



## AP Biology Scope and Sequence

Grading Period	Unit Title	Learning Targets
<b>Throughout the School Year</b>		<p>Students will focus on “The four big ideas: of biology:</p> <p>Big idea 1: The process of evolution drives the diversity and unity of life.</p> <p>Big idea 2: Biological systems utilize free energy and molecular building blocks to grow, to reproduce and to maintain dynamic homeostasis.</p> <p>Big idea 3: Living systems store, retrieve, transmit and respond to information essential to life processes.</p> <p>Big idea 4: Biological systems interact, and these systems and their interactions possess complex properties</p> <p>Students will engage in the following Science Practices (SP):</p> <ol style="list-style-type: none"><li>1. The student can use representations and models to communicate scientific phenomena and solve scientific problems.</li><li>2. The student can use mathematics appropriately.</li><li>3. The student can engage in scientific questioning to extend thinking or to guide investigations within the context of the AP course.</li><li>4. The student can plan and implement data collection strategies appropriate to a particular scientific question.</li><li>5. The student can perform data analysis and evaluation of evidence.</li><li>6. The student can work with scientific explanations and theories.</li><li>7. The student is able to connect and relate knowledge across various scales, concepts and representations in and across domains</li></ol>

<b>First Grading Period</b>	Intro to Biochemistry	<ul style="list-style-type: none"> <li>○ Define life and list its characteristics (characteristics of living things)</li> <li>○ Explain the concept of Emergent Properties and give an example</li> <li>○ List and give an example of Biological classification in order smallest to largest. (from cells all the way to the biosphere)</li> <li>○ List the 3 domains of life, and give examples of each.</li> <li>○ Differentiate between Prokaryotic and Eukaryotic cells.</li> <li>○ Draw a model of an atom based of the information given on a periodic table</li> <li>○ Identify the various types of “bonds” (Covalent, Ionic, hydrogen, etc.) that play an important role in Biology.</li> <li>○ Differentiate between ions. (Cation vs. Anion)</li> <li>○ List out and give examples of water’s many emergent properties</li> <li>○ Relate these properties to water’s polarity</li> <li>○ Recount the importance of water’s emergent properties to living things.</li> <li>○ Explain how acids and bases act in regard to H<sup>+</sup> and OH<sup>-</sup></li> <li>○ Use a pH scale and compare items found on the scale in regard to its strength</li> <li>○ Explain the importance to Carbon to living things</li> <li>○ Explain significance of Carbons valence</li> <li>○ list the valences of Hydrogen, Oxygen, Nitrogen, and Carbon</li> <li>○ differentiate between the different types of isomers.</li> <li>○ Identify the 6 functional groups in given depictions of various molecules.</li> <li>○ Predict the number and types of bonds that could be found on incomplete models of organic molecules.</li> </ul>
	Macromolecules and Metabolism	<ul style="list-style-type: none"> <li>○ Differentiate between dehydration reaction and hydrolysis</li> <li>○ Identify the type of bond used to link carbohydrate monomers together</li> <li>○ Visually recognize a carbohydrate by looking at its structural formula</li> <li>○ Categorize carbohydrates as mono, di, and polysaccharides as well as biologically important subdivisions of each.</li> <li>○ Explain the difference between <math>\alpha</math> and <math>\beta</math> glucose, and why this structural difference is important to how polymers consisting of one or the other are used.</li> <li>○ Explain how different types of carbohydrates are used by living things (energy, storage, or structure)</li> <li>○ Identify the type of Bond used to build Lipids</li> <li>○ Visually recognize a lipid by looking at its structural formula or that of its component parts</li> </ul>

