FREEHOLD REGIONAL HIGH SCHOOL DISTRICT

OFFICE OF CURRICULUM AND INSTRUCTION

SCIENCE DEPARTMENT

ADVANCED PLACEMENT BIOLOGY

Grade Level: 10-12

Credits: 5

BOARD OF EDUCATION ADOPTION DATE:

AUGUST 26, 2013

FREEHOLD REGIONAL HIGH SCHOOL DISTRICT

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Advanced Placement Biology

Course Philosophy

Advanced Placement Biology is designed to foster a more profound thought process, which will enable students to make connections between overarching scientific themes. The world is constantly changing and new discoveries are being made daily. Therefore, AP Biology is not a course about the acquisition of facts. It is all about the quest to make those facts live. It is a course that focuses on studying the complex relationships that occur within and between organisms. It is the study of how the environment may impact living things in both positive and negative ways. This course should open students' eyes and minds to the world around them so that they are better able to make informed decisions that will not only affect themselves, but also affect the future.

Course Description

The AP Biology curriculum emphasizes critical and independent thinking in order to facilitate a "big picture" understanding of biology. This includes a considerable amount of studying, memorizing, and analyzing the structure and function of living organisms. The rigor of the course is equivalent to an entry-level college course, and students are expected to rise to the challenge of the College Board AP Biology exam. Students are expected to apply the content and make connections between the four "big ideas."

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

Course Map			
CCSS	Enduring Understandings	Essential Questions	Common Assessments
5.3.12.E.3 11-12.WHST.1, 9	The origin of living systems is explained by natural processes.	What scientific evidence supports the hypothesis about the origin of life on Earth?	AP Essay on Origin of Life
5.1.12.D.3 5.3.12.A.1 11-12.RST.3, 8	The subcomponents of a biological molecule and their sequence determine the properties of that molecule.	How do interactions between molecules affect their structure and function?	Macromolecule Lab
5.1.12.D.2 5.3.12.C.2 11-12.RST.7,9	Interactions among living systems and with their environment result in the movement of matter and energy.	What role do the biogeochemical cycles play in living systems?	Biogeochemical Cycles Project
5.1.12.D.2 5.3.12.A.1 11-12.RST.9 11-12.WHST.9	Cells are the basic unit of structure and function in living things.	How do eukaryotic cells differ from prokaryotic cells?	Cell Project
5.3.12.A.2 5.3.12.B.1 5.1.12.D.3 11-12.RST.3, 8	All living systems require a constant input of free energy.	How do the laws of thermodynamics affect the change in free energy required for an organism to maintain organization, grow and reproduce?	AP Enzyme Lab
5.3.12.B.3, 4, 5 5.1.12.D.3 11-12.RST.3, 8	Organisms capture and store energy for use in biological processes.	What biological processes are involved in the capture, processing and transfer of free energy and the movement of matter within living systems?	AP Cellular Respiration Lab & AP Photosynthesis Lab
5.1.12.D.3 5.3.12.A.3 11-12.RST.3, 8	Cell membranes are selectively permeable due to their structure and function in order to maintain growth and dynamic homeostasis for the movement of molecules across barriers.	How does the structure of the cell membrane determine the processes used to transport molecules and transmit information between biological systems in order to maintain physiological processes?	AP Diffusion/Osmosis Lab
5.3.12.A.3 11-12.RST.9	Growth and the homeostatic mechanisms of a biological system are influenced by changes in the system's environment.	What chemical defense mechanisms do animals and plants use to protect against infections affecting their dynamic homeostasis?	Immune System Project

Course Map			
CCSS	Enduring Understandings	Essential Questions	Common Assessments
5.1.12.D.3 5.3.12.C.1 11-12.RST.3, 8	Timing and coordination of physiological events and behavior are regulated and important to natural selection.	How do internal and external signals regulate the behavioral and physiological responses of populations?	AP Animal Behavior Lab
5.1.12.D.3 5.3.12.A.4 5.3.12.D.1, 3 11-12.RST.3, 8	DNA, and in some cases RNA, are the primary source of heritable information.	What role do DNA and RNA play in inheritance?	AP Mitosis Lab & AP Meiosis Lab
		How are DNA and/or RNA used in genetic engineering?	AP Gel Electrophoresis Lab
5.1.12.D.3 5.3.12.A.4 5.3.12.D.3 11-12.RST.3, 8	The transmission of genes from parent to offspring occurs through mitosis, meiosis and fertilization.	How is heritable information passed through mitosis or meiosis followed by fertilization?	AP Mitosis Lab & AP Meiosis Lab
5.1.12.A.2 11-12.WHST.4	Patterns of inheritance can be explained through both Mendelian and non-Mendelian genetics.	How are Mendel's laws related to gene expression?	Genetic Problem Analysis
		What patterns of inheritance cannot be explained by simple Mendelian genetics?	
5.1.12.D.3 5.3.12.D.2 11-12.RST.3, 8	Biological systems have a variety of multiple processes that increase genetic variation.	What mechanisms introduce variation in prokaryotic and eukaryotic cells?	AP Transformation Lab
		How does the reproduction of viruses lead to the introduction of genetic variation in host cells?	
5.1.12.D.2 11-12.WHST.6	Signal transduction pathways mediate gene expression and facilitate cell to cell communication and changes to signal transduction pathways that may alter cellular response.	How does cell to cell communication influence cellular and physiological responses?	Signal Transduction Pathway Representation
5.1.12.D.3 5.3.12.A.6 11-12.WHST.9	Expression of genetic information involves cellular and molecular mechanisms.	How do transcription, translation and the regulation of these processes relate to the development and differentiation of an organism?	Protein Synthesis Activity
5.3.12.E.4 5.1.12.A.2 11-12.RST.3, 8	Natural selection is a major mechanism of evolution.	How do natural selection and random processes act on phenotypic variations in populations?	AP Hardy-Weinberg Lab

