbon-containing molecules and are central to living systems. ▪ Molecules and atoms from the environment are necessary to build new molecules. ▪ Identify the common elements found in organisms and give examples of where these elements occur in cells. ▪ Explain how carbon moves from the environment to organisms and its role as	***Students will be able to:*** ▪ Pose questions and provide evidence-based explanations about understanding and observations of biological phenomena and processes in regards to the detection of organic molecules in food. (SP3) ▪ Justify the selection of the kind of data needed to answer scientific questions about the detection of organic macromolecules in food. (SP4)

the essential component of all organic molecules. ▪ Describe the importance of organic molecules and inorganic ions in biological systems. ▪ Describe how nitrogen moves from the environment to organisms and where it is used in the synthesis of nucleic acids and proteins. ▪ Describe the importance of organic molecules and inorganic ions in biological systems. ▪ Describe how nitrogen moves from the environment to organisms and where it is used in the synthesis of nucleic acids and proteins. ▪ Describe how phosphorus moves from the environment to organisms and where it is used in the synthesis of nucleic acids and some lipids. ▪ Describe the basic structure and roles of carbohydrates, amino acids, proteins, lipids, nucleotides, and nucleic acids. ▪ Recognize simple tests to detect these molecules in food. ▪ Water's properties make it essential to life. ▪ Using examples, explain the dependence of living systems on the properties of water. ▪ Relate the properties of water to its structure, including its dipole nature. ▪ Distinguish between monomers and polymers. ▪ Describe the range of macromolecules produced by cells and explain how these are used. ▪ Describe the synthesis of macromolecules by condensation and their breakdown by hydrolysis. ▪ Identify the bonds formed or broken in condensation and hydrolysis reactions. ▪ Explain how the properties of a polymer, specifically nucleic acids and proteins, are determined by the component nomomers. ▪ Explain the biological significance of the amphipathic nature of some lipids, such as phospholipids and cholesterol. ▪ Using examples, explain how the properties of a polysaccharide are determined by monomers present and the nature of the bonds between them. ▪ Explain how directionality in component monomers influences the structure and function of a polymer. ▪ Explain how the specific order of amino acids in a polypeptide interacts with the	▪ Select and use appropriate tools and techniques when designing and conducting experiments related to detection of organic macromolecules in food. (SP4) ▪ Communicate an analysis of the findings of an investigation into tests to detect organic macromolecules in food. (SP6)

environment to determine the overall shape of the protein, which also involves secondary, tertiary and quarternary structure and, thus, its function. ▪ Categorize the R-group of an amino acid by chemical properties such as hydrophobic and hydrophilic, and describe how the interactions of these R-groups determine the structure and function of that region of the protein. ▪ Explain how directionality influences the structure and function of a polymer.	

Name:	**Dates: September/October**
Course/Subject: AP Biology	**Unit 2: The Cell and Cell Environment**

Stage 1 – Desired Results

PA Standards Addressed: Biology Assessment Anchors: Pennsylvania Biology Keystone Standards and Eligible Content

Biology Assessment Anchors: Pennsylvania Biology Keystone Standards and Eligible Content
BIO.A.1.1 Explain the characteristics common to all organisms.
BIO.A.1.1.1 Describe the characteristics of life shared by all prokaryotic and eukaryotic organisms.
BIO.A.1.2 Describe the relationships between structure and function at biological levels of organization.
BIO.A.2.2 Describe and interpret relationships between structure and function at various levels of biochemical organization; such as atoms, molecules and macromolecules.
BIO.A.4.1 Identify and describe the cell structures involved in transport of materials into, out of and throughout a cell.

AP Biology Big Ideas, Enduring Understandings and Essential Knowledge:
Big Ideas:

Big Idea 1: The process of evolution drives the diversity and unit of life.
Big Idea 2: Biological systems utilize free energy and molecular building blocks to grow, to reproduce and to maintain dynamic homeostasis.
Big Idea 4: Biological systems interact, and these systems and their interactions possess complex properties.

Enduring Understandings:
2.B Growth, reproduction and dynamic homeostasis require that cells create and maintain internal environments that are different from their external environments.
1.B Organisms are linked by lines of descent from common ancestry.
4.A Interactions within biological systems lead to complex properties.