		<ul style="list-style-type: none"> <li>○ Identify different kinds of lipids and can give examples as to their use in living things (storage, structure, communication)</li> <li>○ Identify and Explain the difference between Saturated, Unsaturated, and Hydrogenated fats</li> <li>○ Explain the importance of hydrogen in fats in regards to energy in living things</li> <li>○ Identify an amino acid and can explain the significance of the R group.</li> <li>○ List evidence to support the claim that proteins have a wide range of functions in living things.</li> <li>○ Visually recognize an amino acid/polypeptide chain by looking at the structural formula</li> <li>○ Identify the type of bond that holds a polypeptide together</li> <li>○ Explain the importance of each level of protein structure and how they contribute to overall protein conformation</li> <li>○ Compare/Contrast DNA and RNA</li> <li>○ Visually recognize a nucleic acid by looking at the structural formula (as well as its component parts)</li> <li>○ Describe the Shape and Composition of DNA</li> <li>○ Describe how the laws of thermodynamics relate to the biochemical process that provide energy to living systems</li> <li>○ Explain the role and importance of ATP in living systems</li> <li>○ Explain how ATP powers the work of living systems</li> <li>○ Explain how enzymes regulate the rate of chemical reactions.</li> <li>○ Explain how environmental factors can effect an enzyme.</li> <li>○ Relate how the specificity of an enzyme depends on its structure.</li> <li>○ Explain how the activity of an enzyme is regulated (inhibition and/or activation)</li> <li>○ Explain how the two types of feedback (positive/negative) can influence enzyme activity based off the physical structure of the enzyme</li> </ul>
	Cells and Membranes	<ul style="list-style-type: none"> <li>○ Compare/contrast Prokaryotic and Eukaryotic cells</li> <li>○ List the factors that limit cell size</li> <li>○ List the organelles (as well identify models of them) of a cell and describe their function</li> <li>○ Explain how organelles function together in cellular processes (such as digestion &amp; waste elimination, or in protein production &amp; secretion)</li> <li>○ List the members of the endomembrane system and how they interact (via vesicles)</li> <li>○ Give examples of how motor proteins are used in a cell</li> </ul>

- List the components and functions of the cytoskeleton.
- Explain the similarities between cilia and flagella.
- Describe the ECM (extracellular matrix) of a cell.
- List and Describe the different junctions found between cells (Tight, Gap, Desmosomes, Plasmodesmata)
- Identify and Describe the current model of the molecular architecture of membranes (Fluid Mosaic Model)
- Relate the structure of the phospholipid to its function/role in membrane function.
- Describe the functions of membrane proteins (Channel, Receptor, Transport, Marker, etc)
- Explain the importance to the selective permeability of membranes to an organisms ability to maintain homeostasis.
- Explain what the various mechanisms by which substances cross membranes are (active transport, exo/endocytosis, passive transport, facilitated transport)
- Relate direction of movement to the amount of energy needed in regard to concentration gradients (diffusion vs active transport)
- Predict how living cells would react to changes in solute concentrations of their environments. (hypo, hyper, isotonic solutions)
- Describe the process of exocytosis and endocytosis
- List the different types of endocytosis (pino, phago)

Photosynthesis and Cellular Respiration

- define and differentiate between Oxidation and Reduction.
- explain what a **redox** reaction is
- explain what is an "Electron Carrier"
- explain what a "high energy" electron is
- explain the "purpose" of cellular respiration.
- list out the steps in order of Cellular Respiration.
- list where each step of Cellular Respiration takes place (specifically)
- compare and contrast Oxidative and Substrate-Level Phosphorylation.
- list the "inputs" and "outputs" of Cellular Respiration.
- describe function of ATP synthase
- explain what chemiosmosis is.
- compare and contrast Alcoholic and Lactic Acid Fermentation.
- compare and contrast the use of NADH in Fermentation as opposed to Cell Respiration.
- explain the evolutionary significance of Glycolysis as a process that is found in both prokaryotic and eukaryotic life.

		<ul style="list-style-type: none"> <li>○ explain the importance of Autotrophs (to food webs, ecological pyramids, and ecology)</li> <li>○ explain the “purpose” of Photosynthesis</li> <li>○ explain where each stage of Photosynthesis takes place</li> <li>○ list the “inputs” and “outputs” of Photosynthesis</li> <li>○ identify Chlorophyll based off its chemical structure.</li> <li>○ differentiate between cyclic and noncyclic flow.</li> <li>○ explain the purpose of both cyclic and noncyclic flow in plants</li> <li>○ explain the process of photorespiration</li> <li>○ describe the difference in C<sub>3</sub>, C<sub>4</sub>, and CAM plants in regards to photosynthesis and photorespiration</li> </ul>
<p><b>Second Grading Period</b></p>	<p>Cell Communication</p>	<ul style="list-style-type: none"> <li>○ Categorize chemical signals in terms of proximity of the communication cells. (Paracrine, Synaptic, Hormone, etc)</li> <li>○ Describe the three main stages of cell signaling (Reception, Transduction, Response)</li> <li>○ Describe the nature of a ligand-receptor interaction and state how such interactions initiate a signal-transduction system.</li> <li>○ Compare and contrast G-protein-coupled receptors, receptor tyrosine-kinases, and ligand-gated ion</li> <li>○ Define what is meant by a transcription factor.</li> <li>○ Describe several advantages of using a multistep pathway in the transduction stage of cell signaling (Speed, amplification, diversity of response, etc)</li> <li>○ Explain what is usually passed along in a signal-transduction pathway</li> <li>○ Describe the role of phosphorylation plays in signal transduction pathways</li> <li>○ Describe how Cyclic AMP (cAMP) is formed and what its role is</li> <li>○ Describe how cytoplasmic concentration of calcium ions can be altered and how this increases pool is involved with signal transduction</li> <li>○ Describe how signal information is transduced into cellular responses in the cytoplasm and in the nucleus</li> <li>○ Describe how signal amplification is accomplished in target cells</li> <li>○ Describe how target cells tell the difference among signals and how the same signal can create many different cellular responses</li> <li>○ Explain how scaffolding proteins help to increase the efficiency of signal transduction</li> </ul>