Course Map			
CCSS	Enduring Understandings	Essential Questions	Common Assessments
5.1.12.D.3 5.3.12.C.1, 2 11-12.RST.3, 8	Abiotic and biotic factors influence the fitness of populations, communities and ecosystems.	How do the interactions between populations and their environment affect natural selection?	AP Dissolved Oxygen Lab AP Transpiration Lab
5.1.12.D.3 5.3.12.E.2 11-12.RST.3, 8	Organisms share many conserved core processes and features that act as evidence of evolution.	What types of evidence can be used to support the similarities that exist within the diversity of existing organisms?	Anatomical or Molecular Homology Lab
5.3.12.E.4 11-12.WHST.1	Speciation and extinction lead to changes in populations throughout Earth's evolutionary history.	What factors influence a population's likelihood to undergo speciation or extinction?	AP Reproductive Isolation Essay

Enduring Understandings & Pacing		
Unit Title	**Unit Understandings**	**Recommended Duration**
1: Introduction to Biology & the Chemistry of Life	The origin of living systems is explained by natural processes. The subcomponents of a biological molecule and their sequence determine the properties of that molecule. Interactions among living systems and with their environment result in the movement of matter and energy. Cells are the basic unit of structure and function in living things.	4 weeks
2: Energy & Dynamic Homeostasis	All living systems require a constant input of free energy. Organisms capture and store energy for use in biological processes. Cell membranes are selectively permeable due to their structure and function in order to maintain growth and dynamic homeostasis for the movement of molecules across barriers. Growth and the homeostatic mechanisms of a biological system are influenced by changes in the system's environment. Timing and coordination of physiological events and behavior are regulated and important to natural selection.	10 weeks
3: Genetics – Reproduction, Development, & Technology	DNA, and in some cases RNA, are the primary source of heritable information. The transmission of genes from parent to offspring occurs through mitosis, meiosis and fertilization. Patterns of inheritance can be explained through both Mendelian and non-Mendelian genetics. Biological systems have a variety of multiple processes that increase genetic variation. Signal transduction pathways mediate gene expression and facilitate cell to cell communication and changes to signal transduction pathways that may alter cellular response. Expression of genetic information involves cellular and molecular mechanisms.	10 weeks

Enduring Understandings & Pacing		
Unit Title	**Unit Understandings**	**Recommended Duration**
4: Evolution & Ecology	Natural selection is a major mechanism of evolution. Abiotic and biotic factors influence the fitness of populations, communities and ecosystems. Organisms share many conserved core processes and features that act as evidence of evolution. Speciation and extinction lead to changes in populations throughout Earth's evolutionary history.	6 weeks
5: Post-AP Exam Unit	*The first 30 weeks of the course are designed to prepare students for the material presented in the College Board AP Exam, however the AP course itself focuses on preparing students for exemption from and/or preparation for a first-year college biology course. In an effort to provide students with the level of rigor and understanding required to achieve these goals, the post-AP exam unit should be dedicated to application of biology topics to real world situations and/or the introduction of units not expanded upon during the year. Suggested topics and activities can be utilized, however the AP biology teacher can use any enhancement activities that promote critical thinking and application.*	6 weeks

AP BIOLOGY
UNIT 1: INTRODUCTION TO BIOLOGY & THE CHEMISTRY OF LIFE **SUGGESTED DURATION: 4 WEEKS**

UNIT OVERVIEW	
ENDURING UNDERSTANDINGS	ESSENTIAL QUESTIONS
The origin of living systems is explained by natural processes.	EQ1: What scientific evidence supports the hypothesis about the origin of life on Earth?
The subcomponents of a biological molecule and their sequence determine the properties of that molecule.	EQ2: How do interactions between molecules affect their structure and function?
Interactions among living systems and with their environment result in the movement of matter and energy.	EQ3: What role do the biogeochemical cycles play in living systems?
Cells are the basic unit of structure and function in living things.	EQ4: How do eukaryotic cells differ from prokaryotic cells?

LEARNING TARGETS			
NJCCCS/CCSS	COMMON ASSESSMENT	EQs	LEARNING GOALS
5.3.12.E.3 11-12.WHST.1, 9	AP Essay on Origin of Life	EQ1	The proficient student will: • describe how the chemical data obtained from the origin of life experiments led to the conclusion of the creation of life on earth.
5.1.12.D.3 5.3.12.A.1 11-12.RST.3, 8	Macromolecule Lab: Students test a variety of substances to determine what macromolecules are present. Create a food plan for a day and indicate the types of macromolecules present and their importance to activity and cell function.	EQ2	The proficient student will: • read and safely follow a scientific protocol to test the composition of various polymers; • explain the connection between the sequence and the subcomponents of a biological polymer and its properties; • identify how molecular interactions affect their structure and function.
5.1.12.D.2 5.3.12.C.2 11-12.RST.7,9	Biogeochemical Cycles Project: Divide students into groups, each representing a different chemical cycle, and create an illustration depicting the cycle and its importance. Set up a gallery walk for students to comment upon and enhance illustrations.	EQ3	The proficient student will: • represent graphical or model quantitatively the exchange of molecules between an organism and its environment and the use of these molecules to build new ones that facilitate homeostasis, growth and reproduction.
5.1.12.D.2 5.3.12.A.1 11-12.RST.9 11-12.WHST.9	Cell Project: Students will create a catalog, analogy, model or poster to show understanding of the structure and function of organelles.	EQ4	The proficient student will: • use representations and models to analyze situations qualitatively to describe how interactions of subcellular structures, which possess specialized functions, provide essential functions.

