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| 1. What is Science?    1. What Science Is and Is Not    2. Scientific Methodology: The Heart of Science 2. Science in Context    1. Exploration and Discovery: Where Ideas Come From    2. Communicating Results: Reviewing and Sharing Ideas    3. Scientific Theories    4. Science and Society 3. What is Biology?    1. Characteristics of Living Things    2. Big Ideas in Biology    3. Performing Biological Investigations | * State the goals of science. * Define the purpose for the field of Biology * Design and evaluate a scientific investigation using evidence of the scientific thinking and problem solving * **Develop a problem statement and hypothesis for an original idea (objective should be embedded and repeated throughout the year)** * Describe how scientific inferences are made * Discuss the importance of a universal system of measurement. * Describe the steps used in scientific methodology. * Explain how scientific attitudes generate new ideas. * Describe the importance of peer review. * Review what a scientific theory is. * Identify and correlate the relationship between science and society. * List the characteristics of living things. * Identify the central themes of biology. * Explain how life can be studied at different levels. * Use the example of a current event to relate the field of Biology to its importance in society. |

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| 1. Types of Ecosystems    1. Major Biomes\*\*       1. Abiotic Factors (climate, soil)       2. Biotic Factors (plants, animals)       3. Different roles of organisms    2. Aquatic Systems       1. Distribution of Life       2. Chemical Factors (pH, Salinity, Oxygen, Nitrogen, Phosphorus, Carbon Dioxide) 2. Review of Community Interactions    1. Niche    2. Competition    3. Symbiosis       1. Mutualism       2. Parasitism       3. Commensalism 3. Changes in Ecosystems (seasonal variations, succession, climate change)    1. Factors Affecting Climate       1. Solar Energy & Greenhouse Effect       2. Latitude & Solar Energy    2. Succession       1. Primary vs. Secondary       2. Natural and Human Caused Disturbances | * Describe and compare the characteristics of the major land biomes. * Identify the different roles of organisms in any ecosystem. * Compare and contrast the difference between biotic and abiotic factors * **Explain that different types of organisms exist within aquatic systems due to chemistry, geography, light, depth, salinity, and/or temperature.** * Investigate the chemical factors (pH, oxygen, carbon dioxide, nitrogen, phosphorous, and salinity) in aquatic systems. * Analyze the role competition plays in shaping communities. * Compare and contrast the relationships among organisms such as mutualism, predation, parasitism, competition, and commensalism. * **Describe the potential changes to an ecosystem resulting from seasonal variations, climate changes, and/or succession.** * Explain how ecosystems recover from a disturbance. |

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| 1. Population Dynamics    1. Factors Affecting Growth       1. Birth rates and death rates       2. Immigration and emigration    2. Type of Growth       1. Exponential growth       2. Logistic growth       3. Carrying Capacity    3. Human population       1. Age Population pyramids       2. Patterns of population growth 2. Limiting Factors (abiotic/biotic)    1. Density-Dependent       1. Predation       2. Competition       3. Human Activity    2. Density-Independent       1. Seasonal Variations       2. Catastrophic Events       3. Natural Disasters | * **Utilize data and information about population dynamics, abiotic factors, and/or biotic factors to explain and/or analyze a change in carrying capacity and its effect on population size in an ecosystem.** * Compare the different types of growth in a species population. * Synthesize an original example of carrying capacity in an ecosystem. * Investigate how natural disasters have affected human population and life in Florida. * Explain that science is one of the processes that can be used to inform decision making at the community, state, national, and international levels. * Describe and investigate various limiting factors in the local ecosystem and their impact on native populations, including food, shelter, water, space, disease, parasitism, predation, and nesting sites. * Identify the impact that humans have had on Earth, such as deforestation, urbanization, desertification, erosion, air and water quality, changing the flow of water. * Explain how political, social, and economic concerns can affect science, and vice versa. |

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| 1. Role of Organisms    1. Producers    2. Consumers    3. Decomposers 2. Food Chains and Food Webs 3. Trophic Levels and Energy Reduction    1. Law of Conservation of Matter & Energy    2. Trophic Levels    3. Energy Pyramids    4. Pathway of Energy Transfer 4. Biogeochemical Cycles    1. Water Cycle    2. Carbon Cycle | * Explain and illustrate roles and relationships among producers, consumers, and decomposers in the process of energy transfer in a food web. * Cite evidence that living systems follow the Laws of Conservation of Mass and Energy. * Investigate and describe the transformation of energy from one form to another. * Cite evidence to explain that energy cannot be created nor destroyed, only changed from one form to another. * **Describe the energy pathways through the different trophic levels of a food web or energy pyramid.** * Predict the effect of reduction of energy on a top predator in an ecosystem. * Identify the role of different types of organisms in the energy pathways of a food web. * Differentiate and show interactions among the geosphere, hydrosphere, cryosphere, atmosphere, and biosphere. * **Analyze the movement of matter through different biogeochemical cycles.** * Construct a scientific model of the carbon cycle to show how matter and energy are continuously transferred within and between organisms and their physical environment. |

