Honors Biology/Lab

Biology is the science that seeks to understand, explain & even control the living world by observing, asking questions & forming hypotheses that can be tested by experimentation. The course offers a focus on biological concepts through inquiry based investigations & weekly laboratory experiments reinforcing the content. Honors Biology is taught in a series of modules based on specific content: basic biological principles, biochemistry, bioenergetics, cell transport & homeostasis, cell division, genetics, evolution, & ecology. Other enrichment opportunities will include special laboratory investigations through a lab setting using the latest technology, video conferences, outside speakers and a research project. This course prepares students for the state mandated Keystone Biology Exam that must be taken as a graduation requirement & entrance into a four year college. **This is an advanced level 105 course.**

Course Information:

Frequency & Duration: Daily for 42 minutes; 6 periods per week (includes one lab period)

Text: Biology: Miller & Levine; Foundation Edition; Copy wright 2010

Module 1 Basic Biological Principles	**Duration:** Aug./ Sept. (3 weeks)
Big Idea	Basic Biological Principles are needed as an essential part of Biology
Essential Question	How do we know if something is alive? How is structure related to function at the various levels of cellular organization?
Eligible Content	•Describe and explain the characteristics of life common to all organisms. •Compare and contrast the cellular structures and degrees of complexity •Relate life processes to sub-cellular and cellular structures to their functions. •Explain how organisms maintain homeostasis (e.g., thermoregulation, water regulation, oxygen regulation •Compare cellular structures and their functions in prokaryotic and eukaryotic cells •Identify the advantages of multi-cellularity in organisms. •Describe and interpret relationships between structure and function at various levels of biological organization (i.e., organelles, cells, tissues, organs, organ systems, and multicellular organisms). •Recognize that systems within cells and multicellular organisms interact to maintain homeostasis •Explain how organisms maintain homeostasis (e.g., thermoregulation, water regulation, oxygen regulation).

	•Distinguish between the scientific terms: hypothesis, inference, law, theory, principle, fact, and observation
Instructional & Engagement Activities	• Students will be able to describe and explain the common characteristics of life common to all organisms • Given prokaryotic and eukaryotic Organisms compact and contrast the cellular structures and complexity. • Students will be able to determine structures in Eukaryotic cells that developed from Prokaryotic cells • Students will be able to relate life processes to sub-cellular and cellular structures to their functions. • Students will be able to explain how organisms maintain homeostasis (e.g., thermoregulation, water regulation, oxygen regulation • Students will be able to compare cellular structures and their functions in prokaryotic and eukaryotic cells. • Students will be able to identify the advantages of multi-cellularity in organisms. • Students will be able to describe and interpret relationships between structure and function at various levels of biological organization (i.e., organelles, cells, tissues, organs, organ systems, and multicellular organisms). • Students will be able to recognize that systems within cells and multicellular organisms interact to maintain homeostasis • Students will be able to explain how organisms maintain homeostasis (e.g., thermoregulation, water regulation, oxygen regulation Students will be able to distinguish between the scientific terms: hypothesis, inference, law, theory, principle, fact, and observation
ASSESMENTS	**Module 1 workbooks with power points** • Word meanings worksheet • Living/nonliving activity • Homeostasis worksheet • Scientific method simulations • Cell parts guided notes & drawing • Endosymbiotic theory • Investigating organelle diseases **Lab:** • Lab Equipment Activity • Microscope lab • Experimental Design lab • Plant/animal cell lab **Project** • Cellular organelle Resume **WEEKLY QUIZES AND A COMMON ASSESSMENT**
Standards	3.1.10.A1 Explain the characteristics of life common to all organisms. 3.1.B.A1. Describe the common characteristics of life. Compare and contrast the cellular structures and degrees of complexity of prokaryotic and eukaryotic organisms 3.1.10.A5. Relate life processes to sub-cellular and cellular structures to their functions. 3.1.B.A8.CHANGE AND CONSTANCY Recognize that systems within cells and multicellular organisms interact to maintain homeostasis.