	Mendel & Meiosis	<ul style="list-style-type: none"> <li>○ Compare/Contrast the stages of Meiosis to Mitosis</li> <li>○ Explain the purpose of meiosis</li> <li>○ Explain Independent assortment</li> <li>○ Explain what “Crossing Over” is, when it takes place, and its relationship to recombinant chromosomes.</li> <li>○ Explain the role of random fertilization in genetic variation</li> <li>○ Explain Mendel's experiments using key vocabulary from the unit.</li> <li>○ Explain Law of Segregation &amp; Law of Independent Assortment.</li> <li>○ Relate the 2 laws above to Meiosis and Fertilization.</li> <li>○ Use the Rule of Multiplication and Addition to solve genetic problems (probability)</li> <li>○ Explain the difference between Incomplete Dominance and Codominance.</li> <li>○ Give an example of multiple alleles and explain the significance.</li> <li>○ Explain the concept of Pleiotropy and Epistasis</li> <li>○ Explain human disorders that follow Mendelian patterns of inheritance.</li> <li>○ Identify common fruit fly traits as well as some mutant traits.</li> <li>○ Differentiate between male and female fruit flies.</li> <li>○ Explain Sex Linked genes</li> <li>○ Explain the relationship between linked genes and crossing over rates.</li> <li>○ Explain how sex is determined as it relates to chromosomes</li> <li>○ Use probability to determine likelihood of appearance of sex linked disorders</li> <li>○ Differentiate between nondisjunction, and polyploidy.</li> <li>○ Identify alterations such as inversion, translocation, duplication, etc.</li> </ul>
	DNA and Gene Expression	<ul style="list-style-type: none"> <li>○ List out the contribution of various scientists that lead to our current understanding of DNA (Watson/Crick, Hershey, Franklin, Griffith, Chargaff, etc.)</li> <li>○ Describe the make-up of DNA (shape, direction, composition)</li> <li>○ Explain how DNA's form relates to DNA's ability to replicate</li> <li>○ List out the steps to DNA replication in order.</li> <li>○ List the enzymes and their role in replication.</li> <li>○ Relate the term “Antiparallel” to the arrangement of Carbon in DNA.</li> <li>○ Explain the direction that DNA is “read” and “written”</li> <li>○ Identify a leading and lagging strand in replication.</li> <li>○ Relate the importance of Telomeres in regard to Replication.</li> <li>○ Describe the shape and composition of a chromosome</li> <li>○ Explain the importance of Cell division as it relates to an Organism.</li> </ul>

- Explain the differences between DNA, chromatin, chromosomes, chromatids, and sister chromatids
- List the stages of cell cycle in order as well as describe the important events that take place in stage.
- List the stages of mitosis in order as well as describe the important events that take place in each stage
- Relate the role of various types of spindle fibers in Mitosis.
- Compare/contrast Mitosis and Binary Fission.
- Describe how cyclins and cyclin dependant kinases help control cell cycle.
- Explain the importance of checkpoints found in different stages of the cell cycle
- Compare the activities of healthy cell to cancerous cells.
- Explain what is meant by “one gene one \_\_\_\_ (protein, peptide, etc.)”
- Relate Codons, to the triplet code for protein synthesis.
- Use the Codon Chart to: Find an Amino Acid based off a codon, find the tRNA anti-codon, the original DNA strand, etc.
- Explain the evolutionary significance of the Triplet Code for Amino Acids.
- List the key elements/enzymes of transcription and their function.
- Explain how mRNA is processed and “refined.”
- List out the role of each type of RNA in protein synthesis,
- Explain the steps of protein synthesis in order
- Explain how errors in transcription/translation can lead to mutation.
- Describe the different type of mutations