SUGGESTED STRATEGIES		
ACTIVITIES	DECLARATIVE KNOWLEDGE	PROCEDURAL KNOWLEDGE
EQ-all: Apply the scientific method to all laboratory investigations and use experimental data to create and analyze graphs.	Control vs. experimental group Hypothesis Independent vs. dependent variable	• Use inquiry to design an experiment and apply the scientific method.
EQ1: Research DNA/RNA differences to understand reasons why RNA was the first genetic material, but why DNA has become the primary nucleic acid due to natural selection. Create a chart on the board to compare/contrast these two nucleic acids based on student research.	DNA RNA Ribozyme	• Justify the scientific claim that organisms share many conserved core processes and features that evolved and are widely distributed among organisms today.
EQ1: Quick write: students will individually read over the experiments of Oparin, Miller and Urey for homework. In class, students take three minutes to summarize this information and follow it up with a five minute pair-share. Conduct group discussion.	Protocells Primordial soup	• Explain how observations and experiments in chemistry, geology and physics have led to the proposed theory of life on earth.
EQ2: Monomer-Polymer Activity: practice with dehydration synthesis and hydrolysis to add and remove water to illustrate how easy it is to create and break polymers during the spontaneous origin time on Earth.	Monomer, polymer, glycoside, phosphodiester, peptide, ester, lipid, glycerol, monosaccharide, disaccharide, polysaccharide, amino acids, nucleotides, nucleic acid, protein, dehydration synthesis, hydrolysis	• Evaluate scientific hypotheses about the origin of life on Earth, so students will accurately create and degrade polymers to understand spontaneous origin.
EQ2: Functional Group Flash Cards: students draw functional groups and functions on one side and name the functional group on the other. As a "do now, " students can quiz each other.	Hydroxyl, carbonyl, carboxyl, sulfhydryl, phosphate and amino	• Analyze the effects that a functional group has on the behavior of a molecule.
EQ2: Provide students with several illustrations of molecules and have them complete the illustrations by adding and briefly explaining the types of bonds that can form and why this process occurs.	Intermolecular/ intramolecular forces, covalent/ ionic/ hydrogen bonding, electronegativity	• Identify the types of inter- and intramolecular forces and their different functions.
EQ2: Properties of Water Lab: create a mind map to illustrate the properties of water Or set up lab stations to investigate the various properties of water.	Polar/ nonpolar covalent, cohesion/ adhesion, surface tension, density, specific heat, universal solvent, evaporative cooling, solute, solvent, solution, aqueous, hydrophobic, hydrophilic	• Show how the properties of water contribute to the suitability of life on Earth.
EQ2: Activity to introduce pH and buffers: choose one of the many pH/ buffer lab activities presented through AP Central web sites to reinforce the effect pH and buffers have on metabolic activities such as cellular respiration, digestion, etc. or biological systems, ie Acid rain	Hydroxide, hydrogen ions (hydronium), buffers, pH scale, acid, base, acid rain	• Understand how different substances can act as acids, bases and/or buffers and how they influence homeostasis.

SUGGESTED STRATEGIES		
ACTIVITIES	DECLARATIVE KNOWLEDGE	PROCEDURAL KNOWLEDGE
EQ3: Write an essay that relates how the biogeochemical cycles relate to the cycling of nutrients that are necessary for the formation of polymers and the continuity of the ecosystem	Carbon cycle, phosphorus cycle, nitrogen cycle, ammonification, nitrification, denitrification, nitrogen fixation, photosynthesis, respiration, carbohydrates, lipids proteins, nucleic acids	• Relate the cycling of nutrients to the formation of organic monomers.
EQ4: Create a Venn diagram to compare and contrast plant, animal, and eukaryotic cells.	Organelles, plant, animal, bacteria	• Identify any of these cells based on their characteristics.
EQ4: Mechanism of the Muscle contraction activity: have students create a diagram, analogy, cartoon etc. to represent the role of the cytoskeleton in the movement of muscles.	Motor neuron, acetylcholine, signal transduction pathway, sarcoplasmic reticulum, calcium ions, actin, myosin, tropin, tropomyosin, sarcomere	• Relate the components of the cytoskeleton to the contraction of muscles.

TECHNOLOGY INTEGRATION	
ACTIVITY ALTERNATIVES	STUDENT MONITORING
● Muscle contraction animations to show the mechanism of a sarcomere ● Khan Academy or BozemanScience videos to trace the origin of life ● Harvard University: Inner Life of the Cell video to illustrate a working cell and identify various parts	● "Name that Functional Group" game with SMART Responders ● Instead of a Venn Diagram, students will use Socratic App to brainstorm differences

DIFFERENTIATION
● Biogeochemical Cycle Project: students can create a Prezi, poster, PowerPoint, pamphlet, or video to illustrate a biogeochemical cycle. ● Cell project: students can create an analogy, a booklet, a poster, a model of a eukaryotic cell.

AP BIOLOGY
UNIT 2: ENERGY & DYNAMIC HOMEOSTASIS **SUGGESTED DURATION: 10 weeks**

UNIT OVERVIEW	
ENDURING UNDERSTANDINGS	ESSENTIAL QUESTIONS
All living systems require a constant input of free energy.	EQ1: How do the laws of thermodynamics affect the change in free energy required for an organism to maintain organization, grow and reproduce?
Organisms capture and store energy for use in biological processes.	EQ2: What biological processes are involved in the capture, processing and transfer of free energy and the movement of matter within living systems?
Cell membranes are selectively permeable due to their structure and function in order to maintain growth and dynamic homeostasis for the movement of molecules across its barrier.	EQ3: How does the structure of the cell membrane determine the processes used to transport molecules and transmit information between biological systems in order to maintain physiological processes?
Growth and the homeostatic mechanisms of a biological system are influenced by changes in the system's environment.	EQ4: What chemical dense mechanisms present in animals and plants are used to protect against infections affecting their dynamic homeostasis?
Timing and coordination of physiological events and behavior are regulated and important to natural selection.	EQ5: How do internal and external signals regulate the behavioral and physiological responses of populations?

LEARNING TARGETS			
NJCCCS/CCSS	COMMON ASSESSMENT	EQs	LEARNING GOALS
5.1.12.D.3 5.3.12.A.2 5.3.12.B.1 11-12.RST.3, 8	AP Enzyme Lab: hands-on lab activity using a variety of enzyme and graphing their ability to speed up reaction times as well as comparisons reactions have when affected by environmental factors. Completion of lab analysis and graphs.	EQ1	The proficient student will: • read and safely follow a scientific protocol to test various factors that affect enzyme activity; • justify a scientific claim that free energy is required for living systems to maintain organization, to grow or to reproduce.
5.1.12.D.3 5.3.12.B.3, 4, 5 11-12.RST.3, 8	AP Cellular Respiration Lab & AP Photosynthesis Lab: hands-on AP standard labs that allow students to manipulate plants and peas to test the effects of variables on cell respiration and photosynthesis. Completion of lab analysis questions and graphs.	EQ2	The proficient student will: • read and safely follow a scientific protocol to investigate factors that affect cellular respiration and photosynthesis; • design experiments and construct explanations of the mechanisms and the structural features of cells used to capture, store and transfer free energy .
5.1.12.D.3 5.3.12.A.3 11-12.RST.3, 8	AP Diffusion/Osmosis Lab: hands-on AP Standard lab that allows students to work with a variety of sources to test the movement of water, the importance of transpiration, hydration and the connection to the water cycle and cell communication.	EQ3	The proficient student will: • read and safely follow a scientific protocol to determine where water and/or particles will flow under various environmental conditions; • use representations and models to analyze situations or solve problems qualitatively and quantitatively to investigate whether dynamic homeostasis is maintained by the movement of molecules across semi-permeable membranes.