	BIO.A.4.2.1 Explain how organisms maintain homeostasis (e.g., thermoregulation, water regulation, oxygen regulation). BIO.A.1.2.1. Compare cellular structures and their functions in prokaryotic and eukaryotic cells. 3.1.10.A6. Identify the advantages of multi-cellularity in organisms BIO.A.1.2.2. Describe and interpret relationships between structure and function at various levels of biological organization (i.e., organelles, cells, tissues, organs, organ systems, and multicellular organisms). BIO.A.4.1.4 Explain how organisms maintain homeostasis (e.g., thermoregulation, water regulation, oxygen regulation). BIO.B.3.3.1 Distinguish between the scientific terms: hypothesis, inference, law, theory, principle, fact, and observation.
Common Core	Writing: CC.3.6.9-10.B,CC.3.6.9-10.C,CC.3.6.9-10.D,CC.3.6.9-10.I,CC.3.6.9-10.A. Reading: CC.3.5.9-10.B, CC.3.5.9-10.D,CC.3.5.9-10.E,CC.3.5.9-10.H,CC.3.5.9-10.I, CC.3.5.9-10.J
Vocabulary	**Cell**- The basic unit of structure & function in all living organisms; **Eukaryotic Cells-** A cell with a nuclear membrane and organelles; **Homeostasis-** Regulation of an organism's internal conditions to maintain life; **Homeostatic Mechanism** – A regulatory mechanism that contributes to maintaining a state of equilibrium; **Control** – Part of an experiment that stays the same; **Independent Variable (manipulative)** – The part of the experiment that we change; **Dependent Variable (responding)** – The part of the experiment that we are measuring from what we manipulated; **Scientific Method** – The process that scientists use to solve a problem; **Hypothesis-** An educated guess; **Law** – A law that generalizes a body of observations, it explains but does not describe them. **Prokaryotic Cells**- a cell lacking a true membrane-bound nucleus; **Theory**- This has been proven by many experiments that have been performed over time. **Characteristics of Life** – Characteristics common to most life forms; **Cell Wall** – Supports & protects the cell & made from cellulose; **Chloroplast** – Organelle found in plant cells or other eukaryotic photosynthetic organisms where photosynthesis occurs; **Extracellular** – outside of cell; **Intracellular** – Inside of cell; **Endoplasmic reticulum** – Organelle, containing folded membranes, responsible for production, processing & transportation of materials inside & outside an eukaryotic cell. The two forms are **Rough ER** that has surface ribosomes & participates in protein synthesis & **smooth ER** that has no ribosomes & participates in the synthesis of proteins mostly for export by the cell as well as synthesis of lipids & steroids; **Endosymbiosis** – A theory that earlier eukaryotic cells were formed from simpler prokaryotes; **Golgi apparatus** – An organelle found in eukaryotic cells responsible for the final stages of processing proteins for release by the cell; **Lysosomes** – Breaks down cellular components that are no longer needed as well as unwanted molecules that are ingested by the cell; **Mitochondrion** – The membrane bound organelle in eukaryotes that is the site of cellular respiration; **Unicellular** – Made up of one cell; **Multicellular** – Made from more than one cell; **Nucleus** – The Command center of the

	cell; **Nucleolus** – Found in the nucleus & produces ribosomes; **Tissue** – composed of cells; **Organ** – Composed of tissues; **Organ system** – composed of organs; **Organelle** – Little organs of the cell; **Plasma membrane (Cell membrane)** – A thin, phospholipid & protein molecule bilayer that covers the cell & controls movement of materials in & out of the cell; **Plastids** – A group of organelles found in photosynthetic organisms that is responsible for synthesis & storage of food; **Ribosome** – An organelle composed of RNA & proteins that is the site of protein synthesis; **Vacuoles** – An organelle mostly found in plant cells, but some animal & bacterial cells that stores food, water or waste; **Stomates** – Tiny opening or pore that is used for gas exchange on the underside of plant leaves.

Module 2: Biochemistry	**Duration: September/October (5 weeks)**
Big Idea	Chemistry is the basis of all living things
Essential Questions	How is life a product of the organization & interaction of matter?
Eligible Content	• Describe the unique properties of water. • Explain how the unique properties of water make life on Earth possible. • Describe the structure of a carbon atom. • Explain how carbon atoms bond to form biological macromolecules. • Describe how biological macromolecules form from monomers. • Compare the structure and function of carbohydrates, lipids, proteins & nucleic acids in organisms. • Explain how enzymes act as catalysts to regulate biochemical reactions. • Explain how environmental factors affect the function & reaction rate of the enzyme. • Interpret graphs to analyze enzyme catalyzed reactions.
Instructional/Engagement Strategies	• The student will describe the unique properties of water. • The student will explain how the unique properties of water make life on Earth possible. • The student will describe the structure of a carbon atom. • The student will explain how carbon atoms bond to form biological macromolecules. • The student will describe how biological macromolecules form from monomers. • The student will compare the structure and function of carbohydrates, lipids, proteins & nucleic acids in organisms. • The student will explain how enzymes act as catalysts to regulate biochemical reactions. • The student will explain how environmental factors affect the function & reaction rate of the enzyme. • The student will interpret graphs to analyze enzyme catalyzed reactions
Assessments	Weekly quizzes and Biochemistry common assessment **LABS**

	• Bonding • Water lab • Temperature Effects on Enzymes • Which detergent Works Best? • The Need for Speed • Macromolecule building • Who took Jerrell's IPod?
Standards	Bio.A.2.1.1: Describe the unique properties of water & how these properties support life on earth Bio.A.2.2.1: Explain how carbon is uniquely suited to form biological macromolecules. BIO.A.2.2.2: Describe how biological macromolecule for from monomers. Bio.A.2.2.3: Compare the structure & function of carbohydrates, lipids, proteins, & nucleic acids in organisms. 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, & concentration levels can affect enzyme function.
Common Core	Writing: CC.3.6.9-10.B,CC.3.6.9-10.C,CC.3.6.9-10.D,CC.3.6.9-10.I,CC.3.6.9-10.A. Reading: CC.3.5.9-10.B, CC.3.5.9-10.D,CC.3.5.9-10.E,CC.3.5.9-10.H,CC.3.5.9-10.I, CC.3.5.9-10.J,CC.3.5.9-10.A,CC.3.5.9-10.C
Vocabulary	**Adhesion** – Attraction between difference substances – water and another substance; **Atom** – smallest unit of an element; **Cohesion** – The attraction between like molecules – water attracted to water; **Carbohydrates** – A macromolecule that contains the atoms of carbon, hydrogen & oxygen and serves as a major source of energy for organisms; **Catalyst** – A substance that speeds up a reaction; **Enzyme** – A protein that increase the rate of a chemical reaction; Freezing point – The temperature where a liquid changes to a solid; **Lipids** – A macromolecule made from carbon, hydrogen & oxygen that stores energy; **Macromolecule** – A polymer made from individual monomers. Examples are lipids, carbohydrates, proteins & nucleic acids; **Molecule** – The smallest particle of a substance; **Monomer** – A molecules of any compound that can react with other molecules of the same or different compound to form a polymer; **Nucleic Acid** – A biological macromolecule composed of the elements C, H, N, O, & P and carries genetic information (DNA & RNA); **Organic molecule** – Any molecule that has carbon in it; **pH** – Measure of acidity or alkalinity of an aqueous solution scaling from 1-14; Protein – A macromolecule that contains the principal components of organisms; carbon, hydrogen, oxygen & nitrogen & performs many important functions in an organism; **Hydrophobic** – water fearing; **Hydrophilic** – water loving; **Hydrolysis** – A chemical process in which a molecule of water is added to a substance which splits the molecule; **Dehydration synthesis** – A type of reaction, where a compound is formed at the cost of losing a water molecule; **specific heat** – The measure of heat energy required to increase the temperature of a unity quantity of a substance by a certain temperature interval; **Temperature** – A measure of the average kinetic energy of particles in a sample of matter.