Essential Knowledge:
2.B.3 Eukaryotic cells maintain internal membranes that partition the cell into specialized regions. (mastered)
4.A.2 The structure and function of subcellular components, and their interactions, provide essential cellular processes. (mastered)
2.B.1 Cell membranes are selectively permeable due to their structure. (mastered)
2.B.2 Growth and dynamic homeostasis are maintained by the constant movement of molecules across membranes. (mastered)
2.B.3 Eukaryotic cells maintain internal membranes that partition the cell into specialized regions. (mastered)
1.B.1 Organisms share many conserved core processes and features that evolved and are widely distributed among organisms today. (introduced)

Understanding(s):	**Unit Essential Question(s):**

Students will understand . . . 1. Biological systems utilize free energy and molecular building blocks to grow, to reproduce and to maintain dynamic homeostasis. 2. Biological systems interact, and these systems and their interactions possess complex properties. 3. The process of evolution drives the diversity and unit of life.	▪ To what extent does the structure of a cell determine the function of the cell, tissues, organs or an organism? ▪ How does life result from chemical structure and function? ▪ How is a biological balance maintained between internal and external environments in a living system?
Learning Objectives: ***Students will know . . .*** *Essential Knowledge:* ▪ Cells are the fundamental units of life. ▪ Cells share many of the same components but there are distinguishing differences between the cells of different kingdoms. ▪ In eukaryotic cells, specialized organelles localize reactions and promote functional efficiency. ▪ Using examples such as endoplasmic reticulum, chloroplast, mitochondria, or Golgi, describe the role of membranes in localizing metabolic processes within the cell. ▪ Describe the structure of a prokaryotic cell, recognizing the nucleoid region and cell wall. ▪ Explain where metabolic processes and enzymatic reactions take place in the absence of discrete membrane-bound cellular organelles. ▪ Describe the structure of ribosomes, ER (smooth and rough), Gogli, mitochondria, lysosomes, vacuoles, chloroplasts, flagella, centrioles and cytoskeleton and relate this to function. ▪ Recognize the contribution of microscopy to our modern understanding of cell structure and function. ▪ Cellular metabolism depends on the transport of substances across cellular membranes. ▪ Cell size is limited by surface area to volume ratio. ▪ Describe the role of the plasma membrane in separating the internal environment of the cell form the external environment. ▪ Describe the fluid mosaic model of the plasma membrane, including the amphipathic character of the phospholipids that make up the structural framework of the membrane and the role of transmembrane proteins, glycoproteins and glycolipids.	***Students will be able to:*** ▪ Demonstrate an ability to use stereo and light microscopes to locate material and focus images, collect data/evidence to provide evidence-based explanations about biological phenomena and calculate linear magnification. (SP4) ▪ Pose questions and provide evidence-based explanations about understanding and observations of biological phenomena and processes in regards to movement of molecules across a membrane. (SP3) ▪ Create representations and models that describe movement of molecules across a membrane. (SP1) ▪ Draw information from chemistry to explain why molecules spontaneously move from an area of high concentration to an area of low concentration. (SP7) ▪ Justify the selection of the kind of data needed to answer scientific questions about the movement of molecules across a membrane. (SP4) ▪ Apply mathematics to quantities that describe natural phenomena related to movement of molecules across a membrane and the relationship between cellular surface area and volume. (SP 2) ▪ Select and use appropriate tools and techniques when designing and conducting experiments related to the movement of molecules across a membrane. (SP4) ▪ Communicate an analysis of the findings of an investigation into movement of molecules across a membrane. (SP6)

▪ Explain how the properties of the embedded proteins contribute to the selectively permeable nature of the membrane. Include reference to aquaporins, and embedded channel proteins and carrier proteins. ▪ Describe and evaluate the experimental evidence for the current model of membrane structure. ▪ Distinguish between the plasma membrane and the cell wall of plants, bacteria, algae, fungi, and some Archaea. ▪ Recognize that the cell wall lies outside the plasma membrane and provides a structural boundary to the cell and a permeability barrier for some substances.	

Name:	**Dates: October/November**
Course/Subject: AP Biology	**Unit 3: Cellular Energy and Metabolism**

Stage 1 – Desired Results

PA Standards Addressed: Biology Assessment Anchors: Pennsylvania Biology Keystone Standards and Eligible Content

BIO.A.2.3 Explain how enzymes regulate biochemical reactions within a cell.
BIO.A.2.3.1 Describe the role of an enzyme as a catalyst in regulating a specific biochemical reaction.
BIO.A.2.3.2 Explain how factors such as pH, temperature, and concentration levels can affect enzyme function.
BIO.A.3.1 Identify and describe the cell structures involved in processing energy.
BIO.A.3.1.1 Describe the fundamental roles of plastids in energy transformation.
BIO.A.3.2 Identify and describe how organisms obtain and transform energy for their life processes.
BIO. A.3.2.1 Compare the basic transformation of energy during photosynthesis and cellular respiration.
BIO.A.3.2.2 Describe the role of ATP in biochemical reactions.

AP Biology Big Ideas, Enduring Understandings and Essential Knowledge:

Big Ideas:

Big Idea 2: Biological systems utilize free energy and molecular building blocks to grow, to reproduce and to maintain dynamic homeostasis.
Big Idea 4: Biological systems interact, and these systems and their interactions possess complex properties.