LEARNING TARGETS			
NJCCCS/CCSS	COMMON ASSESSMENT	LEARNING GOALS	
5.3.12.A.3 11-12.RST.9	Immune System Project: students will be asked to create a cartoon, fable, skit or multimedia presentation describing how the various components of the immune system respond to infection, viruses, allergies and organ transplants.	EQ4	The proficient student will: • create representations and models to describe the immune system of plants and animals.
5.1.12.D.3 5.3.12.C.1 11-12.RST.3, 8	AP Animal Behavior Lab: hands-on standard AP lab, students have the opportunity to work with small organisms such as pill bugs, butterflies, etc. to test their responses to outside stimuli and connect this behavior to reproductive fitness and evolution.	EQ5	The proficient student will: • read and safely follow a scientific protocol to determine what types of behaviors are exhibited by organisms in order to survive; • justify the selection of the kind of data needed to answer scientific questions about the relevant mechanism that organisms use to respond to changes in their external environment.

SUGGESTED STRATEGIES		
ACTIVITIES	DECLARATIVE KNOWLEDGE	PROCEDURAL KNOWLEDGE
EQ1, 2: Pair share: explain the meaning of each component in the equation for the change in free energy of a spontaneous chemical reaction. Why are spontaneous reactions important in the metabolism of a cell? Group discussion: Explain how the highly ordered structure of a cell does not conflict with the second law of thermodynamics. Create a diagram of the structure and regeneration of ATP.	Energy, kinetic, heat, chemical, potential energy, metabolism, catabolic and anabolic pathways. Laws of thermodynamics, entropy, free energy, endergonic and exergonic reactions, structure and hydrolysis of ATP, energy coupling, phosphorylation	• Explain how biological systems use free energy to maintain organization, grow and reproduce.
EQ1, 2: Research a drug that acts as a competitive or noncompetitive inhibitor and report its effects. Conduct Toothpick-ase lab activity to form a Vmax graph. Design or analyze a graph that illustrates how activation energy barriers and enzymes affect free energy and timing of chemical processes. Student-led mini lectures.	Active site, competitive inhibitor, non-competitive inhibitor, enzyme, substrate, active site, Vmax, catalyst, activation energy, substrate active site vs induced fit factors that affect enzyme activity cofactors, coenzymes, enzyme inhibition, regulation of enzymes, allosteric	• Use technology to predict how changes to normal processes affect chemical reactions and homeostasis. • Utilize experimental data to construct and analyze a graph of enzyme kinetics.
EQ3: Create a concept map for the process of cellular respiration. Students can do a fermentation-in-a-baggie lab activity. Design a diamante poem for cellular respiration and/or fermentation. Quick write: use no more than 20 words to describe the process of chemiosmosis.	Cellular respiration in prokaryotes and eukaryotes, structure of mitochondria, Redox reactions, aerobic vs anaerobic respiration, ETC, glycolysis, Krebs, ATP synthase, chemiosmosis, proton gradient, pyruvate, NADH, FADH2 Fermentation (alcohol and lactic acid)	• Write arguments to introduce a precise, knowledgeable claim and construct explanations of the mechanisms and structural features that allow organisms to capture, store and use free energy.

SUGGESTED STRATEGIES		
ACTIVITIES	DECLARATIVE KNOWLEDGE	PROCEDURAL KNOWLEDGE
EQ3: Prepare a graphic organizer to show the flow of electrons through the process of photosynthesis. Leaf structure activity: microscope slides of cross section of leaf. Create a poem for xylem and phloem. Create a Venn diagram to illustrate the similarities and differences between chemiosmosis of cellular respiration and the light reaction of photosynthesis.	Photosynthesis in prokaryotes and eukaryotes, electromagnetic spectrum, wavelength, photons, pigments, structure of a leaf (mesophyll, stomata, xylem, phloem). Structure of chloroplast Light reactions, Calvin cycle, carbon fixation, ETC, NADPH	• Understand that certain biological processes are conserved throughout evolution and that the same process can be evident in unrelated species.
EQ4: Create food chain/web and label of the trophic levels of each organism.	Food chains, webs, biomass, trophic structure, energetic hypothesis (10% rule), law of conservation of mass, primary and secondary production, gross and net primary production, limitations nutrients, eutrophication, turn over	• Create representations and models of natural phenomenon to illustrate the flow of energy through a food chain.
EQ5: Design a cartoon with characters representing each of the parts of the cell membrane. Draw and label a diagram of the cell membrane.	Cell transport in animal and plant cells, cell wall, selective permeability, fluid mosaic model, phospholipid bilayer, amphipathic, integral, peripheral and transport proteins, glycolipids, glycoproteins, aquaporins	• Use representations and models to illustrate the structure of the cell membrane.
EQ6: Creative projects • Create a pictorial collage, using images from the internet or drawn by the student, to illustrate the modes of cell transport. • Fashion clothing line: design a campaign for a piece of clothing that represents one of the cell transport concepts. Describe how it represents the concept, make an illustration of the article with logo advertising the transport method, use at least three paragraphs to describe how the name of the clothing lie will help it sell how the illustration shows the transport method and how wearing the clothing will help a student learn the method of transport • Analyze graphs to predict whether a solution is hypertonic, hypotonic or isotonic with its environment. • Create a summary chart to illustrate what types of molecules pass into/out of a cell via osmosis, simple diffusion, facilitated diffusion, active transport, or endo/exocytosis. • Calculate water potential by taking the sum of pressure potential and solute potential for both covalent and ionic solutes.	Passive transport, diffusion, concentration gradient, equilibrium, tonicity, isotonic, hypertonic, hypotonic, osmoregulation, turgid, flaccid, plasmolysis, facilitated diffusion, ion channels, active transport, sodium potassium pump, membrane potential electrochemical gradient, electrogenic pump, proton pump, cotransport, exocytosis, endocytosis	• Evaluate how the direction and force of the movement of molecules across a membrane effects cell activity.
EQ7: Trace the path of food through the digestive system.	Human digestive system- mouth, esophagus, stomach, liver, gallbladder, pancreas, small intestine, large intestine, villi, hepatic portal vein Enzymatic hydrolysis, amylase, pepsin, lipase, nuclease	• Explain how each component and enzyme of the digestive system contributes to the degradation and absorption of the macromolecules used for metabolic activity.