Module 3: Bioenergetics	**Duration:** November (4 weeks)
Big Idea	All living organisms must obtain cellular energy to perform life functions.
Essential Questions	How do organisms obtain & use energy to carry out their life processes?
Eligible Content	• Describe the structure of mitochondria & chloroplasts in eukaryotic cells. • Describe the fundamental roles of plastids (e.g., chloroplasts) and mitochondria in energy transformations. • Compare the basic transformations of energy during photosynthesis and cellular respiration. • Describe the structure of ATP • Describe the role of ATP in biochemical reactions
Instructional/Engagement Strategies	• The student will describe the structure of mitochondria & chloroplasts in eukaryotic cells. • The student will describe the fundamental roles of plastids (e.g., chloroplasts) and mitochondria in energy transformations. • Student will compare the basic transformations of energy during photosynthesis and cellular respiration. • The student will describe the structure of ATP • The student will describe the role of ATP in biochemical reactions
Assessments	Weekly quizzes and Bioenergetics common assessment **LABS:** • Running Man • Photosynthesis
Standards	BIO.A.3.1.1 Describe the fundamental roles of plastids (e.g., chloroplasts) and mitochondria in energy transformations. 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. BIO.A.3.2.1 Compare the basic transformation of energy during photosynthesis and cellular respiration.
Common Core	Writing: CC.3.6.9-10.A. Reading: CC.3.5.9-10.B, CC.3.5.9-10.D,CC.3.5.9-10.E,CC.3.5.9-10.H,CC.3.5.9-10.I, CC.3.5.9-10.J
Vocabulary	**Calvin Cycle**- A biochemical pathway of photosynthesis in which CO2 is converted into carbohydrates; **Adenosine Triphosphate (ATP)** = A molecule of particles from an area of low concentration to an area of high concentration that uses energy provided by ATP or a difference in electrical charges across a cell membrane. **Cellular Respiration** = A complex set of chemical reactions involving an energy transformation where potential chemical energy in the bonds of

	"food" molecules is released & partially captured in the bonds of adenosine triphosphate (ATP) molecules. **Photosynthesis** = A process in which solar radiation is chemically captured by chlorophyll molecules & through a set of controlled chemical reactions resulting in the potential chemical energy in the bonds of carbohydrate molecules. **Bioenergetics** = The study of energy flow (energy transformations) into & within living systems.

Module 4 **Cell Transport & Homeostasis**	**Duration:** December (3 weeks)
Big Idea	All living cells maintain are made up of complex structures that require homeostasis
Essential Questions	How do organisms maintain a biological balance between their internal and external environments?
Eligible Content	• Describe how the structure of the plasma membrane allows it to function as a regulatory structure and/or protective barrier for a cell. • Compare & contrast active vs. passive transport mechanisms • Describe how membrane-bound cellular organelles facilitate intracellular transport of materials. • Explain mechanisms organisms use to maintain homeostasis.
Instructional/Engagement Strategies	• Students will be about to explain the role of ATP in cell metabolism • Students will be able to explain how the cell membrane functions as a regulatory structure and protective barrier for the cell • Students will be able describe transport mechanisms across the plasma membrane • Students will be able to Compare the mechanisms that transport materials across the plasma membrane (i.e., passive transport—diffusion, osmosis, facilitated diffusion; and active transport—pumps, endocytosis, exocytosis).
Assessments	Weekly quizzes & a cell transport common assessment LABS: • Osmosis/Diffusion • Building the cell membrane • Egg activity
Standards	BIO.A.4.1.1 Describe how the structure of the plasma membrane allows it to function as a regulatory structure and/or protective barrier for a cell. BIO.A.4.1.2 Compare the mechanisms that transport materials across the plasma membrane (i.e., passive transport—diffusion, osmosis, facilitated diffusion; and active transport—pumps, endocytosis, exocytosis). BIO.A.4.1.3 Describe how membrane-bound cellular organelles (e.g., endoplasmic reticulum, Golgi apparatus) facilitate the transport of materials within a cell.