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| 1. Predict Impact on Systems    1. Soil       1. Agriculture       2. Deforestation       3. Desertification       4. Erosion    2. Urbanization    3. Water Pollution       1. Biomagnification    4. Air Pollution    5. Biodiversity       1. Importance       2. Causes (Invasive Species)       3. Conservation 2. Cost and Benefits of Resources    1. Renewable (e.g. Wind, Solar)    2. Non-Renewable (e. g. Fossil Fuels) 3. Sustainability & Environmental Policy    1. Sustainability       1. Ecological Footprint       2. Human Health    2. Case Studies: Environmental Monitoring & Decision Making       1. Atmospheric Ozone       2. Overfishing       3. Climate Change       4. Energy: Renewable vs. Non-renewable | * **Predict how the actions of humans may impact environmental systems and/or affect sustainability.** * **Evaluate possible environmental impacts resulting from the use of renewable and/or nonrenewable resources.** * Identify the impact that humans have had on Earth, such as deforestation, urbanization, desertification, erosion, air and water quality, changing the flow of water. * **Identify ways in which a scientific claim is evaluated (e.g., through scientific argumentation, critical and logical thinking, and/or consideration of alternative explanations).** * Explain that science is one of the processes that can be used to inform decision making at the community, state, national, and international levels. * Identify positive and/or negative consequences that result from a reduction in biodiversity. * Explain that scientific knowledge is the result of a great deal of debate and confirmation within the science community. * Identify an instance from the history of science in which scientific knowledge has changed when new evidence or new interpretations are encountered. |

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| 1. Origins of Life    1. Scientific Explanations and theories    2. Conditions allowing for life on Earth    3. Organic molecules/ Eukaryotes/ Chemical evolution 2. Theories on the Origins of Life    1. Abiogenesis (Spontaneous Generation)    2. Endosymbiotic Theory 3. First Organic Molecules    1. Miller’s Experiment    2. Free Oxygen as Catalyst for Change | * **Explain several scientific explanations for the origin of life (abiogenesis and biogenesis).** * Explain the evidence supporting the scientific theory of the origin of eukaryotic cells (endosymbiosis). * **Identify situations or conditions contributing to the origin of life on Earth.** * Describe the experiments done to try and prove the origin of life on Earth. * Evaluate the different ideas about how organic molecules and cells first came about. * Recognize the criteria that biologists use for judging the validity of scientific theories and that among scientists there are different interpretations of data. * Identify and describe the scientific contributions of biological researchers from various ethnic and cultural backgrounds. |

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| 1. Evidence for The Theory of Evolution    1. Fossil Record    2. Comparative Anatomy (Homologous and Vestigial)    3. Comparative Embryology    4. Biogeography    5. Molecular Biology (e.g. Molecular Clocks)    6. Observed Evolutionary change 2. Macroevolution    1. Extinctions    2. Speciation (Reproductive and Geographic Isolation; Ecological Competition)    3. Adaptive Radiation    4. Molecular Evolution    5. Punctuated Equilibrium    6. Convergent Evolution    7. Coevolution | * **Explain how evidences such as fossils, biochemical similarities, embryonic development, homologous and vestigial structures, and similarities and differences between organisms in different parts of the world are used to substantiate biological changes through time.** * Recognize, define, and provide examples of the major patterns of evolution that operate above the species level. * Identify the conceptual progression of different types of evolutionary patterns. * Predict ancestry of certain organisms based on homologous or vestigial structures. * Analyze molecular information for statistical evidence of evolution. * Compare and contrast gradualism and punctuated equilibrium. * Describe the relationship between population growth and competition and its effect on evolution. * Synthesize the future characteristics of body structure, niche, etc. of an organism based on a given scenario |