Enduring Understandings:

2.A Growth, reproduction and maintenance of the organization of living systems require free energy and matter.
2.B Growth, reproduction and dynamic homeostasis require that cells create and maintain internal environments that are different from their external environments.
2.D Growth and dynamic homeostasis of a biological system are influenced by changes in the system's environment.
2.E Many biological processes involved in growth, reproduction and dynamic homeostasis include temporal regulation and coordination.
4.A Interactions within biological systems lead to complex properties.
4.B Competition and cooperation are important aspects of biological systems.

Essential Knowledge:
2.A.1 All living systems require constant input of free energy.
2.A.2 Organisms capture and store free energy for use in biological processes.
2.D.1 All biological systems from cells and organisms to populations, communities and ecosystems are affected by complex biotic and abiotic interactions involving exchange of matter and free energy.
2.E.2 Timing and coordination of physiological events are regulated by multiple mechanisms.
4.A.2 The structure and function of subcellular components, and their interactions, provide essential cellular processes.
4.B.1 Interactions between molecules affect their structure and function.
4.B.2 Cooperative interactions within organisms promote efficiency in the use of energy and matter.

Understanding(s): ***Students will understand . . .***	**Unit Essential Question(s):**
1. Biological systems utilize free energy and molecular building blocks to grow, to reproduce and to maintain dynamic homeostasis. 2. Biological systems interact, and these systems and their interactions possess complex properties.	▪ To what extent does the structure of an organelle determine the function of the organelle, cell, tissues, organs or an organism? ▪ How is energy transferred in a living system? ▪ How do enzymes control metabolism in a living organism?
Learning Objectives: ***Students will know . . .*** *Essential Knowledge:* ▪ ATP is the universal energy currency in cells. ▪ Explain how order in biological systems is maintained by constant input of free energy. ▪ Explain what happens when there is loss of order of free energy flow. ▪ Distinguish between autotrophs and heterotrophs with respect to their source of free energy and carbon. ▪ Using examples, explain how exergonic reactions are coupled with energetically unfavorable reactions to offset entropy in biological systems. ▪ Using examples, describe how energy-related pathways in biological systems are sequential and may be entered at multiple points in the pathway. ▪ Explain the role of ATP in metabolism. ▪ Describe the synthesis of ATP and explain how it stores and releases energy. ▪ Compare cellular respiration and photosynthesis as energy transformation processes. ▪ Describe the structure and function of a mitochondrion. ▪ Identify the location of each step in glucose catabolism: glycolysis, Krebs cycle and electron transport chain. ▪ Describe glycolysis and recognize it as the major anaerobic pathway in cells.	***Students will be able to:*** ▪ Pose questions and provide evidence-based explanations about understanding and observations of cellular respiration and/or photosynthesis. (SP3) ▪ Create representations and models that describe cellular respiration and/or photosynthesis. (SP1) ▪ Draw information from chemistry to explain the synthesis of ATP and how it stores and releases energy. (SP7) ▪ Justify the selection of the kind of data needed to answer scientific questions about cellular respiration and/or photosynthesis. (SP4) ▪ Apply mathematics to quantities that describe natural phenomena related to primary productivity. (SP 2) ▪ Select and use appropriate tools and techniques when designing and conducting experiments related to cellular respiration and/or photosynthesis. (SP4) ▪ Communicate an analysis of the findings of an investigation into cellular respiration and/or photosynthesis. (SP6)

- State the new yield of ATP and $NADH_2$ from glycolysis.
- Describe the complete oxidation of glucose to CO_2, including: conversion of pyruvate to acetyl-coA, oxidation in the Krebs cycle, generation of ATP by chemiosmosis in the ETC and the role of oxygen as the final electron acceptor.
- Describe fermentation in mammalian muscle and in yeast, identifying the H^+ acceptor to each case.
- Compare and explain the differences in the yields of ATP from aerobic respiration and fermentation.
- Describe the structure and role of chloroplasts.
- Explain the role of chlorophyll and accessory pigments in light capture by green plants.
- Explain what is meant by the absorption spectrum and action spectrum of pigments.
- Describe and explain photosynthesis in a C_3 plant, including reference to: the generation of ATP and $NADPH_2$ in the light dependent phase, the Calvin cycle and the fixation of CO_2 using ATP and $NADPH_2$ in the light dependent phase, including the reduction of GP and the regeneration of ribulose pisphosphate.
- Describe and explain factors affecting photosynthetic rate and yield.
- Using enzymes as an illustrative example, explain how change I the structure of a molecular system may change its function.
- Describe the general role of enzymes as biological catalysts, with particular attention to active sites and the importance of specificity.
- Using enzyme-substrate complex and activation energy, explain how enzymes work as catalysts to bring about reactions in cells.
- Explain the induced fit model of enzyme function and compare to the older lock and key model.
- Describe the effect of substrate concentration, enzyme concentration, pH and temperature on enzyme activity.
- Recognize that enzymes can be natured.
- Distinguish between cofactors and coenzymes. Explain the role of cofactors in enzymatic activity.
- Describe enzyme inhibition.
- Explain the role of allosteric interactions in the control of metabolic pathways by end-product inhibition.