	BIO.A.4.2.1 Explain how organisms maintain homeostasis (e.g., thermoregulation, water regulation, oxygen regulation).
Common Core	Writing: CC.3.6.9-10.A. Reading: CC.3.5.9-10.B, CC.3.5.9-10.D,CC.3.5.9-10.E, CC.3.5.9-10.H,CC.3.5.9-10.I, CC.3.5.9-10.J
Vocabulary	**Active Transport** the movement of ions or molecules across a cellular membrane from a lower to a higher concentration, requiring the consumption of energy; **Diffusion** the movement of molecules from an area of higher concentration to lower concentration; **Endocytosis** A process in which a cell engulfs extracellular material through an inward folding of its plasma membrane. Two types are phagocytosis & pinocytosis; **Exocytosis** the transport of material out of a cell by means of a sac or vesicle that first engulfs the material and then is extruded through an opening in the cell membrane; **Facilitated Diffusion-** process by which substances are transported across cell membranes by means of protein carrier molecules; **Passive Transport-** is the cellular process of moving molecules and other substances across membranes; does not require energy; **Osmosis-**the Movement of water molecules from an area of higher or lower concentration. **Carrier Proteins** – Proteins embedded in the plasma membrane involved in the movement of ions, small molecules, & macromolecules into & out of cells; also known as transport proteins; **Concentration** – The measure of the amount of proportion of a given substance when combined with another substance; **Concentration Gradient** – The graduated difference in concentration of a solute per unit distance through a solution; **Impermeable** – Not permitting passage of a substance; **Pumps** – Any of several molecular mechanisms in which ions or molecules are transported across a cellular membrane requiring the use of an energy source; **Equilibrium** – Concentration of molecules is the same in & out of the cell; **Hypotonic Solution** – Concentration of dissolved substances is lower in the solution outside the cell than inside the cell; **Hypertonic solution** – Concentration of dissolved substances outside the cell is higher than inside the cell; **Isotonic Solution** – Concentration of dissolved substances in the solution is the same as the concentration of dissolved substances inside the cell.

Module 5 **Cell Growth & Reproduction**	**Duration:** January (4 weeks)

Big Idea	Cells grow & develop through a series of stages
Essential Questions	How do new cells arise from the division of pre-existing cells?
Eligible Content	• Describe the events that occur during the cell cycle • Compare the processes and outcomes of mitotic and meiotic nuclear divisions • Describe how the process of DNA replication results in the transmission and/or conservation of genetic information. • Explain the functional relationships between DNA, genes, alleles, and chromosomes and their roles in inheritance
Instructional/Engagement Strategies	• Students will be able to describe the cell cycle and the process and significance of mitosis. • Students will be able to examine how interactions among the different molecules in the cell cause the distinct stages of the cell cycle which can also be influenced by other signaling molecules • Students will be able to explain the role of mitosis in the formation of new cells and its importance in maintaining chromosome number during asexual reproduction. • Students will be able to relate mitosis and meiosis at the molecular level • Students will be able to describe how the process of meiosis results in the formation of haploid gametes and analyze the importance of meiosis in sexual reproduction. • Students will be able to compare and contrast the function of **mitosis** and **meiosis**. • Students will be able to illustrate that the sorting and recombining of genes in sexual reproduction results in a great variety of possible gene combinations in offspring. • Students will be able to describe processes that can alter composition or number of chromosomes (i.e., crossing-over, nondisjunction, duplication, translocation, deletion, insertion, and inversion). •
Assessments	• Weekly quizzes and a common assessment on mitosis/meiosis • Mitosis simulation lab • Mitosis stages under a microscope • Good cells Gone Bad • Leksak Bird activity
Standards	BIO.B.1.1.1 Describe the events that occur during the cell cycle: interphase, nuclear division (i.e., mitosis or meiosis), Compare and contrast a virus and a cell. Relate the stages of viral cycles to the cell cycle. Cytokinesis BIO.B.1.1.2 Compare the processes and outcomes of mitotic and meiotic nuclear divisions. BIO.B.1.2.1 Describe how the process of DNA replication results in the transmission and/or conservation of genetic information. BIO.B.1.2.2 Explain the functional relationships between DNA, genes, alleles, and chromosomes and their roles in inheritance
Common Core	Writing: CC.3.6.9-10.B, CC.3.6.9-10.C, CC.3.6.9-10.D, CC.3.6.9-10.I, CC.3.6.9-10.A.

	Reading: CC.3.5.9-10.B, CC.3.5.9-10.D, CC.3.5.9-10.E, CC.3.5.9-10.H, CC.3.5.9-10.I, CC.3.5.9-10.J, CC.3.5.9-10.A, CC.3.5.9-10.C, CC.3.5.9-10.G
Vocabulary	**Asexual Reproduction** -reproduction, as budding, fission, or spore formation, not involving the union of gametes; **Cell Cycle-** the events of cell division including interphase, mitosis, and cytokinesis; **Cell Division**- the division of a cell in reproduction or growth; **Chromosome-** any of several threadlike bodies, consisting of chromatin, that carry the genes in a linear order: the human species has 23 pairs, designated 1 to 22 in order of decreasing size and X and Y for the female and male sex chromosomes respectively; **Cytokinesis**- the division of the cell cytoplasm that usually follows mitotic or meiotic division of the nucleus; **Embryo-** the young of a viviparous animal, especially of a mammal, in the early stages of development within the womb, in humans up to the end of the second month; **Gametes**- a mature sexual reproductive cell, as a sperm or egg, that unites with another cell to form a new organism; **Haploid**- an organism or cell having only one complete set of chromosomes, ordinarily half the normal diploid number; **Interphase-** the period of the cell cycle during which the nucleus is not undergoing division, typically occurring between mitotic or meiotic divisions; **Lysogenic cycle-** the replication of viruses without causing immediate destruction of the host cell; **Lytic cycle-** the replication process of viruses that results in the destruction of the host cell; **Meiosis** - part of the process of gamete formation, consisting of chromosome conjugation and two cell divisions, in the course of which the diploid chromosome number becomes reduced to the haploid; **Mitosis-** the usual method of cell division, characterized typically by the resolving of the chromatin of the nucleus into a threadlike form, which condenses into chromosomes, each of which separates longitudinally into two parts, one part of each chromosome being retained in each of two new cells resulting from the original cell; **Sexual reproduction-** reproduction involving the union of gametes; **Virus-** a nonliving particle composed of a nucleic acid and protein coat

Module 6 Genetics Part A & DNA Part B	**Duration: February/March (8 weeks)**
Big Idea	All organisms inherit traits from their ancestors
Essential	How do organisms pass their inheritance onto their offspring?

