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| Scientific Method / STERNGRR: Module #1 |
| Essential Standard:Science as InquiryBio.2.1 Analyze the interdependence of living organisms within their environments |
| Clarifying Objectives:Bio.2.1.2 Analyze the survival and reproductive success of organisms in terms of behavioral, structural, and reproductive adaptations. |
| Unpacking – What does this standard mean a child will know, understand, and be able to do?Bio 2.1.2 * Analyze how various organisms accomplish life functions through adaptations within particular environments (example: water or land) to ensure survival and reproductive success.
* Relate prior understanding of survival and reproductive success to evidence of variations observed in species three areas:

 ▪  *behavioral adaptations –* suckling, taxes/taxis, migration, estivation, hibernation, habituation, imprinting, classical conditioning, and trial  and error learning* *structural adaptations –* nutrition, respiration, transport and excretion mechanisms, camouflage, movement
* *reproductive adaptations* – sexual vs. asexual, eggs, seeds, spores, placental, types of fertilization
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| Key Vocabulary:3rd Tier Words: variable (independent / dependent), control, experimental, hypothesis, data, synthesis, transport, excretion, respiration, nutrition, growth/development, reproduction, regulation, homeostasis, quantitative, qualitative, metabolism, theoretical, stimulus, differentiation 2nd Tier Words: essential, expend, conclusion, camouflage, movement, alter, alternative, discard, estimate, effective, ineffective, fundamental, infer, moderate, processes |
| Common Misconceptions: * A given experiment can test for the effects of everything that is included in the study, whether these variables are allowed to vary or are held constant.
* A given experiment tests for the effects of ALL related variables, regardless of whether they are allowed to vary or are held constant.
* When testing the effect of a variable on the outcome of the experiment, it does not matter if other relevant variables change at the same time.
* A controlled experiment tests for the effect of variables that are held constant, not the variable that is allowed to change.
* If two variables change at the same time, one can learn about the effect of each variable on the outcome.
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| **Essential Questions** | **Criteria for Success: “I Will”** | **Suggested Resources / Activities** |
| **Science as Inquiry**How do you design an experiment? | * Given the purpose of an experiment, I will identify the independent and dependent variables, the control group, experimental groups, and constants
* I will use the independent and dependent variable to write a hypothesis for an experiment, based on background information.
* I will interpret charts and graphs to derive the meaning of the data displayed.
* I will analyze quantitative (numerical) and qualitative (descriptive) data to form a conclusion and accept or reject a hypothesis.
* I will recognize the changing nature of science and the benefits of scientific collaboration.
 | Biology Handbook:* Module 1(Nature of Biology)

Essential Labs & Activities Manual* Bacteria Bound
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| **2.1.2**How living organisms carry out the STERNGRR life processes. | * I will provide a simple description for each of the STERNGRR life processes.
* Given a description, I will identify the STERNGRR life process being described.
* I will provide examples for each of the STERNGRR life processes.
 | Biology Handbook:* Module 1(Nature of Biology)
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| Ecology: Module #15 |
| Essential Standard:Bio.2.1 Analyze the interdependence of living organisms within their environments |
| Clarifying Objectives:Bio.2.1.1 Analyze the flow of energy and cycling of matter (such as water, carbon, nitrogen and oxygen) through ecosystems relating the significance of each to maintaining the health and sustainability of an ecosystem. Bio 2.1.3 Explain various ways organisms interact with each other (including predation, competition, parasitism, mutualism) and with their environments resulting in stability within ecosystems. Bio.2.1.4 Explain why ecosystems can be relatively stable over hundreds or thousands of years, even though populations may fluctuate (emphasizing availability of food, availability of shelter, number of predators and disease).  |
| Unpacking – What does this standard mean a child will know, understand, and be able to do?Bio.2.1.1 • Deconstruct the carbon cycle as it relates to photosynthesis, cellular respiration, decomposition and climate change. • Summarize the nitrogen cycle (including the role of nitrogen fixing bacteria) and its importance to synthesis of proteins and DNA. • Identify factors that influence climate such as: * greenhouse effect (relate to carbon cycle and human impact on atmospheric CO2)
* natural environmental processes (relate to volcanic eruption and other geological processes)