▪ Explain how compartmentalization within cells and organisms contributes to functional efficiency.	

Name:	**Dates: December**
Course/Subject: AP Biology	**Unit 4: Cellular Communication**

Stage 1 – Desired Results

PA Standards Addressed: Biology Assessment Anchors: Pennsylvania Biology Keystone Standards and Eligible Content

BIO.A.1.2 Describe the relationships between structure and function at biological levels of organization.
BIO.A.2.2 Describe and interpret relationships between structure and function at various levels of biochemical organization; such as atoms, molecules and macromolecules.
BIO.A.4.1 Identify and describe the cell structures involved in transport of materials into, out of and throughout a cell.
BIO.A.4.2 Explain mechanisms that permit organisms to maintain biological balance between their internal and external environments.
BIO.A.4.2.1 Explain how organisms maintain homeostasis.

AP Biology Big Ideas, Enduring Understandings and Essential Knowledge:

Big Ideas:

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

Enduring Understandings:

3.D: Cells communicate by generating, transmitting and receiving chemical signals.

Essential Knowledge:

3.D.1 Cell communication processes share common features that reflect a shared evolutionary history. (mastered)
3.D.2 Cells communicate with each other through direct contact with other cells or from a distance via chemical signaling. (mastered)
3.D.3 Signal transduction pathways link signal reception with cellular response. (mastered)
3.D.4: Changes in signal transduction pathways can alter cellular response. (mastered)

Understanding(s): ***Students will understand that . . .*** 1. Living systems store, retrieve, transmit and respond to information essential to life processes.	**Unit Essential Question(s):** ▪ How do cells communicate within an organelle, cell, tissues, organs or an organism to direct life processes?
Learning Objectives: ***Students will know . . .*** *Essential Knowledge:* ▪ Explain the basis of communication from cells, organisms or the environment. ▪ Understand and explain why there is strong selective pressure for the correct and appropriate signal transduction. ▪ Using an example such as quorum sensing in bacteria, describe and explain the signal transduction pathways for response in single-celled organisms. ▪ Using examples, explain how signal transduction pathways coordinate the activities of cells in multicellular organisms.	***Students will be able to:*** ▪ Create representations and models that describe signal transduction pathways and cell to cell communication. (SP1)

▪ Describe the temperature-dependent sex determination in some vertebrates/reptiles. ▪ Describe signal transduction pathways for the repair of DNA. ▪ Describe epinephrine-induced breakdown of glycogen to glucose. ▪ Using an example such as growth factor, explain how cells communicate via cell-to-cell contact (paracrine signaling). ▪ Describe and explain how cells communicate over short distances using local regulators such as neurotransmitters, autoinducers for bacterial luminescence, and morphogens. ▪ Using lipid soluble and water soluble hormones, describe how signals from endocrine cells can be transported in the blood or hemolymph to influence the activity of distant target cells. ▪ Explain the process of signal transduction, including with recognition of the ligand by a receptor molecule, initiation of transduction, relay of the signal, and the cellular response. ▪ Explain the role of second messengers, such as cyclic AMP, in the functioning of signal cascades. ▪ Describe the role of protein modification and phosphorylation cascades in signal transduction pathways. ▪ Describe and explain how changes in a signal transduction pathway can alter cellular response. Use examples to show how blocked or defective signal transduction pathways can be detrimental or preventative.	
Name:	**Dates: December**
Course/Subject: AP Biology	**Unit 5: The Cell Cycle**

Stage 1 – Desired Results

PA Standards Addressed: Biology Assessment Anchors: Pennsylvania Biology Keystone Standards and Eligible Content

Biology Assessment Anchors: Pennsylvania Biology Keystone Standards and Eligible Content
BIO.B.1.1 Describe the three stages of the cell cycle: interphase, nuclear division, cytokinesis.
BIO.B.1.1.1 Describe the events that occur during the cell cycle: interphase, nuclear division (mitosis or meiosis), cytokinesis.
BIO.B.1.1.2 Compare the processes and outcomes of mitotic and meiotic nuclear divisions.

AP Biology Big Ideas, Enduring Understandings and Essential Knowledge:
Big Ideas:

Big Idea 1: The process of evolution drives the diversity and unity of life.
Big Idea 3: Living systems store, retrieve, transmit and respond to information essential to life processes.

Enduring Understandings:
3.A Heritable information provides for continuity of life.

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.

Understanding(s):
Students will understand that . . .

1. Living systems store, retrieve, transmit and respond to information essential to life processes.

Unit Essential Question(s):

- How does a cell transmit information essential to cellular processes from one generation to another?

Learning Objectives:
Students will know . . .