SUGGESTED STRATEGIES		
ACTIVITIES	DECLARATIVE KNOWLEDGE	PROCEDURAL KNOWLEDGE
EQ7: Summarize the step by step mechanism of the action potential and correlate each step to the parts of the action potential graph.	Nervous system: structure and function of neurons, membrane and resting potential, gated ion channels, hyper and depolarization, action potential, voltage gated ion channels, threshold, synapse, flow of information processing	• Analyze the data to identify patterns or relationships.
EQ7: Explain the signal transduction pathway associated with ADH (anti-diuretic hormone) and the change in permeability of the cells lining the collecting duct in order to maintain homeostasis.	Homeostatic control of breathing $-CO_2$ and oxygen, antidiuretic hormone ADH, fruit ripening, lactation, labor, blood clotting hormones	• Connect the concepts of signal transduction pathways and homeostasis.
EQ8: Relate cell transport to kidney function by labeling the parts of a nephron and explaining the function of each region.	Adaptations of digestive systems - intracellular and extracellular digestion, ruminant Gas exchange: aquatic vs. terrestrial Excretion systems: osmoregulation, kidney, nephron, nephridia, movement through the human kidney	• Synthesize information from a range of organisms into a coherent understanding of adaptations that affect homeostasis.
EQ9: Analyze a graph of the primary and secondary immune response by writing an AP essay.	Primary immune response, secondary immune response, memory cells, antibodies, B cells, plasma cells	• Connect concepts in and across domain(s) to predict how environmental factors affect responses to information and change behavior
EQ10: Poster project: students will choose a type of learning and create a poster or cartoon that illustrates an animal performing a particular behavior. Project will explain the evolutionary significance of the behavior.	Fixed action pattern, imprinting, habituation, social learning, cognition, operant and classical conditioning, natural selection, fitness, phototropism, circadian rhythm, hibernation, pheromones	• Justify scientific claims, using evidence, to describe how timing and coordination of behavioral events are regulated by several mechanisms.

TECHNOLOGY INTEGRATION	
ACTIVITY ALTERNATIVES	STUDENT MONITORING
• Use computer software to create Venn diagrams and graphs.	• Use Google Drive, TitanPad or other service to collaborate on lab data. • Use SMART Responders or Socratic App for formative assessments.

DIFFERENTIATION
• Students can create flow charts, analogies, graphic organizers, posters, etc. to illustrate understanding of concepts throughout this chapter. • Lab activities can be broken down by skill level.

AP BIOLOGY
UNIT 3: GENETICS – REPRODUCTION, DEVELOPMENT, & TECHNOLOGY **SUGGESTED DURATION: 10 weeks**

UNIT OVERVIEW	
ENDURING UNDERSTANDINGS	ESSENTIAL QUESTIONS
DNA, and in some cases RNA, are the primary source of heritable information.	EQ1: What role do DNA and RNA play in inheritance? EQ2: How are DNA and/or RNA used in genetic engineering?
The transmission of genes from parent to offspring occurs through mitosis, meiosis and fertilization.	EQ3: How is heritable information passed through mitosis or meiosis followed by fertilization?
Patterns of inheritance can be explained through both Mendelian and non-Mendelian genetics.	EQ4: How are Mendel's laws related to gene expression? EQ5: What patterns of inheritance cannot be explained by simple Mendelian genetics?
Biological systems have a variety of multiple processes that increase genetic variation.	EQ6: What mechanisms introduce variation in prokaryotic and eukaryotic cells? EQ7: How does the reproduction of viruses lead to the introduction of genetic variation in host cells?
Signal transduction pathways mediate gene expression, facilitate cell to cell communication and changes to signal transduction pathways that may alter cellular response.	EQ8: How does cell to cell communication influence cellular and physiological responses?
Expression of genetic information involves cellular and molecular mechanisms.	EQ9: How do transcription, translation and the regulation of these processes relate to the development and differentiation of an organism?

LEARNING TARGETS

NJCCCS/CCSS	COMMON ASSESSMENT	EQs	LEARNING GOALS
5.1.12.D.3 5.3.12.D.1 11-12.RST.3, 8	AP Gel Electrophoresis Lab: hands-on standard AP lab where students work with restriction enzymes and prepare and run a gel electrophoresis allowing them to compare the pattern differences in DNA.	EQ2	The proficient student will: • read and safely follow a scientific protocol to successfully create a Southern Blot; • justify the claim that humans can manipulate heritable information by identifying commonly-used technology.
5.1.12.D.3 5.3.12.A.4 5.3.12.D.3 11-12.RST.3, 8	AP Mitosis Lab & AP Meiosis Lab: hands-on AP lab activity, students use manipulatives to demonstrate their knowledge of these processes. Completion of lab analysis questions.	EQ1 EQ3	The proficient student will: • read and safely follow a scientific protocol to identify the various stages of mitosis and meiosis; • construct scientific explanations that use the structures and mechanisms of DNA and RNA to support the claim that DNA and/or RNA are the sources of heritable information that are passed through mitosis, or meiosis followed by fertilization.
5.1.12.A.2 11-12.WHST.4	Genetic Problem Analysis: students will be given and asked to create a set of genetics problems and determine the genetic probability of the offspring.	EQ4 EQ5	The proficient student will: • apply mathematical routines to determine Mendelian and non-Mendelian patterns of inheritance provided by data sets.
5.1.12.D.3 5.3.12.D.2 11-12.RST.3, 8	AP Transformation Lab: hands-on AP standard lab. Students will create a lab using lab safety tested bacteria. Lab will show how bacteria can take up genes from other sources and create new strains and be useful in the area of gene technology.	EQ6 EQ7	The proficient student will: • read and safely follow a scientific protocol to successfully cause bacteria to take in foreign DNA; • predict how a change in a specific DNA or RNA sequence can result in changes in gene expression.