• Explain the recycling of matter within ecosystems and the tendency toward a more disorganized state. • Analyze energy pyramids for direction and efficiency of energy transfer.  ▪ Living systems require a continuous input of energy to maintain organization. The input of radiant energy which is converted to chemical energy allows organisms to carry out life processes.  ▪ Within ecosystems energy flows from the radiant energy of the sun through producers and consumers as chemical energy that is ultimately transformed into heat energy. Continual refueling of radiant energy is required by ecosystems. Bio 2.1.3 • Identify and describe symbiotic relationships such as mutualism and parasitism. (middle school review) • Explain patterns in predator /prey and competition relationships and how these patterns help maintain stability within an ecosystem with a focus on population dynamics. Note: *There is much debate about whether commensalistic relationships are just early mutualism. We may just not understand the benefits to each organism.* Bio.2.1.4 • Generalizing that although some populations have the capacity for exponential growth, there are limited resources that create specific carrying capacities and population sizes are in a dynamic equilibrium with these factors. (e.g. food availability, climate, water, territory). • Explain how disease can disrupt ecosystem balance. (Examples: AIDS, influenza, tuberculosis, Dutch Elm Disease, Pfiesteria, etc.) *in a*  |
| Key Vocabulary:3rd Tier Words: Biosphere, biomes ecosystem, biotic, abiotic, communities, populations, niche, trophic level, producer, autotroph, consumer, heterotroph, herbivore/primary consumer, carnivore/secondary or tertiary consumer, quaternary consumer, apex consumer, omnivore, scavenger, decomposer, recycling, food web, radiant/solar energy, chemical energy, energy pyramid, ecological efficiency, 10% rule, entropy/disorder, water/hydrologic cycle, precipitation, infiltration, run-off, evaporation, transpiration, carbon cycle, photosynthesis, cellular respiration, greenhouse effect, fossil fuel, climate change, nitrogen cycle, nitrogen fixation, competition, predation, predator, prey, symbiosis, mutualism, parasitism, commensalism, biotic potential, J-curve, exponential growth, limiting factors, S-curve, carrying capacity, dynamic equilibrium, density-dependent factors, density-independent factors, aquatic, terrestrial, marine, biogeochemical process, biomass, food chain, detritus, lag phase, ammonification, nitrates/nitrites, legume, nitrification, denitrification2nd Tier Words: mortality, rapid, stability, interpret, pattern, equivalent, decline, expand, immigrate, emigrate, fluctuate, exceed, constantly, crowd, stress, imply, essential, interaction, network, interconnected, transfer, eliminate, plateau, maintain  |
| Common Misconceptions: * If a population in a food web is disturbed, there will be little or no effect on populations below it in the food web.
* The top predator in a food web will never be significantly affected by changes in the populations of organisms below it in the food web.
* Organisms of the same species do not compete with each other for resources.
* Populations exist in states of either constant growth or decline.
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| **Essential Questions** | **Criteria for Success: “I Will”** | **Suggested Resources / Activities** |
| **2.1.1**How is matter reused in an ecosystem?Where does the energy needed for life processes originate and how is it transferred in an ecosystem? | * I will explain that matter in an ecosystem is not created or destroyed, but is continually recycled
* I will diagram and explain the water cycle
* I will diagram and explain the carbon cycle
* I will summarize the nitrogen cycle, explaining the need for bacteria to “fix” atmospheric nitrogen so that is accessible to living organisms so that they may manufacture proteins and DNA
* I will explain basic energy transformations in an ecosystem from its origin (solar/radiant) energy, to the production of food (chemical energy) to the “loss” of some energy due to life processes (heat energy) and that these transformations lead to a more disorganized form of energy
* I will identify and describe the trophic levels in an ecosystem by constructing /interpreting food webs
* I will calculate the amount of energy transferred between different trophic levels on an energy pyramid using the 10% rule
 | Biology Handbook:* Module 15 (Ecological Principles)

Essential Labs and Activities Manual:* Energy Flow in an Ecosystem

Common Core Performance Tasks:* Photosynthesis-Respiration
* Foods Webs and Energy Transfer
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| **2.1.3**How do living organisms interact / depend on one another in a community? | * I will explain that living organisms in a community interact with one another in a variety of ways including competition, predation, and symbiotic relationships
* I will identify and explain examples of symbiosis including mutualism, commensalism and parasitism
* I will explain that predators and their prey exist in a state of dynamic equilibrium by interpreting a graph of cycles of growth compared to each other
* I will explain that predator/prey dynamics and competition among organisms helps maintain ecosystem stability by regulating energy flow
 | Biology Handbook:* Module 15 (Ecological Principles)