Genetics

- Compare/Contrast the stages of Meiosis to Mitosis
- Explain the purpose of meiosis
- Explain Independent assortment
- Explain what “Crossing Over” is, when it takes place, and it relationship to recombinant chromosomes.
- Explain the role of random fertilization in genetic variation
- Explain Mendel's experiments using key vocabulary from the unit.
- Explain Law of Segregation & Law of Independent Assortment.
- Relate the 2 laws above to Meiosis and Fertilization.
- Use the Rule of Multiplication and Addition to solve genetic problems (probability)
- Explain the difference between Incomplete Dominance and Codominance.
- Give an example of multiple alleles and explain the significance.
- Explain the concept of Pleiotropy and Epistasis

		<ul style="list-style-type: none"> <li>○ Explain human disorders that follow Mendelian patterns of inheritance.</li> <li>○ Identify common fruit fly traits as well as some mutant traits.</li> <li>○ Differentiate between male and female fruit flies.</li> <li>○ Explain Sex Linked genes</li> <li>○ Explain the relationship between linked genes and crossing over rates.</li> <li>○ Explain how sex is determined as it relates to chromosomes</li> <li>○ Use probability to determine likelihood of appearance of sex linked disorders</li> <li>○ Differentiate between nondisjunction, and polyploidy.</li> <li>○ Identify chromosomal alterations such as inversion, translocation, duplication, etc.</li> </ul>
	Gene Regulation	<ul style="list-style-type: none"> <li>○ Explain what an Operon is.</li> <li>○ Draw and label the basic structure of both a repressible and inducible Operon.</li> <li>○ Identify all the key components of an Operon.</li> <li>○ Explain the role of each of the components of an Operon</li> <li>○ Describe the series of events that must take place for Bacterial gene regulation.</li> <li>○ Explain how a regulatory gene works</li> <li>○ Draw and label the basic structure of an eukaryotic gene.</li> <li>○ Identify all the key components of Eukaryotic gene expression</li> <li>○ Describe the steps to gene control in Eukaryotes.</li> <li>○ Explain how Chromatin's form allows it to play a role in gene regulation</li> <li>○ Differentiate between Methylation (DNA) and Acetylation (Histone)</li> <li>○ Define "Epigenetic inheritance"</li> <li>○ Describe the function of Enhancers and various transcription factors in regard to Gene Regulation</li> <li>○ Give examples of how Noncoding RNA aids in control of gene expression.</li> <li>○ Describe the basic form of a virus.</li> <li>○ Compare and Contrast the lytic and lysogenic cycles</li> <li>○ Compare and contrast the different types of Virus</li> <li>○ Explain (detailed) as to how a retrovirus (such as HIV) reproduce</li> <li>○ Compare and contrast Viruses, Prions, and Viroids</li> </ul>
<b>Third Grading Period</b>	Biotech	<ul style="list-style-type: none"> <li>○ Explain how advances in nucleic acid hybridization technology have helped scientists study the eukaryotic genome.</li> <li>○ Summarize the Dideoxy Chain Termination Method for DNA sequencing.</li> <li>○ Summarize how the Next Generation Method for DNA sequencing works.</li> <li>○ Describe what a nucleic acid probe is.</li> <li>○ Describe the function of restriction enzymes in prokaryotes.</li> </ul>