LEARNING TARGETS			
NJCCCS/CCSS	COMMON ASSESSMENT	LEARNING GOALS	
5.1.12.D.2 11-12.WHST.6	Written or Visual Representation of a Signal Transduction Pathway: students will create a flow chart or skit to illustrate the ability and process cells use to communicate signals within and between body systems.	EQ8	The proficient student will: • use representations to describe how gene regulation influences cell products and function.
5.1.12.D.3 5.3.12.A.6 11-12.WHST.9	Protein Synthesis Activity: students design activity that indicates knowledge of how DNA determines the characteristics of organisms through the creation of proteins.	EQ9	The proficient student will: • read and safely follow a scientific protocol follow the flow of information from DNA to protein; • use representations to describe how gene regulation influences cell product and function.

SUGGESTED STRATEGIES		
ACTIVITIES	DECLARATIVE KNOWLEDGE	PROCEDURAL KNOWLEDGE
EQ1: Student groups are each assigned the job of researching one of the scientists that participated in the discovery of DNA as the genetic material. Each group presents a poster advertisement supporting the claims and experiment that lead to their discovery. Label the structure of DNA and RNA.	Structure of DNA and RNA Antiparallel, semiconservative model, complementary base pairing	• Synthesize information from a range of sources into a coherent understanding of the processes used by Griffith and Hershey and Chase that lead to the discovery of DNA as genetic material and its structure.
EQ2: Short essay. Discuss how the genetic basis of life plays a central role in biotechnology. Philosophical chairs: Research and find an article that deals with debate surrounding government funding and embryonic stem cell research or the danger in the ability to customize babies or perform DNA analysis at birth for identification purposes.	Genetic testing- amniocentesis, karyotyping, genetic engineering, recombinant DNA, plasmids, restriction enzymes, gene cloning PCR, gel electrophoresis, stems cells, transgenic animals, gene therapy, GMO's	• Develop claims that supply the most relevant data and evidence for the use of gene technology as a solution for societal issues.
EQ3: Assign roles to all students and have them act out the process of DNA replication. Each student must draw a replication bubble and label all of its parts.	Describe the replication of DNA, origin of replication, active enzymes (helicases, primases, DNA polymerase etc.), leading and lagging strand (Okazaki fragments), editing and proof reading (mismatch repair, nuclease), evolutionary importance of telomeres	• Relate the steps of DNA replication the continuity of life.
EQ3: Create a flow diagram of each step of meiosis when 2n = various. Include crossing over and fertilization. Analyze a karyotype to identify the differences between autosomes and sex chromosomes.	Sexual vs. asexual reproduction, bacterial transformation, stages of meiosis, gametes, somatic cells, haploid, diploid, zygote, fertilization, homologous chromosomes, sex chromosomes, autosomes, alternation of generation, synapsis, crossing over, recombinant chromosomes	• Create a representation or model that illustrates how meiosis and fertilization lead to genetic variation.

SUGGESTED STRATEGIES		
ACTIVITIES	DECLARATIVE KNOWLEDGE	PROCEDURAL KNOWLEDGE
EQ4, 5: Design a pedigree using Mendelian inheritance patterns. Construct a linkage map by applying calculated map units from related genetics problems. Calculate Chi Square analysis.	Explain the Mendel's law of inheritance, distinguish between gene and allele, DNA, chromosome, chromatin, true breed and hybrid, dominant and recessive, homozygous and heterozygous, complete/incomplete/co-dominance, pleiotropy, epistasis, polygenic and sex linked inheritance, effects of linked genes, wild vs. mutant type	• Apply mathematical routines to explain and predict the inheritance of offspring.
EQ6: Research an inherited genetic disease to relate how mutations affect phenotype and present in a mini-lecture.	Non disjunction aneuploidy, alterations of chromosome structure (deletion, duplication, inversion, translocation) point mutations, mutagens	• Predict how changes in genotype change the expression of phenotype and provide variation that can be subject to natural selection.
EQ7: Draw a diagram of the lytic and lysogenic cycles and describe the difference between them. Research an emerging virus and discuss how society is coping with is (Swine flu, Hanta virus, Ebola).	Transduction, lytic, lysogenic, provirus, prophage, bacteriophage, HIV, AIDS, retrovirus, reverse transcriptase, CD4, helper T cell, capsid, envelope, RNA viruses, DNA viruses, emerging viruses	• Use technology to produce, publish and update individual writing products regarding viruses.
EQ8: Obtain an article on a current cancer treatment and relate it to the cell cycle.	Cell cycle and cell signaling pathway, stages of mitosis, binary fission, cytoplasmic signals, cell cycle control system (cyclin, MPF), cancer, malignant, benign, metastasis, oncogenes, tumor, suppressor genes, ras gene, p53 gene, genetic programs for embryonic development, differentiation, morphogenesis, homeotic genes	• Gather relevant information from multiple authoritative print and digital sources.

SUGGESTED STRATEGIES		
ACTIVITIES	DECLARATIVE KNOWLEDGE	PROCEDURAL KNOWLEDGE
EQ9: Students create an analogy to explain protein synthesis. Using the genetic code, determine the amino acid strand that will be generated from a given strand of DNA. Given any of the following strands, NA, tRNA, mRNA, or amino acid, convert to the other strands.	mRNA, RNA polymerase, ribosomes, tRNA, rRNA, template strand, genetic code, codon, anticodon, triplet code, promoter, terminator, TATA box. Poly(A) tail, RNA splicing, introns, exons, spliceosome, wobble hypothesis, polyribosomes	• Realize that protein synthesis is a conserved process that is used to determine the phenotypes of all organisms.
EQ9: Watch PBS documentary *Ghost In Your Genes* and explain the role of epigenetics in gene expression. Draw and label the two types of operons and describe how it affects protein synthesis. Create a Venn diagram to compare/contrast inducible and repressible operons. Four Corners Activity: Each group will summarize the effects of one of the various eukaryotic gene regulatory mechanisms.	Regulation of gene control, bacteria, basic concept of operons (operator, operon, repressor, inducer, cyclic amp [cAMP]), eukaryotic, epigenetics, DNA methylation, histone acetylation, genomic imprinting, non-coding DNA and RNA's role on gene expression, microRNA, RNA interference, siRNA, pseudogenes, transposons	• Explain how the regulation of gene expression is essential for the processes and structures that support efficient cell function and create observed differences between organisms.