Questions	
Eligible Content	• Describe and/or predict observed patterns of inheritance (i.e., dominant, recessive, co-dominance, incomplete dominance, sex-linked, polygenic, and multiple alleles) • Describe processes that can alter composition or number of chromosomes (i.e., crossing-over, nondisjunction, duplication, translocation, deletion, insertion, and inversion) • Describe how the processes of transcription and translation are similar in all organisms. • Describe the role of ribosomes, endoplasmic reticulum, Golgi apparatus, and the nucleus in the production of specific types of proteins • Describe how genetic mutations alter the DNA sequence and may or may not affect phenotype (e.g., silent, nonsense, frame-shift) • Explain how genetic engineering has impacted the fields of medicine, forensics, and agriculture (e.g., selective breeding, gene splicing, cloning, genetically modified organisms, gene therapy).
Instructional/Engagement Strategies	• Students will be able to explain that the information passed from parents to offspring is transmitted by means of genes which are coded in DNA molecules. • Students will be able to explain the basic process of DNA replication. • Students will be able to explain how mutations can alter genetic information and the possible consequences on resultant cells • Students will be able to describe the structure of the DNA and RNA molecules • Students will be able to describe the basic structure of DNA and its function in genetic inheritance • Students will be able to describe the basic structure of DNA, including the role of hydrogen bonding. • Students will be able to describe the basic processes of transcription and translation • Students will be able to describe how genetic mutations alter the DNA sequence and may or may not affect ph silent, nonsense, frame-shift) • Students will distinguish from different genetic diseases • Students will learn from the "Father of Genetics" and his research • Students will determine probabilities of outcomes through monohybrid & dihybrid crosses. • Students will learn how species can be genetically engineered through cloning, transgenic crops, GMOs, etc..
Assessments	Weekly quizzes and one common assessment on genetics and one on DNA LABS • Punnett Squares & Probability • Karyotypes • Building DNA • Lego Protein synthesis • Monstrous Mutations • DNA Fingerprinting
Standards	BIO.B.2.1 Compare Mendelian and non-Mendelian patterns of inheritance BIO.B.2.1.1 Describe and/or predict observed patterns of inheritance (i.e., dominant, recessive, co-dominance, incomplete dominance, sex-linked, polygenic, and multiple alleles) BIO.B.2.1.2 Describe processes that can alter composition or number of chromosomes (i.e., crossing-over, nondisjunction, duplication, translocation, deletion, insertion, and

	inversion) BIO.B.2.2 Explain the process of protein synthesis (i.e., transcription, translation, and protein modification) 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 the DNA sequence and may or may not affect phenotype (e.g., silent, nonsense, frame-shift) BIO.B.2.4.1Explain how genetic engineering has impacted the fields of medicine, forensics, and agriculture (e.g., selective breeding, gene splicing, cloning, genetically modified organisms, gene therapy).
Common Core	Writing: CC.3.6.9-10.B, CC.3.6.9-10.C, CC.3.6.9-10.D, CC.3.6.9-10.I, CC.3.6.9-10.A.
Vocabulary	**Crossing over**- the interchange of corresponding chromatid segments of homologous chromosomes with their linked genes; **Deletion**- a type of chromosomal aberration in which a segment of the chromosome is removed or lost; **DNA-** deoxyribonucleic acid: an extremely long macromolecule that is the main component of chromosomes and is the material that transfers genetic characteristics in all life forms; **DNA Replication**- the process of producing two identical replicas from one original DNA molecule; **Duplication-** a type of chromosomal aberration in which a region of the chromosome is repeated; **Gene-** the basic physical unit of heredity; a linear sequence of nucleotides along a segment of DNA that provides the coded instructions for synthesis of RNA, which, when translated into protein, leads to the expression of hereditary character; **Genetic Code** -the biochemical instructions that translate the genetic information present as a linear sequence of nucleotide triplets in messenger RNA into the correct linear sequence of amino acids for the synthesis of a particular peptide chain or protein; **Genetic Variation**- describes the variation in alleles of genes in a gene pool; **Mutations**- a sudden departure from the parent type in one or more heritable characteristics, caused by a change in a gene or a chromosome; **Phenotypic variations**- the observable constitution of an organism; **RNA**- ribonucleic acid: any of a class of single-stranded molecules transcribed from DNA in the cell nucleus or in the mitochondrion or chloroplast; **Transcription**- the process by which genetic information on a strand of DNA is used to synthesize a strand of complementary RNA; **Translation**- the process by which a messenger RNA molecule specifies the linear sequence of amino acids on a ribosome for protein synthesis; **Alleles**- any of several forms of a gene, usually arising through mutation, that are responsible for hereditary variation; **Codominant-** of or relating to two different alleles that are fully expressed in a heterozygous individual; **Dominant**- the trait or character determined by such an allele; **Incomplete dominance-** the appearance in a heterozygote of a trait that is intermediate between either of the trait's homozygous phenotypes; **Genotypic Variations**- the genetic makeup of an organism or