Essential Labs and Activities Manual:* Owls as Predators

Common Core Performance Tasks:* Niche
* Interrelationship Cartoons
* Symbiosis Personal Ads
* Predator – Prey Relationships
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| **2.1.4**How do communities change over time?What limits the size of a population of organisms? | * I will graph/interpret graphs of populations showing unlimited exponential growth (J-curve) and graphs showing stabilization following a period of exponential growth (S-curve)
* I will explain that the carrying capacity for a population is determined by environmental limits
* I will identify density-dependent and density-independent limiting factors for a specific population including diseases and evaluate the impact of a disease epidemic
* I will explain that populations fluctuate around the carrying capacity in a state of dynamic equilibrium
 | Biology Handbook:* Module 15 (Ecological Principles)

Common Core Performance Tasks:* Limiting Factors
* Lesson of the Kaibab
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| Human Impact on the Environment: Module #16 |
| Essential Standard:Bio.2.1 Analyze the interdependence of living organisms within their environmentsBio.2.2 Understand the impact of human activities on the environment (one generation affects the next). |
| Clarifying Objectives:Bio.2.1.1 Analyze the flow of energy and cycling of matter (such as water, carbon, nitrogen and oxygen) through ecosystems relating the significance of each to maintaining the health and sustainability of an ecosystem. Bio.2.1.4 Explain why ecosystems can be relatively stable over hundreds or thousands of years, even though populations may fluctuate (emphasizing availability of food, availability of shelter, number of predators and disease). Bio.2.2.1 Infer how human activities (including population growth, pollution, global warming, burning of fossil fuels, habitat destruction and introduction of nonnative species) may impact the environment. Bio.2.2.2 Explain how the use, protection and conservation of natural resources by humans impact the environment from one generation to the next.  |
| Unpacking – What does this standard mean a child will know, understand, and be able to do?Bio.2.1.1 • Deconstruct the carbon cycle as it relates to photosynthesis, cellular respiration, decomposition and climate change. • Identify factors that influence climate such as: * greenhouse effect (relate to carbon cycle and human impact on atmospheric CO2)
* natural environmental processes (relate to volcanic eruption and other geological processes)

Bio.2.1.4 • Generalizing that although some populations have the capacity for exponential growth, there are limited resources that create specific carrying capacities and population sizes are in a dynamic equilibrium with these factors. (e.g. food availability, climate, water, territory). • Interpret various types of population graphs – human population growth graphs indicating historical and potential changes, factors influencing birth rates and death rates, and effects of population size, density and resource use on the environment. • Explain how disease can disrupt ecosystem balance. (Examples: AIDS, influenza, tuberculosis, Dutch Elm Disease, Pfiesteria, etc.) Bio.2.2.1 • Summarize how humans modify ecosystems through population growth, technology, consumption of resources and production of waste. • Interpret data regarding the historical and predicted impact on ecosystems and global climate. • Explain factors that impact North Carolina ecosystems. (Examples: acid rain effects in mountains, beach erosion, urban development in the Piedmont leading to habitat destruction and water runoff, waste lagoons on hog farms, Kudzu as an invasive plant, etc.). Bio.2.2.2• Explain the impact of humans on natural resources (e.g. resource depletion, deforestation, pesticide use and bioaccumulation ) • Exemplify conservation methods and stewardship. *in a cell produces specific*  |
| Key Vocabulary:3rd Tier Words: Agricultural revolution, industrial revolution, urbanization, technology, natural resources, conservation, stewardship, recycle, sustainability, global warming / climate change, greenhouse gases, thermal expansion, beach erosion, air pollution, acid precipitation, NOx and SOx, water pollution, waste lagoons, *Pfisteria*, biodiversity, habitat destruction, deforestation, fragmentation, invasive species, kudzu, dutch elm disease, bioaccumulation, biomagnifications, endangered species, extinction, eutrophication, clear cutting, monoculture, crop rotation, chlorofluorocarbons, pollutant, fossil fuel, limiting factors, pesticide, DDT, toxin, non-renewable resource, renewable resource, combustion, emission 2nd Tier Words: depletion, manufacture, accumulate, global, impact, significant, sources, varies, trend, quality, piedmont, porous, impervious, concentrated, decay, compress |
| Common Misconceptions: * Climate is always changing or it has changed many times in the past before humans began burning coal and oil.
* There is no reason to believe humans are causing warming today.
* Recent global warming is caused by the sun.
* Human activities alone are what causes the greenhouse effect.
* Global warming is caused by the “hole” in the ozone layer which was created by chemicals like hair spray.
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| **Essential Questions** | **Criteria for Success: “I Will”** | **Suggested Resources / Activities** |
| **2.1.1**How is Earth’s climate regulated by the cycling of matter? | * I will evaluate human impact on the carbon cycle pertaining to the use of fossil fuels
* I will differentiate between Earth’s normal greenhouse effect and climate change due to human impact on the carbon cycle
 | Biology Handbook* Module 16 (Human Impact on the Environment)