Essential Knowledge:

- Describe the cell cycle in eukaryotes, recognizing interphase and mitosis.
- Describe the events in the three stages of interphase: G_1, S and G_2.
- Explain how the cell cycle is regulated through a series of internal controls or checkpoints.
- Explain how the cell cycle is regulated by external signals or growth factors.
- Describe the role of cyclin-dependent kinases in the regulation of the cell cycle.
- Recognize that differentiation of cells into specialized cell types involves controlled modifications of gene expression.
- Recognize that some cells cease to divide.
- Describe the role of mitosis in growth and repair and asexual reproduction.
- Describe mitosis as a continuous process with distinct structural stages.
- State the cellular outcome of mitosis followed by cytokinesis.
- Compare cytokinesis in plant and animal cells.
- Describe the role of DNA replication in interphase and that it is important in both mitosis and meiosis.
- Summarize the principal events in meiosis and their significance including; synapsis,

Students will be able to:

- Pose questions and provide evidence-based explanations about understanding and observations of biological phenomena and processes in regards to the stage of the cell cycle that a cell is in. (SP3)
- Justify the selection of the kind of data needed to answer scientific questions about the stage of the cell cycle that a cell is in. (SP4)
- Select and use appropriate tools and techniques when designing and conducting experiments related to the stage of the cell cycle that a cell is in. (SP4)
- Communicate an analysis of the findings of an investigation into the stage of the cell cycle that a cell is in. (SP6)

chiasma formation, chromatid separation and the production of haploid cells. ▪ Describe the behavior of homologous chromosomes and their associated alleles during meiosis and fertilization. ▪ Describe the results of crossing over and linkage. ▪ Explain the independent assortment of maternal and paternal chromosomes and the role in genetic diversity. ▪ Explain how the events of meiosis lead to new allele combinations in gametes and the resulting fertilized egg.	

Name:	**Dates: January/February**
Course/Subject: AP Biology	**Unit 6: Mendelian and Molecular Genetics**

Stage 1 – Desired Results

PA Standards Addressed: Biology Assessment Anchors: Pennsylvania Biology Keystone Standards and Eligible Content

Biology Assessment Anchors: Pennsylvania Biology Keystone Standards and Eligible Content

BIO.1.2 Explain how genetic information is inherited.
BIO.1.2.1 Describe how the process of DNA replication results in the transmission and/or conservation of genetic information.
BIO.1.2.2 Explain the functional relationships between DNA, genes, alleles, and chromosomes and their roles in inheritance.
BIO.B.2 Compare Mendelian and non-Mendelian patterns of inheritance.
BIO.B.2.1.1 Describe and/or predict observed patterns of inheritance.
BIO.B.2.1.2 Describe processes that can alter composition or number of chromosomes.
BIO.B.2.2 Explain the process of protein synthesis.
BIO.B.2.2.1 Describe how the processes of transcription and translation are similar in all organisms.
BIO.B.2.2.2 Describe the role of ribosomes, endoplasmic reticulum, Golgi apparatus, and the nucleus in the production of specific types of proteins.
BIO.B.2.3 Explain how genetic information is expressed.
BIO.B.2.3.1 Describe how genetic mutations alter DNA sequence and may or may not affect phenotype.
BIO.B.2.4 Apply scientific thinking, processes, tools and technologies in the study of genetics.
BIO.B.2.4.1 Explain how genetic engineering has impacted the fields of medicine, forensics and agriculture.

AP Biology Big Ideas, Enduring Understandings and Essential Knowledge:
Big Ideas:

- Big Idea 1: The process of evolution drives the diversity and unit of life.
- Big Idea 2: Biological systems utilize free energy and molecular building blocks to grow, to reproduce and to maintain dynamic homeostasis.
- Big Idea 3: Living systems store, retrieve, transmit and respond to information essential to life process.
- Big Idea 4: Biological systems interact, and these systems and their interactions possess complex properties.

Enduring Understandings:

2.E Many biological processes involved in growth, reproduction and dynamic homeostasis include temporal regulation and coordination.
3.A Heritable information provides for continuity of life.
3.B Expression of genetic information involves cellular and molecular mechanisms.
3.C The processing of genetic information is imperfect and is a source of genetic variation.
4.C Naturally occurring diversity among and between components within biological systems affects interactions with the environment.

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. (mastered)
3.A.1 DNA, and in some cases RNA, is the primary source of heritable information. (mastered)
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. (reviewed)
3.A.3 The chromosomal basis of inheritance provides an understanding of the pattern of passage of genes from parent to offspring. (mastered)
3.B.1 Gene regulation results in differential gene expression, leading to cell specialization. (mastered)
3.B.2 A variety of intercellular and intracellular signal transmissions mediate gene expression. (reviewed)
3.C.1 Changes in genotype can result in changes in phenotype.(mastered)
3.C.2 Biological systems have multiple process that increase genetic variation. (mastered)
3.C.3 Viral replication results in genetic variation and viral infection can introduce genetic variation into the hosts. (mastered)
4.C.1 Variation in molecular units provides cells with a wider range of functions. (mastered)
4.C.2 Environmental factors influence the expression of the genotype in an organism. (introduced)

Understanding(s):
Students will understand that . . .