		<ul style="list-style-type: none"> <li>○ Describe the function of restriction enzymes in biotechnology.</li> <li>○ Explain what “sticky ends” are (blunt vs. staggered),</li> <li>○ Described how “sticky ends” are used in creation of recombinant DNA molecules.</li> <li>○ Outline the procedures for cloning a eukaryotic gene in bacteria. (through use of a plasmid)</li> <li>○ Explain what a vector is</li> <li>○ Explain how Eukaryotic Genes are cloned to avoid the problems associated with introns. (how cDNA is made)</li> <li>○ Explain the advantages to using Yeast over Bacteria as cloning hosts</li> <li>○ Describe the purpose behind PCR</li> <li>○ Explain the materials and steps needed for PCR to occur.</li> <li>○ Explain how gel electrophoresis is used to analyze nucleic acids and proteins, and distinguish between two alleles of a gene</li> <li>○ Explain what a RFLP and its significance to biotech</li> <li>○ Explain how DNA tech is used in forensic sciences.</li> <li>○ Describe how gene manipulation has practical applications for environmental and agricultural work.</li> <li>○ Compare totipotent and pluripotent stem cells.</li> <li>○ Explain the benefits of DNA technology.</li> <li>○ Understand and explain the various ethical problems that can exist due to our growing knowledge of DNA and its manipulation.</li> <li>○ Explain what we learned from the Human Genome Project</li> <li>○ Explain the process of chromosome walking</li> <li>○ Explain the significance of single nucleotide polymorphisms in the study of the human genome.</li> <li>○ Explain how Chromosomal errors (Duplication, Translocation, Insertions, etc...) may contribute to Evolution.</li> <li>○ Explain what a Transposon is.</li> </ul>
	Evolution	<ul style="list-style-type: none"> <li>○ Explain the basics behind the theories that influenced Darwin’s views toward evolution.</li> <li>○ Summarize what is meant by: “Descent with Modification”</li> <li>○ List out the 2 Observations and 2 Inferences in Darwin’s theories.</li> <li>○ List examples of natural selection in action</li> <li>○ List examples of artificial selection in action</li> </ul>

		<ul style="list-style-type: none"> <li>○ Name and describe the evidence of evolution throughout biology (homologies, biogeography, fossil records, etc)</li> <li>○ Explain why a population is considered the “Basic Unit of Evolution”</li> <li>○ List and describe the 2 main causes of Microevolution.</li> <li>○ List the 5 main conditions of the Hardy-Weinberg equilibrium.</li> <li>○ Define the components of the Hardy-Weinberg equation.</li> <li>○ Use the Hardy–Weinberg to determine the percent of a population possessing a given allele or genotype.</li> <li>○ Explain the significance of genetic variation on population evolutions.</li> <li>○ Explain the difference between Discrete and Quantitative characters.</li> <li>○ Explain what is meant by “heterozygote advantage”</li> <li>○ Explain why diploidy and balanced polymorphism help to preserve variation in populations.</li> <li>○ List and describe the effects of differing forms of selection on characteristics in a population. (disruptive, stabilizing, sexual, etc)</li> <li>○ Define species as it relates to the biological species concept</li> <li>○ Identify the prezygotic and postzygotic barriers that separate differing species (behavioral, gametic, temporal, etc)</li> <li>○ List and describe alternative concepts of what a species is.</li> <li>○ Explain the different modes of speciation (allopatric vs sympatric)</li> <li>○ Identify the major causes of speciation (forms of isolation)</li> <li>○ Explain what the term Macroevolution means in regard to speciation</li> <li>○ Summarize the basics of the theories of the origin of life.</li> <li>○ Give some historical examples of Mass Extinctions</li> <li>○ Relate the function of <i>Hox</i> genes to evolution.</li> <li>○ Relate a Cladogram to Phylogeny and its use as representation (model) of evolutionary history.</li> <li>○ Be able to list out the taxonomic groups out in order</li> <li>○ Relate a Cladogram to Phylogeny and its use as representation (model) of evolutionary history.</li> </ul>
	Plants	<ul style="list-style-type: none"> <li>○ List out the 3 basic plant organs and their function</li> <li>○ List and describe the function of the 3 tissue types of plants.</li> <li>○ List and describe the 3 plant cells and link them to tissue they comprise.</li> <li>○ Describe the different types of meristems found in plants</li> <li>○ Compare/contrast Primary and Secondary growth in plants</li> <li>○ Label a cross section of a tree trunk, and describe the role of the layers found within.</li> </ul>