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| 1. Ideas That Shaped Darwin’s Thinking    1. Darwin’s Voyage on the Beagle    2. Geological Change (Lyell and Hutton)    3. Overpopulation and Resources (Malthus)    4. Acquired Traits (Lamarck)    5. Artificial Selection 2. Darwin’s Theory of Evolution by Natural Selection    1. “Struggle for Existence”    2. “Survival of the Fittest”    3. Descent with Modification    4. Common ancestor 3. Evolution of Populations (Microevolution)    1. Gene pool    2. Genetic Drift    3. Fitness and Polygenic Traits (Directional, Stabilizing, and Disruptive Selection) | * Recognize the criteria that biologists use for judging the validity of scientific theories and that among scientists there are different interpretations of data. * Identify and describe the scientific contributions of the different scientists that contributed to Darwin’s ideas and theory. * Provide an example of comparison between natural and artificial selection. * Summarize ideas from Darwin’s time that influenced his work. * Describe the processes of adaptation and evolution using the tenets of Darwin. * **Identify factors that could influence natural selection and explain an example such as, climate, overpopulation, mutations, recombination of genes and pollution.** * Describe how biological diversity is increased by the origin of new species and how it is decreased by the natural process of extinction. * **Explain how (conceptually) genetic drift, gene flow, mutation, and natural selection contribute to changes in a gene pool.** * List the five conditions needed to maintain genetic equilibrium. (not assessed) * Explain how natural selection affects different types of traits in a species. |

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| 1. Primate Evolution    1. Characteristics    2. Major groups 2. Hominid Evolution    1. Adaptations    2. Ancestors    3. Modern Humans 3. Trends in Human Evolution    1. Brain size,    2. Jaw size    3. Language    4. Tools | * Identify common characteristics all primates share including but not limited to: opposable thumb, binocular vision, well- developed cerebrum * Identify the different groups of primates and their characteristics * **Identify the major parts of the brain on diagrams** * Use of fossils to analyze the evolutionary relationships between the hominoid species. * Discuss specific fossil hominids and what they show about human evolution. * Compare and recognize the adaptations that enable later hominine species to walk upright * Identify early human ancestors in terms of their scientific names, place of origin, and evolutionary trends. * Compare and contrast the different theories for the evolution of modern humans. * **Identify examples of and basic trends in hominid evolution from early ancestors to modern humans.** |

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| 1. Domains and Kingdoms    1. System of Classification    2. Binomial nomenclature    3. Review of Linnaean system    4. Archae    5. Eukarya    6. 5 vs. 6 kingdoms 2. Hierarchical classification    1. Cell type    2. Body system    3. DNA    4. Evolutionary relationships 3. Why these classifications change | * **Classify organisms based on their distinguishing characteristics of their domain and/ or kingdom.** * Classify an organism using the Linnaen system of classification. * Create a cladogram to show evolutionary relationship of organisms. * List the six kingdoms of life as they are currently identified. * **Explain the reasons for changes in how organisms are classified.** * Discuss the distinguishing characteristics of the domains and/or kingdoms of living organisms. * **Identify and/or describe how and/or why organisms are hierarchically classified based on evolutionary relationships.** * Describe the goals of binomial nomenclature and systematics. * Explain the reasons for changes in how organisms are classified. * Create a classification system based on futuristic organisms. |

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| 1. What Is a Plant?    1. Characteristics of Plants    2. The History and Evolution of Plants    3. The Plant Life Cycle 2. Types of plants    1. Seedless Plants       1. Green Algae (Protist- first plants)       2. Mosses and Other Bryophytes    2. Vascular Plants       1. Evolution of a Transport System       2. Seedless Vascular Plants       3. Life Cycle    3. Seed Plants       1. The Importance of Seeds       2. The Life Cycle of a Gymnosperm    4. Flowering Plants       1. Flowers and Fruits       2. Angiosperm Diversity | * Identify the characteristics that categorize plants into their kingdom. * **Explain how the structures of plant tissues and organs are directly related to their roles in physiological processes**; roots, stems, leaves, flowers, fruits, and cones. * **Describe the structural characteristics of vascular and non-vascular plants, including their adaptations to life on land**. * Identify bryophytes, pteridophytes, gymnosperms, and angiosperms * Identify the physiological processes in a plant; such as photosynthesis, cellular respiration, transpiration, and reproduction. * Explain the evolutionary importance of vascular tissue as a successful adaptation. * Compare methods of reproduction in higher plants (gymnosperms and angiosperms) with lower plants (algae, mosses, liverworts, and ferns). * Describe the reproductive adaptations of seed plants and the reason for its evolutionary success. * Identify the reproductive structures of gymnosperms and angiosperms. * Identify some of the ways that angiosperms can be categorized. |