1. The process of evolution drives the diversity and unit of life.
2. Biological systems utilize free energy and molecular building blocks to grow, to reproduce and to maintain dynamic homeostasis.
3. Living systems store, retrieve, transmit and respond to information essential to life process.
4. Biological systems interact, and these systems and their interactions possess complex properties.

Unit Essential Question(s):

- To what extent can a biological system increase genetic variation?
- To what extent is gene expression regulated in living systems?

Learning Objectives:
Students will know . . .

Essential Knowledge:

- Describe the structure and function of DNA and RNA.
- Describe and explain the main features of the genetic code.
- Describe protein synthesis in terms of transcription and translation.
- Review the structure of amino acids, polypeptides and the structures of proteins.
- Explain how the activities of proteins determine phenotype.
- Review the role of meiosis and fertilization in generation genetic variation.
- Explain segregation and independent assortment of genes on different chromosomes and their importance to understanding heredity and evolution.
- Explain how the rules of probability are applied to solving genetic problems.
- Demonstrate the proper use of terms associated with genetic studies.
- Solve problems involving monohybrid and dihybrid inheritance of unlinked autosomal

Students will be able to:

- Demonstrate an ability to use biotechnological techniques to provide evidence-based explanations about how genetic engineering techniques can be used to manipulate heritable information. (SP4)
- Pose questions and provide evidence-based explanations about how biotechnological techniques can provide evidence-based explanations about how genetic engineering techniques can be used to manipulate heritable information. (SP3)
- Create representations and models that describe how biotechnological techniques can provide evidence-based explanations about how genetic engineering techniques can be used to manipulate heritable information. (SP1)
- Draw information from chemistry to explain how biotechnological techniques can provide evidence-based explanations about how genetic engineering techniques

genes with simple dominant-recessive inheritance patterns.
- Describe and explain inheritance involving codominance, incomplete dominance, multiple alleles and lethal alleles.
- Solve problems involving dihybrid inheritance of linked genes.
- Explain the probability of linked genes being inherited together as a unit is a function of the distance between them.
- Explain how certain human disorders can be attributed to the inheritance of single gene traits or to specific chromosomal changes such as non-disjunction.
- Discuss the ethical, social and medical issues surrounding human genetic disorders.
- Explain the use of pedigree analysis to illustrate the inheritance of traits in a family tree.
- Recognize that inheritance of many traits in not explained by simple Mendelian genetics by using polygenes as an example.
- Distinguish sex chromosomes from autosomes and describe examples and solve problems involving sex linked genes.
- Explain how some traits are sex-limited.
- Explain how genotype and environment contribute to phenotypic variation.
- Explain how changes in gene expression results in cell differentiation.
- Explain the role of homeotic genes, such as the HOX gene, in developmental patterning in organisms and why these genes are highly conserved in animal phyla.
- Describe an example of a mutation that results in abnormal development and explain the mechanisms by which it operates.
- Distinguish between regulatory sequences, regulatory genes and small regulatory RNSs and their role in controlling gene expression.
- Describe the structure and function of a prokaryotic operon, including repression and induction.
- Explain the regulation of gene expression in eukaryotes by transcription factors.
- Review how signal transduction within and between cells mediates gene expression and cell function.
- Explain how the heritable information of DNA can be manipulated with genetic engineering techniques.

can be used to manipulate heritable information. (SP7)
- Justify the selection of the kind of data needed to answer scientific questions about how biotechnological techniques can provide evidence-based explanations about how genetic engineering techniques can be used to manipulate heritable information. (SP4)
- Select and use appropriate tools and techniques when designing and conducting experiments related to how biotechnological techniques can provide evidence-based explanations about how genetic engineering techniques can be used to manipulate heritable information. (SP4)
- Communicate an analysis of the findings of an investigation into how biotechnological techniques can provide evidence-based explanations about how genetic engineering techniques can be used to manipulate heritable information. (SP6)
- Demonstrate an ability to use BLAST techniques to provide evidence-based explanations about evolutionary relationships. (SP4)
- Communicate an analysis of the findings of a BLAST to provide evidence-based explanations about evolutionary relationships. (SP6)

▪ Describe some outcomes of DNA manipulation.	