		<ul style="list-style-type: none"> <li>○ Describe plant growth in regard to processes taking place in the cells</li> <li>○ Relate the importance of genes in plant development/growth/reproduction</li> <li>○ Describe transport in plants at the cellular level (various transport proteins, etc)</li> <li>○ Describe transport in regard to solute/pressure/and water potential (osmosis)</li> <li>○ Compare/contrast symplastic and apoplastic flow of water through the root.</li> <li>○ Describe how mycorrhizae and root hairs aid in absorption of water/minerals</li> <li>○ Describe Root Pressure</li> <li>○ Describe how Transpirational pull works</li> <li>○ Explain the importance of the sun in regard to bulk flow.</li> <li>○ Describe how Stomata operate.</li> <li>○ Describe the direction of translocation of phloem sap.</li> <li>○ Explain Pressure flow</li> <li>○ List and describe the different forms (types) of a flower</li> <li>○ Draw and label a "perfect" idealized flower</li> <li>○ Draw out an example of an angiosperms lifecycle.</li> <li>○ Describe the structure of a seed</li> <li>○ Review Signal-transduction pathways...relate this to greening, defense against self-pollination, etc.</li> <li>○ Describe how plants prevent self-fertilization</li> <li>○ Describe the experiments with phototropism</li> <li>○ List and describe the first 6 major plant hormones, and their function</li> <li>○ Describe the form and function of a phytochrome</li> <li>○ Explain what Circadian rhythms are.</li> <li>○ Explain what photoperiodism is.</li> <li>○ Name and identify ways plants respond to their environment (Tropisms)</li> <li>○ Give examples of plant defenses</li> </ul>
	<p>Animal Nutrition and Circulation/Gas Exchange</p>	<ul style="list-style-type: none"> <li>○ Give examples that supports the idea that "Form Fits Function"</li> <li>○ Relate similarities between how single and multicellular organisms meet their needs.</li> <li>○ Give examples and functions of the different types of animal body tissues</li> <li>○ Explain how physical laws can constrain animal form.</li> <li>○ Explain how body size and shape can affect interactions with the environment.</li> <li>○ Explain the <b>Q<sub>10</sub> Effect</b></li> <li>○ Explain why maintenance of homeostasis is so important to living things.</li> <li>○ Compare/contrast negative and positive feedback.</li> <li>○ provide an example of feedback that maintains homeostasis in the body</li> </ul>

- Compare/contrast: regulators and conformers
- Compare/contrast endothermic and ectothermic animals
- List and define the 4 physical processes that account for heat gain/loss
- Describe the different forms of Torpor.
- Compare/contrast BMR and SMR
- List the Pros/Cons to being Ectothermic as well as Endothermic
- Explain what an energy budget is, and how this effect organisms
- Explain several reasons why heterotrophs need to eat food.
- List the stages of food processing
- List the 4 feeding mechanism in animals and define them.
- List and describe the four stages of Food Processing in animals.
- Name the organs that play a role in mammalian digestion as well as list their function.
- Explain the path food takes through the body beginning with ingestion and ending with elimination, and explain how food is processed along the way.
- Provide examples of specific digestive enzymes, with the macromolecule it digests, along with the area of the body in which it functions.
- Find the example of negative feedback for the regulation of cellular fuel.
- Compare/contrast open and closed circulatory systems
- Give examples of organisms that have each type of circulatory system.
- Compare/contrast the blood flow through a cardiovascular system of fish, amphibians, and mammals.
- Trace the path blood takes through the body
- Explain the Cardiac Cycle
- Explain how physical laws regarding movement of fluids can affect blood flow and blood pressure.
- Explain the importance of the form of Arteries, Veins, and Capillaries to its function of transference of food/gasses/wastes.
- Compare/contrast the Lymphatic system to the Circulatory system.
- Describe the composition of Mammalian blood.
- Describe the importance of gas exchange.
- Give examples of how different organisms exchange gas. (Insect, Fish, Mammal, Bird)
- Explain countercurrent flow.
- List the organs of the respiratory system of mammals.
- Explain physically how breathing occurs.
- Explain what a buffer is.