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| 1. Plant Tissues and Processes    1. Dermal    2. Vascular    3. Ground    4. Meristamatic 2. Plant Organs and Processes    1. Roots    2. Stems    3. Leaves 3. Photosynthesis    1. Energy: ATP Formation       1. Chemical potential energy       2. ATP-ADP Cycle    2. Light-dependent Reactions       1. Reactants and Product       2. Location       3. Role of NADPH       4. ATP Production    3. Light-independent Reactions (Calvin Cycle)       1. Reactants and Products       2. Location (stroma)    4. Factors affecting photosynthesis       1. Carbon dioxide uptake       2. pH       3. Temperature       4. Water | * **Explain the structure and function of dermal tissue, vascular tissue, and ground tissue.** * **Describe and identify structures limited to cambium, guard cells, phloem, seed, stomata, and xylem.** * Explain the process of transpiration in a plant and gas exchange in leaves relating to homeostasis * **Describe the structures and functions of roots, stems, flowers, leaves, fruits, seeds.** * Identify and describe the overall equation for photosynthesis.\*\* * **Identify the reactants and products of photosynthesis.** * Describe the basic process of photosynthesis and its importance in energy and chemical cycles, including the following: raw materials, forms of energy used and produced chemical products, the role of chlorophyll, and the location of the process. * Describe how the ATP-ADP cycle powers the anabolic and catabolic reactions and its role in photosynthesis and respiration. * Identify factors that affect the rate at which photosynthesis occurs. * Describe how the structure of a leaf enables it to carry out photosynthesis and the products of photosynthesis are transported throughout a plant. |

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| 1. General Equation for Cellular Respiration    1. Reactants needed    2. Interrelationship to photosynthesis 2. Stages    1. Glycolysis & Fermentation (Anaerobic Respiration)    2. Reactants (from photosynthesis) and Products    3. Location (cytoplasm)    4. Role of NADH\*\*    5. Net yield of ATP    6. Lactic acid and alcoholic fermentation (muscle and yeast cells) 3. Krebs Cycle (Aerobic Respiration)    1. Reactants and Products    2. Location (matrix)    3. Role of NADH and FADH2\*\*    4. Net yield of ATP 4. Electron Transport Chain (Aerobic Respiration)\*\*    1. Location (inner membranes of mitochondrion)    2. Role of NADH and FADH2    3. ATP synthesis    4. Products (reactants for photosynthesis)    5. Net yield of ATP | * State the overall equation for cellular respiration. * **Explain how photosynthesis is stored energy and that respiration releases it.** * **Explain and describe how the products of photosynthesis are used as the reactants for respiration and vice versa.** * **Identify the basic reactants and products of cellular respiration, aerobic and anaerobic.** * Describe the basic processes of anaerobic (fermentation) and aerobic respiration and their importance in energy and chemical cycles, including the following: raw materials, form and amounts of energy produced, chemical products, and the location of the processes. * **Connect the role of ATP to energy transfers within the cell.** * Compare and contrast the basic roles of aerobic and anaerobic cellular respiration in organisms. * Analyze the evolutionary connections between the processes of photosynthesis and cell respiration. * Differentiate among the various forms of energy and recognize that they can be transformed from one form to others. |

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| 1. Characteristics of Animals    1. Multicellular    2. Heterotrophic    3. Eukaryotic    4. Homeostasis 2. Evolutionary Body Plans\*\*    1. Symmetry    2. Germ layers    3. Body Cavity    4. Embryonic Development    5. Segmentation    6. Cephalization    7. Limbs 3. Evolutionary Diversity    1. Invertebrates    2. Vertebrates | * Define an animal and the characteristics necessary for that classification. * Identify an organism as an animal from an unknown group of organisms. * Identify the different body plans found in animals. * **Identify and/or describe how and/or why organisms are hierarchically classified based on evolutionary relationships.** * Observe and analyze the evolutionary connections of animals based on body plan evidence. * Describe the characteristics of endotherms and ectotherms and list some adaptations of vertebrates and invertebrates that facilitate survival, including behavior. * Investigate and differentiate among the major characteristics of the phylum invertebrata. * Investigate and differentiate among the major characteristics of the subphylum vertebrata. * Identify and describe a representative organism from the phyla chordata and category invertabrates (consists of at least 33 phyla) * Trace the development of systems among the major chordates from an evolutionary standpoint. |

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| 1. Review of the Human Body\*\*    1. Integumentary System    2. Skeletal System    3. Muscular System    4. Respiratory System    5. Digestive and Excretory System    6. Endocrine & Reproductive Systems 2. Central Nervous System    1. Cerebrum – frontal lobe, parietal lobe, occipital lobe, temporal lobe    2. Cerebellum    3. Brain Stem - Pons, Medulla Oblongata    4. Spinal Cord\*\* 3. Peripheral Nervous system\*\*    1. Neurons    2. Synapses 4. Functions of the Brain    1. Homeostasis    2. Senses | * Explain how the human body is organized. * Review the basic structures of the human body systems. * Review the general functions of the major systems of the human body (digestive, respiratory, excretory, nervous, and musculoskeletal) and describe ways these systems interact with each other to maintain homeostasis. * Identify the central and peripheral nervous systems and their functions. * **Identify the major parts of the brain and their function on a diagram: cerebrum, cerebellum, pons, medulla oblongata, brain stem.** * **Identify the major lobes of the brain: frontal lobe, parietal lobe, occipital lobe, temporal lobe.** * Explain the functions of the brain and spinal cord. |