	group of organisms with reference to a single trait, set of traits, or an entire complex of traits; **Independent Assortment** the principle, originated by Gregor Mendel, stating that when two or more characteristics are inherited, individual hereditary factors assort independently during gamete production, giving different traits an equal opportunity of occurring together; **Law of Segregation** the principle, originated by Gregor Mendel, stating that during the production of gametes the two copies of each hereditary factor segregate so that offspring acquire one factor from each parent; **Multiple alleles**- a series of three or more alternative or allelic forms of a gene, only two of which can exist in any normal, diploid individual; **Phenotypic Variations**- the observable constitution of an organism; **Polygenetic-** one of a group of non-allelic genes that together control a quantitative characteristic in an organism; **Recessive-** that one of a pair of alternative alleles whose effect is masked by the activity of the second when both are present in the same cell or organism; **Sex Linked-** determined by a gene located in a sex chromosome; **Carrier-** Individuals who have one copy of a recessive autosomal allele; **Chromosome Map-** a diagram that shows linear sequence of genes on a chromosome; **Colorblindness-** recessive X-linked disorder in which an individual cannot distinguish between certain colors; **Deletion-** is the loss of a piece of chromosome due to chromosomal breakage; **Frameshift Mutation-** addition or deletion of a single nucleotide causes the remaining codons to be incorrectly grouped; **Inversion-** is a chromosome mutation in which a chromosomal segment breaks off and then reattaches in reverse orientation to the same chromosome; **Monosomy-** zygote with 45 chromosomes has only one copy of a particular chromosome; **Nondisjunction-** the failure of a chromosome to separate from its homologue during meiosis; **Pedigree-** a family record that's shows how a trait is inherited over several generations; **Point Mutation-** the substitution, addition, or removal of a single nucleotide; **Polygenic Trait-** a trait that is controlled by two or more genes; **Sex Linkage-**the presence of a gene on a sex chromosome; **Substitution-** one nucleotide in a codon is replaced with a different nucleotide, resulting in a new codon; **Translocation-** a chromosome piece breaks off and reattaches to another, non-homologous chromosome; **Trisomy-** zygote with 47 chromosomes has three copies or a particular chromosome; **DNA Fingerprint-**a pattern of bands made up of specific fragments from an individual's DNA; **Forensics -** forensics, (used with a singular or plural verb) the art or study of argumentation and formal debate; **Gel Electrophoresis-** separates nucleic acids or proteins, primarily according to their size and charge; **Genetic engineering**-the development and application of scientific methods, procedures, and technologies that permit direct manipulation of genetic material in order to alter the hereditary traits of a cell, organism, or population; **Gene recombination**- the production of offspring with combinations of traits that differ from those found in either parent; **Medicine -** any substance or substances used in treating disease or illness; medicament; remedy; **PCR-** can be used to quickly make many copies of selected segments of the available DNA; **Plasmid-**a ring of DNA found in a bacterium in addition to its main chromosome; **Recombinant DNA-**the combination of DNA from two or more sources; **Restriction Enzyme-**bacterial enzymes used to cut DNA molecules into more manageable pieces;

Module 7 **Origin of Life & Evolution: Evidence & Theory**	**Duration:** **April (3 weeks)**
Big Idea	Species evolve or change over time
Essential Questions	How do natural processes as described by the theory of evolution effect change in a population over time?
Eligible Content	• Explain how natural selection can impact allele frequencies of a population. • Describe the factors that can contribute to the development of new species (e.g., isolating mechanisms, genetic drift, founder effect, migration) • Explain how genetic mutations may result in genotypic and phenotypic variations within a population. Interpret evidence supporting the theory of evolution (i.e., fossil, anatomical, physiological, embryological, biochemical, and universal genetic code)
Instructional/Engagement Strategies	• Students will be able to define endosymbiosis, and explain why it is important in the history of eukaryotes • Students will be able to describe how the examination of fossils led to the development of evolutionary theories • Students will be able to tell how biogeographic observations suggest decent with modification • Students will be able to define evolution • Students will be able to explain Lamarck's theory of evolution and describe how it was flawed • Students will be able to explain Darwin's two major theories • Students will be able to describe the difference between homologous, analogous, and vestigial structure • Students will be able to explain the difference between coevolution, and divergent and convergent evolution • Students will be able to explain how natural selection can impact allele frequencies of a population. • Students will be able to describe the factors that can contribute to the development of new species (e.g., isolating mechanisms, Genetic drift, founder effect, migration)
Assessments	Weekly quizzes and one common assessment on evolution LABS • Missing moths lab • Lamarckia Chocolata Lab • Biochemical evidence of evolution • Genetic Drift • Rock Pocket Mice
Standards	3.1.10.A1 Explain that some structures in eukaryotic cells developed from early prokaryotic cells(e.g., mitochondria, chloroplasts)