<p><b>Fourth Grading Period</b></p>	<p>Immunity and Osmoregulation</p>	<ul style="list-style-type: none"> <li>○ Explain how Carbon Dioxide is transported through the body.</li> <li>○ List and describe the first and second line of defense against infection. (nonspecific).</li> <li>○ Describe the role of Eosinophils, Neutrophils, Monocytes, and NK cells.</li> <li>○ Describe the inflammatory response.</li> <li>○ List and define the 2 main types of lymphocytes.</li> <li>○ Compare and contrast NK Cells (innate) to Cytotoxic T cells (adaptive)</li> <li>○ Explain how clonal selection works.</li> <li>○ Explain the difference between a memory cell and an effector cell.</li> <li>○ Compare primary and secondary response times and link it to immune cells activity.</li> <li>○ Describe the different types of MHC and explain what “antigen presentation” is.</li> <li>○ Compare and Contrast Humoral and Cell-mediated immune response.</li> <li>○ Describe the form and types of Immunoglobulin (antibodies)</li> <li>○ Explain the medical importance of immune response to tissue donations and grafts</li> <li>○ Link allergies to immune response and explain why it occurs</li> <li>○ Compare/contrast regulators and conformers</li> <li>○ Compare/contrast endothermic and ectothermic animals</li> <li>○ List and define the 4 physical processes that account for heat gain/loss</li> <li>○ Describe the different forms of Torpor.</li> <li>○ Explain the role of transport epithelium to osmoregularity and waste disposal</li> <li>○ Compare/contrast the ways Fish, Mammals, Birds process and eliminate Nitrogenous Waste.</li> <li>○ Compare/Contrast osmoregulation in fresh and marine fish.</li> <li>○ Explain how urine is produced through filtration.</li> <li>○ List examples of how different animals filter/excrete wastes.</li> <li>○ Describe the anatomy of a Kidney</li> <li>○ Be able to label and describe what aspect of filtration is occurring at each area of a nephron.</li> </ul>
	<p>Reproduction and Development</p>	<ul style="list-style-type: none"> <li>○ identify the basic physical structure of a neuron.</li> <li>○ describe what a synapse is</li> <li>○ compare and contrast sensory neurons vs interneurons vs motor neurons.</li> <li>○ describe how membrane proteins found in a neuron can affect its membrane potential</li> </ul>

	<ul style="list-style-type: none"> <li>○ name and describe the function of specific ion channels and pumps found on the membrane of a neuron</li> <li>○ describe the difference between action and resting potential</li> <li>○ explain the difference between hyperpolarization and depolarization</li> <li>○ interpret a graph depicting the change in membrane potential during a the generation of an action potential and describe what is physically happening in the cell at each phase. (role of channels and pumps)</li> <li>○ describe how the action potential is conducted down the length of the axon</li> <li>○ describe the importance of myelination of neurons</li> <li>○ describe the roll of Ca<sup>2+</sup> in a neuron</li> <li>○ describe the events occuring at a chemical synapse</li> <li>○ give an example of a neurotransmitter and explain what one does.</li> <li>○ Compare/contrast the CNS and the PNS</li> <li>○ describe the role of a glial cell in the body.</li> <li>○ describe what takes place during a reflex arc</li> <li>○ pick 1 sense of interest and describe how information is taken in and transmitted to a sensory neuron.</li> <li>○ Describe how motor neurons can cause muscle contraction</li> </ul>
Animal Behavior and Ecology	<ul style="list-style-type: none"> <li>○ Explain the importance of both Proximate and Ultimate questions when investigating behaviors in organisms</li> <li>○ Explain what behavior is and causes behavior (gene vs. environment)</li> <li>○ Describe a FAP and give an example</li> <li>○ Explain the concept of Cost-Benefit Analysis in regard to behavior</li> <li>○ Explain the difference between the forms of learning with Maturation</li> <li>○ Explain Imprinting as a development aspect of an organism</li> <li>○ Describe what cognition is and list the different types.</li> <li>○ Compare/contrast: Kinesis and Taxis</li> <li>○ Explain the significance and differing forms of social behavior.</li> <li>○ Describe the different methods of communication within species</li> <li>○ Describe some theories to explain acts of altruism in nature.</li> <li>○ Compare/contrast the various dispersal methods.</li> <li>○ Describe what an organism of different types of a survivorship curve would be like. (type I, II, III)</li> <li>○ Describe populations as seen in exponential and logistical growth models.</li> <li>○ Explain why “real” populations do not always match the logistical growth models.</li> </ul>

- Describe populations that could be referred to as experiencing “K-selection” as well as “r-selection”
- Describe the different limiting factors and explain how they operate.
- List and define the different forms of population interaction
- Describe resource partitioning
- Describe the various forms of organism defense.
- Compare/contrast food webs/chains
- Relate species richness to relative abundance
- Describe Trophic structure (compare/contrast food webs/chains)
- Explain what is meant by “keystone species”
- Describe both Primary and Secondary succession
- Explain how conservation of mass within an ecosystem differs from “energy flow.”
- Describe the trophic relationships found in ecosystems
- Link trophic efficiency to the number of trophic levels in nature
- Give an example of a cycle in nature (Carbon, water, nitrogen, etc.)
- List and describe the 3 levels of biodiversity
- Explain the importance of Biodiversity to nature
- Explain the importance of biodiversity to humans
- List the major threats to biodiversity
- Identify the issues with man-made toxins in nature (biological magnification)