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| 1. Functions and Structures    1. Heart Structure and Blood Flow    2. Circulation    3. Blood as a tissue 2. Factors Affecting Blood Pressure    1. Blood Flow    2. Blood Volume    3. Resistance    4. Disease    5. Exercise 3. Factors Affecting Blood Flow    1. Blood Vessels    2. Heart Disease    3. High Blood Pressure | * Identify and investigate the general functions of the circulatory system. * Describe the structure of the heart and explain how it pumps blood through the body. * Identify and explain the composition and purpose of blood in the body. * Explain the factors that affect blood flow. * Observe heart rate and the different factors that can affect it. * **Analyze how factors such as blood pressure, blood volume, resistance, disease, and exercise affect blood flow through the cardiovascular system**. * Synthesize ways humans can increase heart health. |

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| 1. Basic Function    1. Agents of Infectious Diseases (virus, bacteria, fungi, parasites)    2. Spread of Diseases 2. Types of Responses    1. Nonspecific Immune Response       1. Skin       2. Secretions (e.g. tears)       3. Inflammatory Response       4. Fever    2. Specific Immune Response       1. Humoral Immunity       2. Cell-Mediated Immunity 3. Human Health and Disease Transmission    1. Genetic Risks    2. Environmental Factors    3. Pathogens    4. Immune System Disorders 4. Fighting Infectious Diseases    1. Antibiotics    2. Vaccines    3. Genetic Engineering | * Compare and contrast types of infectious agents that may infect the human body, including viruses, bacteria, fungi and parasites. * **Identify and explain the basic functions of the human immune system, including specific and nonspecific immune responses.** * **Describe how the human immune system responds to vaccines and/or antibiotics.** * Explain the significance of genetic factors, environmental factors and pathogenic agents to health from the perspective of both individual and public health. * Describe ways human beings protect themselves from hazardous weather and sun exposure. * Analyze how heredity and family history can impact personal health. * Analyze strategies for prevention, detection, and treatment of communicable and chronic diseases. |

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| 1. Basic Anatomy & Physiology    1. Sexual Development – Hormones    2. Male Reproductive System       1. Function – sperm development and release       2. Structures - seminal vesicle, prostate gland, vas deferens, urethra, epididymis, scrotum, penis, and testes    3. Female Reproductive System       1. Function – menstrual cycle       2. Structures - ovaries, oviduct (fallopian tube), uterus, cervix, and vagina 2. Human Development – Fertilization to Birth (all stages)    1. First Trimester (months 1-3) – fertilization, implantation, gastrulation, neurulation, placenta    2. Second Trimester (months 4-6)    3. Third Trimester (months 7-9) | * Identify and describe the basic anatomy and physiology of the human reproductive system. * Explain the process of human development from the zygotic stage to the end of the third trimester and birth. * Describe the basic structures and functions of the male human reproductive system: seminal vesicle, prostate gland, vas deferens, urethra, epididymis, scrotum, penis, and testes. * Describe the basic structures and functions of the female human reproductive system: ovaries, oviduct (fallopian tube), uterus, cervix, and vagina. * Explain how the following structures’ function relates to the development of the fetus: placenta, umbilical cord, amniotic sac, and amniotic fluid. * Describe the production of hormones in the context of the physiology of the human reproductive system; not during pregnancy(conceptual understanding) * **Describe the process of human development from the zygotic stage to the end of the third trimester and birth** * Analyze human development during the first trimester (implantation, morula, blastocyst, gastrulation, neurulation), second trimester, and third trimester. |

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| 1. Review Cell Theory and Discovery    1. Microscopes    2. Prokaryotic vs. Eukaryotic 2. Review Cell structure    1. Organization    2. Nucleus 3. Review Cell Organelles: Their Roles and Functions    1. Storage, clean up, support    2. Building Proteins    3. Capture and Release Energy (Photosynthesis and Cellular respiration tie in to previous Topic XII and XIII)    4. Boundaries    5. Comparison of Plant and Animal Cells 4. Cell Transport    1. Passive Transport (Types of solutions)    2. Active Transport | * **Describe the scientific theory of cells (cell theory) and explain how the history of the discovery of the cell theory relates to the process of science.** * **Compare and contrast the general structures of prokaryotic and eukaryotic cells.** * Create metaphors or analogies for the different organelles found in the cell and their roles. Ex: Cell like a factory * **Identify the role of lysosomes, vacuoles, endoplasmic reticulum, Golgi apparatus, cell wall, cell membrane, cytoplasm, nucleus, nuclear envelope, nucleolus, chromatin, ribosomes, microtubules, microfilaments, mitochondria, Golgi apparatus, chloroplasts, cilia, and flagella.** * **Describe how water moves in and out of a cell in different solutions.** * Describe the function of the chloroplasts and mitochondria in the cell to synthesize and use energy in the cell. * Analyze evolutionary connections between the plant and animal cell. * Explain how mass and energy is conserved within a cell. * **Compare and contrast the general structures of plant and animal cells.** * **Explain the role of the cell membrane in reference to passive and active transport**. |