	3.1.10.A8. Investigate the spatial relationships of organisms' anatomical features using specimens, models, or computer programs 3.1.B.C2. Describe the theory suggesting that life on Earth arose as a single, primitive prokaryote about 4 billion years ago and that for the next 2 billion years, a huge diversity of single- celled organisms evolved. Analyze how increasingly complex, multicellular organisms evolved once cells with nuclei developed. Describe the relationship between environmental changes and changes in the gene pool of a population 3.1.10.C3. CONSTANCY AND CHANGE Interpret data from fossil records, anatomy and physiology, and DNA studies relevant to the theory of evolution. (i.e., fossil, anatomical, physiological, embryological, biochemical, and universal genetic code 3.1.B.C3. CONSTANCY AND CHANGE Compare and contrast various theories of evolution. Interpret data from fossil records, anatomy and physiology, and DNA studies relevant to the theory of evolution. PATTERNS Discuss the implications of a universal genetic code for evolution. BIO.B.3.2.1 Interpret evidence supporting the theory of evolution (i.e., fossil, anatomical, physiological, embryological, biochemical, and universal genetic code).
Common Core	Writing: CC.3.6.9-10.B, CC.3.6.9-10.C, CC.3.6.9-10.D, CC.3.6.9-10.I, CC.3.6.9-10.A. Reading: CC.3.5.9-10.B, CC.3.5.9-10.D, CC.3.5.9-10.E, CC.3.5.9-10.H, CC.3.5.9-10.I, CC.3.5.9-10.J, CC.3.5.9-10.A, CC.3.5.9-10.C
Vocabulary	**Analogous-** same function different structure; **Anatomy-** the structure of an animal or plant, or of any of its parts; **Biogenesis-**states that all living things come from other living things; **Coevolution-**the change of two or more species in close association with each other**; Convergent Evolution-** occurs when the environment selects similar phenotypes, even though the ancestral types were quite different from one another; **Divergent Evolution-**two or more related populations or species become more and more dis-similar; **Endosymbiosis-** a mutually beneficial relationship between one organisms and another that lives within it: chloroplasts and mitochondria evolved from endosymbiotic bacteria; **Diversity**- the state or fact of being diverse; difference; unlikeness; **Gene pool-** the total genetic information in the gametes of all the individuals in a population; **Genetic drift**- random changes in the frequency of alleles in a gene pool, usually of small populations; **Half Life-**the length of time it takes for one half of any size sample of an isotope to decay; **Homologous-** same structure but different function; **Natural Selection-** the process by which forms of life having traits that better enable them to adapt to specific environmental pressures, as predators, changes in climate, or competition for food or

	mates, will tend to survive and reproduce in greater numbers than others of their kind, thus ensuring the perpetuation of those favorable traits in succeeding generations; **Physiology-** the organic processes or functions in an organism or in any of its parts; **Population-** the assemblage of a specific type of organism living in a given area; all the individuals of one species in a given area; **Radioactive Dating-**a method used to establish the age of materials; **Species**- the major subdivision of a genus or subgenus, regarded as the basic category of biological classification, composed of related individuals that resemble one another, are able to breed among themselves, but are not able to breed with members of another species; **Spontaneous Generation-**the thought that living things arise from nonliving things; **Vestigial-**features that were useful to an ancestor, but they are not useful to the modern organism; **Allele Frequency** = The measure of the relative frequency of an allele at the genetic locus in a population; expressed as a proportion or percentage; **Embryology** = The branch of zoology studying the early development of living things; **Evolution** = A process in which new species develop from preexisting species (biological evolution or macroevolution); a change in the allele frequencies of a population of organisms from generation to generation (genetic evolution or microevolution); **Extinction** = A term that typically describes a species that no longer has any known living individuals; **Fossils** = The preserved remains or traces of organisms that once lived on Earth; **Founder Effect** = A decrease in genetic variation caused by the formation of a new population by a small number of individuals from a larger population; **Gradualism** = A proposed explanation in evolutionary biology starting that new species arise from the result of slight modifications (mutations & resulting phenotypic changes) over many generations; **Isolating mechanisms** = Features of behaviors, morphology, or genetics which serve to prevent mating or breeding between two different species (Ex. Temporal isolation, in which individuals are active at different times of the day, seasons, or mating periods); **Punctuated Equilibrium** = A proposed explanation in evolutionary biology stating that species are generally stable over long periods of time. Occasionally there are rapid changes that affect some species which can quickly result in a new species; **Speciation** = A process typically caused by the genetic isolation from a main population resulting in a new genetically distinct species.

Module 8: **ECOLOGY**	**Duration:** April/May (6 Weeks)
Big Idea	Ecology is the heart of life through the interactions of organisms with one another and their interrelationship with the environment.
Essential Questions	How do organisms interact and depend on each other in their environment for their survival?
Eligible Content	• Describe & differentiate between the levels of ecological organization.

	• Describe characteristic biotic & abiotic components of terrestrial & aquatic ecosystems. • Describe how energy Flows through an ecosystem. • Describe biotic interactions within an ecosystem. • Describe the niche of an organism. • Describe how matter recycles in an ecosystem. • Describe how ecosystems change in response to natural & human disturbances. • Describe the effects of limiting factors on population dynamics & potential species extinction.
Instructional/Engagement Strategies	• Students will be able to examine the interactions between abiotic and biotic factors within a watershed. • Students will be able to investigate and analyze • Students will be able to identify the ecological levels of organization (i.e, organism, population, community, ecosystem, biome, and biosphere) • Students will be able to describe characteristic biotic and abiotic components of aquatic and terrestrial ecosystems • Students will be able to describe how energy flows through an ecosystem (i.e., food chains, food webs, energy pyramids.) • Student will be able to describe biotic interactions in an ecosystem (i.e., competition, predation, symbiosis) • Students will be able to describe how matter recycles through an ecosystem (i.e., water cycle, carbon cycle, oxygen cycle, and nitrogen cycle.) • Students will be able to describe how ecosystems change in response to natural and human disturbances (i.e., climate changes, introduction of nonnative species, pollution, fires.) • Students will be able to describe the effects of limiting factors on population dynamics and potential species extinction.
Assessments	Weekly quizzes and one common assessment on ecology LABS • Investigating NW vs SE Owl Pellets Lab • Energy Flow activity • Good Buddies Activity • Identifying a Limiting Nutrient Lab • They Day They Parachuted Cats activity • Population Sampling & Mark, recapture Lab • Toad Overload Read
Standards	BIO: B.4.1.1 Describe ecological levels of organization (i.e, organism, population, community, ecosystem, biome, and biosphere) BIO.B.4.1.2 Describe characteristic biotic and abiotic components of aquatic and terrestrial ecosystems BIO.B.4.2.1 Describe how energy flows through an ecosystem (i.e., food chains, food webs, energy pyramids.) BIO.B.4.2.2. Describe biotic interactions in an ecosystem (i.e., competition, predation, symbiosis) BIO. B.4.2.3 Describe how matter recycles through an ecosystem (i.e., water cycle, carbon cycle, oxygen cycle, and nitrogen cycle.) BIO.B.4.2.4. Describe how ecosystems change in response to natural and human disturbances (i.e., climate changes, introduction of nonnative species,