Essential Labs and Activities Manual:* The Climate is a’ Changing
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| **2.1.4**How do communities change over time? | * I will identify and describe factors that have contributed to the growth of the human population including agricultural/industrial revolution and discuss the impact of disease epidemics
* I will interpret age-structure diagrams of developing (fast-growing) and developed (slow-growing, stable, or declining) countries and explain the relationship to human birth and death rates
* I will describe impacts of human population growth on environmental pollution, global changes, and resource consumption
 | Biology Handbook:* Module 16 (Human Impact on the Environment)
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| **2.2.1**Why is human population growth an environmental problem?What evidence do we have that humans are contributing to climate change?How are North Carolina ecosystems affected by human activity? | * I will graph/interpret graphs of human population growth from prior to the agricultural revolution to modern times and explain the changes resulting from events such as the industrial revolution
* I will describe the general impacts of human population growth including air/water pollution, production of waste, and declining natural resources (fossil fuels, minerals, biodiversity)
* I will explain the causes of climate change resulting from human activities (inputs of CO2 and CH4)
* I will discuss impacts of climate change on a global and a local scale
* I will analyze data that displays evidence for human impact on climate change (ex. correlation in CO2 and temperature increase)
* I will explain how air pollutants (NOx and SOx) from human input can result in acid precipitation
* I will discuss the general impacts of acid precipitation and apply these impacts to our local ecosystems
* I will identify sources of water pollutants contributed by humans
* I will discuss the general impacts of water pollution and apply these impacts to our local ecosystems
 | Biology Handbook:* Module 16 (Human Impact on the Environment)
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| **2.2.2**How do humans impact other species?What can you do to protect the environment? | * I will discuss the impact of habitat destruction (deforestation, fragmentation, pollution) on the biodiversity of an ecosystem
* I will discuss the introduction of non-native, invasive species by humans and describe the impact on other species
* I will analyze the impact of pesticide use on other organisms through bioaccumulation and biomagnification, and explain why organisms at higher trophic levels are most at risk
* I will explain the term conservation and identify simple ways to conserve natural resources in my everyday life
* I will provide examples of sustainable environmental practices that exemplify good environmental stewardship
 | Biology Handbook:* Module 16 (Human Impact on the Environment)
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| Biochemistry: Module #2 |
| Essential Standards:Bio 1.2 Analyze the cell as a living systemBio 4.1 Understand how biological molecules are essential to the survival of living organisms |
| Clarifying Objectives:Bio 1.2.1 Explain how homeostasis is maintained in a cell and within an organism in various environments (including temperature and pH)Bio 4.1.1 Compare the structures and functions of the major biological molecules (carbohydrates, proteins, lipids, and nucleic acids) as related to the survival of living organismsBio 4.1.3 Explain how enzymes act as catalysts for biological reactions |
| Unpacking – What does this standard mean a child will know, understand, and be able to do?Bio.1.2.1 • Explain how cells use buffers to regulate cell pH and how cells can respond to maintain temperature, glucose levels, and water balance in organisms. Bio.4.1.1 Compare the structure and function of each of the listed organic molecules in organisms: • Carbohydrates (glucose, cellulose, starch, glycogen) • Proteins (insulin, enzymes, hemoglobin) • Lipids (phospholipids, steroids) • Nucleic Acids (DNA, RNA) Bio.4.1.3 • Develop a cause and effect model for specificity of enzymes - the folding produces a 3-D shape that is linked to the protein function, enzymes are proteins that speed up chemical reactions (catalysts) by lowering the activation energy, are re-usable and specific, and are affected by such factors as pH and temperature. Note: *Students should understand that enzymes are necessary for all biochemical reactions and have a general understanding of how enzymes work in terms of the connection between shape and function*Note: *Students should understand that enzymes are necessary for all biochemical reactions and have a general understanding of how enzymes work in terms of the connection between shape and*  |
| Key Vocabulary:3rd Tier Words: macromolecule, dehydration (condensation synthesis), hydrolysis (decomposition), acid, base (alkaline), pH, buffer, element, atom, compound, bond, molecule, inorganic, organic, carbon, hydrogen, oxygen, nitrogen, phosphorous, polymer, monomer, carbohydrate, monosaccharide (simple sugar), glucose, disaccharide, polysaccharide (complex carbohydrate), starch, cellulose, chitin, glycogen, lipid, glycerol, fatty acid, saturated, unsaturated, phospholipid, steroid, nucleic acid, nucleotide, DNA, RNA, protein, amino acid, R-group, carboxyl group, amino group, hemoglobin, insulin, enzyme, enzyme-substrate complex, lock and key, environmental conditions, denature, catalyst, activation energy, substrate, active site, re-usable, specific, indicator, Benedict’s solution, Biurets solution, Iodine, synthesis, pipette, reaction rate, product, reactant, chemical formula, structural formula2nd Tier Words: flexible, major, optimal, yield, differentiate, subunit, formula, function, regulate, insulation, affect, collision, reusable, globular, activity, mechanism, ratio, counteract |
| Common Misconceptions: * Simple sugars have to be broken down into smaller molecules before they can enter the cells of the body.
* Fatty acids have to be broken down into smaller molecules before they can enter the cells of the body.
* Amino acids provide instructions for making proteins in an organism.
* Four types of amino acids are used to make protein molecules.
* The actions of protein molecules do not affect a plant's behaviors.
* The actions of protein molecules do not affect an organism's behaviors.
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| **Essential Questions** | **Criteria for Success: “I Will”** | **Suggested Resources / Activities** |
| **1.2.1**How do cells maintain conditions suitable for life in different environments? | * I will identify acids and bases as numbers on the pH scale and will explain how buffers are used by living cells to maintain pH balance
 | Biology Handbook :* Module 2 (Cellular Chemistry)