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| 1. Cell Cycle and Process of Mitosis (Nuclear Division)    1. Prokaryotic cell cycle    2. Eukaryotic cell cycle    3. Interphase (G1, S, G2)    4. Mitotic Phase (Mitosis and Cytokinesis)    5. Phases (Prophase, Metaphase, Anaphase, and Telophase)    6. Importance of Maintaining Chromosome Number 2. Regulating Cell Cycle\*\*    1. Cyclins/ Regulatory Proteins    2. Effects of Mutations and Uncontrolled Cell Growth | * **Describe the role of mitosis in asexual reproduction, including how this process may contribute to or limit genetic variation.** * Review the importance and role of mitosis of a cell within in an organism. * **Describe specific events occurring in each of the stages of the cell cycle and/or phases of mitosis.** * Predict and explain what is happening at the different stages of mitosis. * **Explain how mitosis forms new cells and its role in maintaining chromosome number during asexual reproduction and cell and body growth.** * Predict the effects of mistakes made in the process of mitosis in a cell on an organism. * Explain the importance of cyclins and proteins in the role of cell growth. * **Explain how cancer (uncontrolled cell growth) may result from mutations that affect the proteins that regulate the cell cycle.** * Investigate ways to prevent cancer growth within the body. |

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| 1. Meiosis    1. Chromosome number    2. Haploid    3. Diploid    4. Stages I and II (Prophase, Metaphase, Anaphase, Telophase, Cytokinesis) 2. Formation of 4 haploid daughter cells from a diploid parent cell    1. Gamete formation    2. Tetrad formation    3. Role in Sexual reproduction    4. Homologous chromosomes 3. Genetic Variation Resulting From Meiosis    1. Independent Assortment of Chromosomes    2. Crossing Over (Genetic Recombination) 4. Comparison of Mitosis and Meiosis    1. Replication and separation of genetic material    2. Changes in Chromosome number    3. Number of cell divisions | * **Describe the process of meiosis I and meiosis II and what is occurring specifically at each phase.** * **Explain crossing over and how it affects the phenotype in a species and contributes to genetic variation.** * **Describe the role of meiosis in sexual reproduction and how it contributes to genetic variation.** * Compare and contrast homologous chromosomes and sister chromatids. * Differentiate between haploid and diploid cells. * Describe the role meiosis plays in the formation of haploid gametes or spores. * Identify the functions of cell division in unicellular and multicellular organisms, e.g. reproduction, repair, and growth. * **Differentiate between meiosis and mitosis and** **the effects of each process on an organism.** * Describe the process of independent assortment (will be Segway to Topic XXIII) in the resulting cells in meiosis. * **Explain how independent assortment during meiosis contributes to genetic variation.** |

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| 1. Work of Gregor Mendel    1. Experiments       1. Role of fertilization       2. Genes and alleles       3. Principle of dominance       4. Recessive    2. Segregation       1. F1 cross       2. Formation of Gametes 2. Mendel’s Principles    1. Probability and Punnett Squares       1. Predicting outcomes and averages/ ratios       2. Genotype       3. Phenotype       4. Punnett Squares    2. Independent Assortment 3. Other Patterns    1. Incomplete dominance    2. Codominance    3. Multiple Alleles    4. Polygenic traits    5. Genes and environment 4. Human Traits    1. Karyotypes       1. Sex-linked       2. Autosomal    2. Transmission of traits       1. Codominance       2. Multiple alleles (blood type)    3. Predict effects on evolution 5. Genes and Variation    1. Genetic Drift/ types traits | * **Use Mendel's laws of segregation and independent assortment to analyze patterns of inheritance.** * **Identify, analyze, and predict inheritance patterns caused by various modes of inheritance**. * Use Punnett squares to solve problems involving monohybrid and dihybrid crosses. * **Use Punnett squares to solve problems involving incomplete dominance, codominance, multiple allelic inheritance, and sex-linked traits (may assess P and F1 generation)** * Describe genetic drift and its effect on evolution. * Explain how different factors affect genetic equilibrium. * Explain how mutations in the DNA sequence may or may not result in a phenotypic change. * **Predict the possible consequences to a mutation and describe how these variations affect evolution**. * Identify the gene or chromosomal mutation involved in human disorders such as Down’s syndrome, Huntington’s disease, Hemophilia and Tay-Sachs disease. * Recognize disorders caused by sex-linked genes and predict outcomes using Punnett squares. * Identify chromosomal disorders by looking at a karyotype. |