Name: Barbara Nealon	**Dates: February, March**
Course/Subject: AP Biology	**Unit Plan 7: Evolution**

Stage 1 – Desired Results

PA Standards Addressed: Biology Assessment Anchors: Pennsylvania Biology Keystone Standards and Eligible Content

BIO.B.3.1 Explain the mechanisms of evolution.
BIO.B.3.1.1 Explain how natural selection can impact allele frequencies of a population.
BIO.B.3.1.2 Describe the factors that can contribute to the development of new species.
BIO.B.3.1.3 Explain how genetic mutations may result in genotypic and phenotypic variations within a population.
BIO.B.3.2 Analyze the sources of evidence for biological evolution.
BIO.B.3.2.1 Interpret evidence supporting the theory of evolution.
BIO.B.3.3 Apply scientific thinking, processes, tools, and technologies in the study of evolution.
BIO.B.3.3.1 Distinguish between the scientific terms: hypothesis, inference, lay, theory, principle, fact and observation.

AP Biology Big Ideas, Enduring Understandings and Essential Knowledge:

Big Ideas:

Big Idea 1: The process of evolution drives the diversity and unit of life.

Enduring Understandings:

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

Essential Knowledge:

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

Understanding(s): ***Students will understand. . .*** 1. The process of evolution drives the diversity and unit of life.	**Unit Essential Question(s):** ▪ To what extent have living systems changed over time?
Learning Objectives:	

Students will know . . .	***Students will be able to:***
Essential Knowledge: ▪ Describe Darwin's theory of natural select and its significance. ▪ Explain the concept of gene pool and the principle of genetic equilibrium. ▪ Evaluate evidence to qualitatively and quantitatively investigate the role of natural selection in evolution. ▪ Analyze changes in allele frequencies of a population over time using the Hardy-Weinberg equation. ▪ Explain the role of chance and random events in evolutionary processes. ▪ Describe examples that show how a selective environment can change. ▪ Describe the role of genetic variation in natural selection. ▪ Analyze examples of genetic change in real populations over time. ▪ Describe the impact of human activity on variation of other species. ▪ Use Hardy-Weinberg equation to predict future changes in allele frequencies for a population given certain events such as founder effect, genetic bottleneck or migration. ▪ Analyze genetic drift and the effects of selection in the evolution of specific populations. ▪ Use examples to show that biological evolution is supported by scientific evidence from many disciplines, including chemistry and mathematics. ▪ Explain how fossils are formed and how they provide data for diving the history of live on Earth in to geologic periods. ▪ Explain the biochemical evidence provided by the universality of DNA, amino acids and protein structures. ▪ Describe how comparisons of specific molecules between species are used as an indication of relatedness or phylogeny. ▪ Discuss how biochemical variations can be used a molecular clock to determine probable dates of divergence from a common ancestor. ▪ Explain how comparative anatomy and physiology have contributed to an understanding of evolutionary relationships. ▪ Explain how mathematical models and simulations can be used to illustrate and support evolutionary concepts.	▪ Pose questions and provide evidence-based explanations about how genetic drift affects selection in the evolution of specific populations.(SP3) ▪ Create representations and models that describe how phylogenies illustrate speciation events. (SP1) ▪ Draw information from mathematics to explain how genetic drift affects selection in the evolution of specific populations.. (SP7) ▪ Justify the selection of the kind of data needed to answer scientific questions about how genetic drift affects selection in the evolution of specific populations. (SP4) ▪ Select and use appropriate tools and techniques when designing and conducting experiments related to how genetic drift affects selection in the evolution of specific populations. (SP4) ▪ Communicate an analysis of the findings of an investigation into how genetic drift affects selection in the evolution of specific populations. (SP6) ▪ Demonstrate an ability to use BLAST techniques to provide evidence-based explanations about evolutionary relationships. (SP4) ▪ Demonstrate an ability to use cladograms and phylogenetic tree techniques to provide evidence-based explanations about evolutionary relationships. (SP4) ▪ Communicate an analysis of the findings of a BLAST to provide evidence-based explanations about evolutionary relationships. (SP6)

▪ Describe the biochemical evidence of structure and function that supports the relatedness of all domains. ▪ Analyze a cladogram to provide evidence to answer questions about phyologenies based on shared derived characteristics. ▪ Explain how phylogenetic trees illustrate speciation events. ▪ Explain how organisms are assigned to taxonomic categories on the basis of their shared derived characteristics. ▪ Describe the role of natural selection, genetic drift and isolation in speciation. ▪ Use data to predict the effect of selection pressures on a population over time. ▪ Recognize patterns of species formation. ▪ Analyze data related to speciation and extinction throughout Earth's history. ▪ Describe examples to support the current evolution of populations.	

Name:	**Dates: April/May**
Course/Subject: AP Biology	**Unit 8: The Interaction of Biological Systems**

Stage 1 – Desired Results

PA Standards Addressed: Biology Assessment Anchors: Pennsylvania Biology Keystone Standards and Eligible Content

BIO.A.1.2 Describe relationships between structure and function at biological levels of organization.
BIO.A.1.2.2 Describe and interpret relationships between structure and function at various levels of biological organization.