	pollution, fires.) BIO.B.4.2.5 Describe the effects of limiting factors on population dynamics and potential species extinction.
Common Core	Writing: CC.3.6.9-10.B, CC.3.6.9-10.C, CC.3.6.9-10.D, CC.3.6.9-10.I, CC.3.6.9-10.E, CC.3.6.9-10.F, CC.3.6.9-10.G, CC.3.6.9-10.H, CC.3.6.9-10.A. Reading: CC.3.5.9-10.B, CC.3.5.9-10.D, CC.3.5.9-10.E, CC.3.5.9-10.H, CC.3.5.9-10.I, CC.3.5.9-10.J, CC.3.5.9-10.A, CC.3.5.9-10.C, CC.3.5.9-10.G
Vocabulary	**Abiotic**- nonliving factors; that supports life; **Biotic-** Living components of the **Carrying Capacity**- the number of individuals the environment can support over a long period of time; **Commensalism**- an interaction in which one species benefits and the other is not affected; **Community**- all the interacting organisms living in the area; **Ecosystem**- includes all of the organisms and the nonliving environment found in a particular place; **Emigration**- the movement of individuals out of a population; **Immigration**- the movement of individuals into a population; **Mutualism**- a cooperative relationship in which both species derive some benefit; **Population**- includes all the members of a species that live in one place at one time; **Population Dynamics**- populations change in size and composition over time; **Succession**- the gradual sequential regrowth of species in an area; **Watershed**- the region or area drained by a river, stream, etc.; drainage area; **Aquatic** = A term the describes an organism associated with a water environment. **Bioenergetics** = The study of energy flow (energy transformations) into & within living systems. **Biogeochemical cycles** = The movement of abiotic factors between the living & nonliving components within ecosystems; also known as nutrient cycles (ex. Water cycle, carbon cycle, oxygen cycle, & nitrogen cycle) **Biome** = A large area of geographical region with distinct plant & animal groups adapted to that environment. **Biosphere** = The zone of life on Earth; sum total of all ecosystems on Earth Community (Ecological) = Different populations of organisms interacting in a shared environment. **Competition** = When individuals or groups of organisms compete for similar resources such as territory, mates, water, & food in the same environment. **Consumer** = An organism that obtains energy by feeding on other organisms or their remains (heterotroph). **Decomposer** = An organism that obtains nutrients by consuming dead & decaying matter which allows nutrients to be accessible to other organisms. **Ecology** = The study of relationships between organisms & their interactions with the environment. **Energy pyramid** = A model that illustrates the biomass productivity at multiple trophic levels in a given ecosystem. **Energy transformation** = A process in which energy changes from one form to another form while some of the energy is lost to the environment.

	Endemic Species = A species found in its originating location & is generally restricted to that geographic area. **Environment** = The total surroundings of an organism or a group of organisms **Extinction** = A term that typically describes a species that no longer has any known living individuals. **Food chain** = Simple & illustrates the passing of potential chemical energy (food) from one organism to another. **Food web** = A complex arrangement of interrelated food chains illustrating the flow of energy between interdependent organisms. **Habitat** = An area that provides an organism with its basic needs for survival. **Limiting factor** = Chemical or physical factor that limits the existence, growth, abundance, or distribution of an individual organism or a population. **Nonnative Species** = A species normally living outside a distribution range that has been introduced through either deliberate or accidental human activity; also can be known as introduced, invasive, alien, nonindigenous, or exotic (Cane Toad) **Organism** = A form of life; an animal, plant, fungus, protest or bacterium. **Population** = A group of individuals of the same species living in a specific geographical area & reproducing. **Population Dynamics** = The study of short- and long-term changes in the number of individuals for a given population, as affected by birth, death, immigration, & emigration. **Producer** = An organism that uses a primary energy source to conduct photosynthesis or chemosynthesis (autotrophs). **Species** = The lowest taxonomic level of biological classification consisting of organisms capable of reproduction that results in fertile offspring. **Succession** = A series of changes within an ecosystem over time. There are two types: primary – beginning (An example of primary is a volcanic island) and secondary – was once present, but lost (forest fires affect this type of succession). **Symbiotic relationship** = A relationship between two organisms (mutualism is when both species benefits, parasitism is when one species benefits & hurts the other & commensalisms is when one species & does not hurt the other species) **Terrestrial** = This is associated with a land environment. **Trophic level** = The position of an organism in relation to the flow of energy & inorganic nutrients through an ecosystem (producer, consumer & decomposer)