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| 1. Impact on Society, Individual, and Environment    1. Cloning    2. Genetic Engineering    3. Artificial Selection 2. Medical and Ethical Issues    1. Genetically Modified Crops & Animals    2. Genetic Testing    3. Disease Prevention & Treatment    4. Personal Identification | * **Evaluate examples of biotechnology (cloning, genetic engineering, artificial selection) on the individual, society and/or the environment.** * **Explain the possible impact of biotechnology on the on the individual, society and/or the environment.** * Describe how basic DNA technology (restriction digestion by endonucleases, gel electrophoresis, polymerase chain reaction, ligation, and transformation) is used to construct recombinant DNA molecules * Assess how technology is essential to science for such purposes as access to outer space and other remote locations, sample collection, measurement, data collection and storage, computation, and communication of information. * Explain that science is one of the processes that can be used to inform decision making at the community, state, national, and international levels. * Describe some of the issues (medical and ethical) that relate to biotechnology. |

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| 1. Experiments and History\*\*    1. Griffith    2. Bacterial Transformation    3. Hershey & Chase 2. Review of Structure of DNA & Chromosomes\*\*    1. Components of DNA    2. Double helix       1. Nucleotides       2. Nitrogenous bases       3. Sugar-phosphate “backbone”       4. Hydrogen-bonding    3. Location in cell and importance    4. Genes 3. DNA Replication    1. DNA template    2. DNA polymerase    3. Base pairing rules    4. Cell cycle (S Phase); Mitosis, Meiosis, and Mutations    5. Location of process (nucleus) 4. Mutations    1. Effects on individual    2. Effects on offspring | * Summarize the experiments that lead to the discovery of DNA as the genetic material, its structure, location in the cell, and function. \*\* * Identify the relationship between DNA, chromosomes and genes in the process of cellular reproduction. * Identify the nitrogen base pairs found in DNA. * Investigate the structure of DNA as it relates to its function. * Explain the process of DNA replication. * **Describe the process of DNA replication and/or its role in the transmission and conservation of genetic information.** * **Describe gene and chromosomal mutations in the DNA sequence.** * **Explain how gene and chromosomal mutations may or may not result in a phenotypic change.** * **Explain the basic processes of transcription and/or translation, and their roles in the expression of genes.** * **Explain that the basic components of DNA are universal in organisms.** * **Explain how similarities in the genetic codes of organisms are due to common ancestry and the process of inheritance**. * Create an original DNA model and model replication. |

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| 1. RNA\*\*    1. Role in the cell    2. Comparing RNA and DNA    3. Functions of RNA (types) 2. RNA Synthesis    1. Transcription    2. Promoters    3. Editing 3. Protein Synthesis (Translation)    1. Codons (mRNA; Start and Stop)    2. Amino Acids (tRNA; Anticodon)    3. Ribosomes (rRNA; “P” and “A” sites)    4. Translation    5. Gene Expression 4. Mutations    1. Types    2. Effects | * Summarize the process of transcription. * Identify the different types of RNA (mRNA, tRNA, and rRNA) and explain the structure and function of each.\*\* * Demonstrate how specific code sequences are translated into traits through protein synthesis. * Trace the information flow from DNA to a protein. * **Students will explain the basic processes of transcription and/or translation, and their roles in the expression of genes.** * Describe how amino acids are coded. * Identify that certain chromosomal mutations can lead to human disorders such as sickle-cell disease. * List possible mutagens and distinguish between chemical and physical mutagens. * **Students will explain how gene and chromosomal mutations may or may not result in a phenotypic change.** |

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| 1. Review of Nature of Matter \*\*    1. Atoms    2. Elements    3. Types of bonds    4. Acids and bases 2. Carbon Compounds    1. Nature of Carbon 3. Structure and Function of Macromolecules (Biogeochemical Compounds)    1. Carbohydrates    2. Lipids    3. Proteins    4. Nucleic Acids 4. Enzymes    1. Activation energy    2. Lock and key model    3. Role as a catalyst    4. pH and temperature effects | * Identify the most common elements in living things and recognize elements from compounds. \*\* * Differentiate between ionic and covalent bonds. \*\* * Compare acids and bases. \*\* * Identify the four major classes of biochemical compounds important to biological structures and metabolism and their major role(s) in the cell. * Explain why enzymes are important to living things. * Analyze the effects of pH and temperature on the rate of an enzyme-catalyzed reaction. * **Identify and/or describe the basic molecular structure of carbohydrates, lipids, proteins, and/or nucleic acids.** * **Describe the primary functions of carbohydrates, lipids, proteins, and/or nucleic acids in organisms.** * **Explain how enzymes speed up the rate of a biochemical reaction by lowering the reaction’s activation energy.** * **Identify and/or describe the effect of environmental factors on enzyme activity.** * Predict the effects of temperature change on organisms in an ecosystem. |