AP Biology Big Ideas, Enduring Understandings and Essential Knowledge:

Big Ideas:

Big Idea 1: The process of evolution drives the diversity and unit of life.
Big Idea 2: Biological systems utilize free energy and molecular building blocks to grow, to reproduce and to maintain dynamic homeostasis.
Big Idea 3: Living systems store, retrieve, transmit and respond to information essential to life process.
Big Idea 4: Biological systems interact, and these systems and their interactions possess complex properties.

Enduring Understandings:

1.C Life continues to evolve within a changing environment.
2.A Growth, reproduction and maintenance of the organization of living systems require free energy and matter.
3.D Cells communicate by generating, transmitting and receiving chemical signals.
3.E Transmission of information results in changes within and between biological systems.
4.A Interactions within biological systems lead to complex properties.
4.B Competition and cooperation are important aspects of biological systems.
4.C Naturally occurring diversity among and between components within biological systems affects interactions with the environment.

Essential Knowledge:

1.C.3 Populations of organisms continue to evolve. (reviewed)
2.A.1 All living systems require constant input of free energy. (reviewed)
3.D.2 Cells communicate with each other through direct contact with other cells or from a distance via chemical signaling. (reviewed)
3.D.4 Changes in signal transduction pathways can alter cellular response. (reviewed)
3.E.2 Animals have nervous systems that detect external and internal signals, transmit and integrate information and produce responses. (reviewed)
4.A.4 Organisms exhibit complex properties due to interactions between their constituent parts. (mastered)
4.B.2 Cooperative interactions within organisms promote efficiency in the use of energy and matter. (mastered)
4.C.1 Variation in molecular units provides cells with a wider range of functions. (mastered)
4.C.2 Environmental factors influence the expression of the genotype in an organism. (mastered)

Understanding(s): ***Students will understand. . .***	**Unit Essential Question(s):**
1. The process of evolution drives the diversity and unit of life. 2. Biological systems utilize free energy and molecular building blocks to grow, to reproduce and to maintain dynamic homeostasis. 3. Living systems store, retrieve, transmit and respond to information essential to life process. 4. Biological systems interact, and these systems and their interactions possess complex properties.	▪ How do the parts of a biological system interact with each other?
Learning Objectives: ***Students will know . . .*** *Essential Knowledge:* ▪ Explain how interactions and coordination between organs provide essential biological activities. ▪ Explain how interactions and coordination between systems provide essential biological activities. ▪ Explain how specialization of organs in multicellular organisms contributes to the overall functioning of the organism. ▪ Describe interactions among cells of a population of unicellular organisms that are similar to those of multicellular organisms, and that these interactions can lead to increased efficiency and utilization of energy and matter. ▪ Explain how variations within molecular units, such as MHC proteins, provides cells with a wider range of functions. ▪ Explain how environmental factors influence many traits both directly and indirectly in sex determination of reptiles, seasonal fur color in arctic animals or the effect of increased UV on melanin production in humans.	***Students will be able to:*** ▪ Demonstrate an ability to use biotechnological techniques to provide evidence-based explanations about how genetic engineering techniques can be used to manipulate heritable information. (SP4) ▪ Pose questions and provide evidence-based explanations about how biotechnological techniques can provide evidence-based explanations about how genetic engineering techniques can be used to manipulate heritable information. (SP3) ▪ Create representations and models that describe how biotechnological techniques can provide evidence-based explanations about how genetic engineering techniques can be used to manipulate heritable information. (SP1) ▪ Draw information from chemistry to explain how biotechnological techniques can provide evidence-based explanations about how genetic engineering techniques

▪ Describe the neuron as the basic structure of the nervous system. ▪ Explain how action potentials propagate impulses along neurons. ▪ Explain how transmission of information between neurons occurs across synapses. ▪ Explain conditions where signal transduction is blocked or defective altering cellular response. ▪ Explain endocrine signals that can travel long distances through the blood to affect a change in other parts of the body. ▪ Explain how organisms use free energy to regulate body temperature and metabolism. ▪ Explain how organisms use free energy to reproduce and raise offspring. ▪ Explain how evidence of evolution is found in all species.	can be used to manipulate heritable information. (SP7) ▪ Justify the selection of the kind of data needed to answer scientific questions about how biotechnological techniques can provide evidence-based explanations about how genetic engineering techniques can be used to manipulate heritable information. (SP4) ▪ Select and use appropriate tools and techniques when designing and conducting experiments related to how biotechnological techniques can provide evidence-based explanations about how genetic engineering techniques can be used to manipulate heritable information. (SP4) ▪ Communicate an analysis of the findings of an investigation into how biotechnological techniques can provide evidence-based explanations about how genetic engineering techniques can be used to manipulate heritable information. (SP6) ▪ Demonstrate an ability to use BLAST techniques to provide evidence-based explanations about evolutionary relationships. (SP4) ▪ Communicate an analysis of the findings of a BLAST to provide evidence-based explanations about evolutionary relationships. (SP6)