TECHNOLOGY INTEGRATION	
ACTIVITY ALTERNATIVES	STUDENT MONITORING
• SMART Board presentations, video clips/animations	• Prezi presentations, Survey Monkey

DIFFERENTIATION
• Analogies • Role playing various biological processes

AP BIOLOGY
UNIT 4: EVOLUTION & ECOLOGY **SUGGESTED DURATION: 6 weeks**

UNIT OVERVIEW	
ENDURING UNDERSTANDINGS	ESSENTIAL QUESTIONS
Natural selection is a major mechanism of evolution.	EQ1: How do natural selection and random processes act on phenotypic variations in populations?
Abiotic and biotic factors influence the fitness of populations, communities and ecosystems.	EQ2: How do the interactions between populations and their environment affect natural selection?
Organisms share many conserved core processes and features that act as evidence of evolution.	EQ3: What types of evidence can be used to support the similarities that exist within the diversity of existing organisms?
Speciation and extinction lead to changes in populations throughout Earth's evolutionary history.	EQ4: What factors influence a population's likelihood to undergo speciation or extinction?

LEARNING TARGETS			
NJCCCS/CCSS	COMMON ASSESSMENT	EQs	LEARNING GOALS
5.3.12.E.4 5.1.12.A.2 11-12.RST.3, 8	AP Hardy-Weinberg Lab: hands on standard AP lab where students will generate data in order to calculate p and q when Hardy-Weinberg conditions are altered.	EQ1	The proficient student will: • read and safely follow a scientific protocol to gather data and determine whether or not Hardy-Weinberg conditions are met; • use data from mathematical models based on the Hardy-Weinberg equilibrium to analyze genetic drift and effects of selection in the evolution of a specific population.
5.1.12.D.3 5.3.12.C.1, 2 11-12.RST.3, 8	AP Dissolved Oxygen Lab: hands on inquiry-based AP lab where students can vary environmental conditions and determine the amount of dissolved oxygen in a water source. AP Transpiration Lab: hands on inquiry-based AP lab where students can vary environmental conditions to determine the rate of transpiration in a particular plant species.	EQ2	The proficient student will: • read and safely follow a scientific protocol to test how environmental factors affect both dissolved oxygen content and transpiration; • use theories and models to make scientific claims and/or predictions about the effects of variations on a biological system's survival and fitness.
5.1.12.D.3 5.3.12.E.2 11-12.RST.3, 8	Anatomical or Molecular Homology Lab (ex: cytochrome C): hands on lab activity where students will analyze multiple sets of biological data in order to determine the degree of homology between different species.	EQ3	The proficient student will: • read and safely follow a scientific protocol to correctly infer phylogenetic relationships based on analysis of molecular data.
5.3.12.E.4 11-12.WHST.1	AP Essay Topic: reproductive isolation as a mechanism of speciation. Students will be given 20 minutes to investigate the various types of reproductive isolation that cause a species to diverge.	EQ4	The proficient student will: • justify the selection of data that address questions related to reproductive isolation and speciation.

SUGGESTED STRATEGIES		
ACTIVITIES	DECLARATIVE KNOWLEDGE	PROCEDURAL KNOWLEDGE
EQ1: Think-Pair-Share: evaluate the statement, "Differential reproductive success is survival of the fittest." Students think about the answer to the question, compare their answers with another student and collaborate responses. Open discussion about student responses.	Natural selection, differential reproductive success, fitness, evolution, artificial selection	• Evaluate quantitative and qualitative data to investigate the role of natural selection in evolution.
EQ1: Students analyze Lamarck vs. Darwin interpretations in reference to real-life situations to determine whether the trait is an inherited or an acquired trait. Students will determine whether or not the scenario reflects Lamarckism or Darwinism by writing an explanation.	Acquired vs. inherited traits, Lamarckism, Darwinism	• Refine evidence based on data from many scientific principles that supports biological evolution.
EQ2: Gallery Run: show pictures and ask "what is being illustrated and how biotic and abiotic factors influence the ability of a population to survive." Illustrate genetic variation (ex. different colors of squirrels of the same species or an albino deer). Illustrate environmental impact (ex. polar/black bars in native environment). Illustrate competition (ex. deer locking antlers during mating season in an attempt to win favor with females). Students evaluate and summarize how each picture influences evolution. Students should come up with genetic variation, environmental impact and competition.	Biotic factors, abiotic factors, competition, genetic variation, environmental impact, population, community, ecological niche, resource partitioning, competitive exclusion	• Connect evolutionary changes in a population over time to a change in the environment.
EQ2: Students will create a cartoon to illustrate how an animal behavior is subject to evolutionary pressures through natural selection.	Fixed action patterns, habituation, imprinting, migration, territory behaviors, agnostic, promiscuous, polygamous, altruism, monogamous	• Explain how animal behaviors contribute to the fitness of a species.
EQ2: Use Carolina's Peppered Moth Lab kit to simulate changes in moth population due to pollution and predation, and observe how species can change over time. Generate data and make conclusions about the environment's impact on peppered moth phenotypes.	Predation, allele frequency, population, predation	• Apply mathematical methods to data from a real or simulated population to predict what will happen to the population in the future.
EQ2: Analyze data set of R and K populations to illustrate fitness as a measure of reproductive success and calculate rates of population growth. Teacher will provide or students will research examples of R or K strategists, provide data for juveniles, adolescents and adults, graph this data and apply exponential and logistic growth analysis.	R and K strategist, fitness, reproductive success, logistic growth, exponential growth, carrying capacity, density-dependent factors, density-independent factors, survivorship curves	• Convert a data set from a table of numbers that reflect a change in the genetic makeup of a population over time and to apply mathematical methods and conceptual understandings to investigate the causes(s) and effect(s) of this change.
EQ2: Conduct a Four Corners Activity on genetic drift to create a Hardy-Weinberg problem set for others to complete while illustrating how genetic drift affects selection. Each one of four groups will be assigned a different example of genetic drift (including heterozygote advantage) and how it affects Hardy-Weinberg equilibrium. Each group must create a Hardy-Weinberg problem set for others to complete. Worksheet must include a graph of data or a chart. Example must illustrate one of the three types of selection (directional, stabilizing or disruptive). Assigned example must accurately portray how genetic drift affects Hardy-Weinberg equilibrium. Example must be clear enough for others to identify the correct trends and selection types from the data provided.	Hardy-Weinberg equilibrium, genetic drift, heterozygote advantage, directional selection, stabilizing selection, disruptive selection, allele frequency, artificial selection, antibiotic resistance	• Use data from mathematical models based on the Hardy-Weinberg equilibrium to analyze genetic drift and make predictions about the effects of selection in the evolution of specific populations.