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| 1. Properties of Water    1. Polarity    2. Hydrogen Bonding    3. Cohesion    4. Adhesion    5. Heat Capacity ( Ability to moderate temperature)    6. Expansion upon freezing    7. Versatility as a solvent    8. Review of transpiration pull | * Describe how water’s hydrogen bonds moderate temperature. * Explain why ice is less dense than liquid water. * Describe how water’s versatility as a solvent results from the polarity of its molecules. * **Students will explain the properties of water at a conceptual level.** * **Students will explain how the properties make water essential for life on Earth.** * Apply the cohesion of water to the transport of water in plants from their roots to their leaves. * Interpret formula representations of molecules and compounds in terms of composition and structure |

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| 1. Viruses    1. Discovery    2. Structure and    3. Infections (Lytic and Lysogenic Cycle)    4. Diseases 2. Prokaryotes    1. Classifying    2. Structure and Function    3. Reproduction    4. Importance    5. Beneficial and Harmful (Diseases)    6. Antibiotics 3. Protists    1. First Eukaryotes    2. Structure and Function    3. Reproduction    4. Types (Plant-like, Animal-like, and Fungus-like)    5. Parasites (e.g. *Plasmodium*) 4. Fungi    1. Structure and Function    2. Reproduction    3. Types (Zygote, Sac, and Club Fungi; Yeasts and Molds)    4. Symbiotic (e.g. Lichen and Mycorrhizae)    5. Commercial, Disease-causing (e.g.       1. Dutch Elm Disease), and       2. Decomposers | * Describe three physical features that are used to classify prokaryotes. * Explain how prokaryotes reproduce and their modes of nutrition. * Recognize that some prokaryotes aid humans by acting as decomposers and others cause disease that can be treated with antibiotics. * Describe the structure and reproduction of viruses. * Explain how viruses cause disease. * Recognize that protists are difficult to classify and explain why scientists group them by types of nutrition. * Summarize the *Plasmodium* life cycle and explain how it involves two hosts, mosquito and human, to transmit malaria. * Describe the basic structure of fungi. * Explain the function of spores in fungal reproduction. * Decribe two examples of symbiotic fungi, lichen and mycorrhizae. * Describe some human uses of fungi. * Identify some fungal diseases of plants and of humans. * Explain the role of fungi in recycling organic matter. |

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| 1. Human Genetic Disorders    1. Molecule to Phenotype    2. Chromosomal Disorders 2. Human Genome    1. Manipulating DNA    2. The Human Genome Project 3. Causes of Genetic diseases    1. Non-disjunction during meiosis    2. Damaged Chromosomes (duplication, deletion, inversion, and translocation)    3. Gene mutation (e.g. Tay-Sachs disease) 4. Chromosomal Disorders    1. Autosomal Chromosomes (Down Syndrome or Trisomy 21)    2. Sex Chromosomes (Turner’s Syndrome, Klinefelter’s Syndrome & other Trisomy conditions) 5. Sex-Linked Genes    1. Definition    2. Disorders (Colorblindness and Hemophilia)    3. Morgan and Fruit fly eye color    4. Punnett square problems 6. Examining Human Chromosomes &    1. Traits    2. Karyotype    3. Pedigree (automosal or sex-linked, dominant or recessive; e.g. Huntington’s disease) | * Recognize that DNA contains hereditary information and the importance & application of the Human Genome Project. * Describe how chromosomes can be damaged. * Identify the gene or chromosomal mutation involved in human disorders such as Down’s syndrome, Huntington’s disease, Hemophilia and Tay-Sachs disease. * Recognize disorders caused by sex-linked genes and predict outcomes using Punnett squares. * Identify chromosomal disorders by looking at a karyotype. * Identify types of diseases and/or disorders and list their effects upon the human body (degenerative, deficiency, hereditary, and contagious). * Identify conditions or disorders presented in a pedigree. * Summarize the methods of DNA analysis. * State the goals of the Human Genome Project and explain what we have learned so far. * Describe the inheritance of a sex-linked gene such as color-blindness. |