SUGGESTED STRATEGIES		
ACTIVITIES	DECLARATIVE KNOWLEDGE	PROCEDURAL KNOWLEDGE
EQ2: Think-pair-share: brainstorm illustrative examples that prevent certain organisms from mating (pre-post zygotic factors). Collaborate and discuss examples to lead into lecture on allopatric and sympatric speciation Students will write their pre/post zygotic reproductive isolation examples on the board.	Pre-zygotic factors, post-zygotic factors, temporal isolation, geographic isolation, mechanical isolation, gametic isolation, behavioral isolation, reduced hybrid viability, reduced hybrid fertility, hybrid breakdown, allopatric speciation, sympatric speciation	• Justify selection of data that address questions related to reproductive isolation and speciation
EQ3: Poster presentation to illustrate a method to assess relatedness between current and ancestral species. Each group will be assigned a different way to assess relatedness (morphological, molecular, fossils, embryology, etc.) and do a short presentation to illustrate examples. Each group will present illustrative examples of relatedness between current and ancestral species.	Homologous structures, vestigial structures, ancestral species	• Construct and/or justify mathematical models, diagrams or simulations to answer scientific questions regarding how organisms have changed over time using information from morphology, biochemistry and geology.
EQ3: Phylogenic trees and cladograms interpretation with a given data set. Students will accurately complete and assess phylogenic trees and cladograms by identifying closely related species and derived traits.	Phylogenetic tree, cladogram, shared derived trait, speciation	• Create phlylogenetic trees and cladograms from a provided data set and evaluate evidence provided by a data set in conjunction with a phylogenetic tree or a cladogram to determine evolutionary history and speciation.
EQ3: Research core conserved processes/structures. Hox genes, cytochrome C, mitochondrial DNA vs. DNA that codes for rRNA, glycolysis, 9+2 arrangement of microtubules are examples of conserved processes and structures that can be used as examples. Students will research their assigned core, conserved process and write a short paragraph to describe it.	Conserved core process, cytochrome C, mitochondrial DNA, rRNA DNA, domain, transcription, translation, replication, metabolic pathways, cytoskeleton, organelles, chromosomes	• Describe specific examples of conserved core biological processes and features shared by all domains or within one domain of life, and how these shared conserved core processes and features support the concept of common ancestry for all organisms.
EQ3: Quick write activity to compare/contrast divergence and convergence. Students will use no more or less than 20 words to summarize the difference between convergent and divergent evolution.	Divergence, convergence, homologous characteristic, analogous characteristic vestigial characteristic, natural selection, genetic drift, allele frequency	• Describe speciation in an isolated population and connect it to change in gene frequency, change in environment, natural selection and/or genetic drift.
EQ4: Human impact jigsaw. Students will be broken up into specialist groups. Ex: acid rain, ozone depletion, global warming, agricultural soil depletion etc. Each group will become an expert on their topic. Each student expert will then be assigned to a new group so that all new groups will have one expert from each topic area. Students will then teach one another and discuss the current issues surrounding their topic.	CFC, biological magnification, global warming, soil erosion, ozone, eutrophication, habitat destruction, invasive species, overexploitation of resources	• Predict the effects human impact will have on the evolution of future populations.

TECHNOLOGY INTEGRATION	
ACTIVITY ALTERNATIVES	STUDENT MONITORING
• Peppered moth or walking stick Internet simulation to illustrate environmental impact on natural selection	• Use computer-based graphing software to generate graphs from transpiration and/or dissolved oxygen lab. • Online quiz through Quizlet, Survey Monkey, Edmodo, Moodle, etc.

DIFFERENTIATION
• Human impact jigsaw can include poster, PowerPoint, handout, pamphlet, video to teach assigned concept to others.

AP BIOLOGY

UNIT 5: POST-AP EXAM **SUGGESTED DURATION: 6 weeks**

The first 30 weeks of the course are designed to prepare students for the material presented in the College Board AP Exam, however the AP course itself focuses on preparing students for exemption from and/or preparation for a first-year college biology course. In an effort to provide students with the level of rigor and understanding required to achieve these goals, the post-AP exam unit should be dedicated to application of biology topics to real world situations and/or the introduction of units not expanded upon during the year. Suggested topics and activities can be utilized, however the AP biology teacher can use any enhancement activities that promote critical thinking and application.

SUGGESTED TOPICS and ACTIVITIES	
Genetics, Ethics and Technology	Have students obtain articles regarding genetic engineering, GMO's, DNA fingerprinting etc. and conduct Socratic seminars with outside circle students completing an evaluation form for participation. Have students watch a variety of educational videos regarding DNA, ethical issues of genetic engineering, etc.
Evolutionary History of Biological Diversity	Break students up into groups and have them become experts on a phylum in Kingdom Animalia. Students will in turn develop a lesson and teach the class about their phylum. Teacher will develop an appropriate assessment.
Plant Form and Function	Plant structure, growth and development: Lab activity: use microscope to differentiate between the dicot/ monocot. View the parts of the root and shoot, describing the differences between primary and secondary growth. Conduct a walkthrough on campus and have students use dichotomous key to distinguish the types of flora in the area. Evolution of plants: Set up stations with samples of the various plants, from moss through angiosperms, and have students record observations of characteristics and produce a chart that shows the evolutionary changes in the plant kingdom. Lab activity: Obtain various species of plants and observe the number and location of stomata and how that relates to adaptations and fitness.