Essential Labs & Activities Manual* Buffers and Acid/Base Balance Demo
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| **4.1.1**How are chemicals used in my body?Where does my body get the chemicals it needs? | * I will use appropriate terminology in the context of studying chemistry, including atom, element, molecule, and compound.
* I will differentiate between inorganic and organic compounds and will identify them when given a chemical or structural formula.
* I will identify the four major organic compounds in organisms and the subunit (monomer) of each.
* I will build paper models of the four major organic compounds and will identify each when given a chemical or structural formula (based on the elements present).
* I will describe the basic functions of each of the four major organic compounds.
* I will discuss the organic compounds that provide the body with energy (carbohydrates/lipids) vs. the organic compound that is building material (protein).
* I will name several examples of each of the four major organic compounds.
* I will use chemical indicators to identify the presence of organic compounds.
 | Biology Handbook:* Module 2 (Cellular Chemistry)

Essential Labs and Activities Manual:* How can you use Carbohydrates to Catch a Criminal?
* Eggbert and Roberta’s Stomachs
* McMush
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| **4.1.3**Why are enzymes necessary for life? | * I will explain that proteins differ in their sequence of amino acids and that this sequence determines the structure of the protein, and thus, its function.
* I will identify enzymes as types of protein that regulate all chemical reactions in an organism.
* I will interpret a graph showing the rate of a biochemical reaction with and without an enzyme and will explain that enzymes catalyze the reaction by lowering the activation energy.
* I will diagram an enzyme mediated pathway, labeling shapes to represent the enzyme, substrate, enzyme-substrate complex, and product(s)
* I will differentiate between a synthesis and decomposition reaction and provide an example of each.
* I will identify environmental factors that can cause an enzyme to denature, and explain that this will cause the enzyme to lose its shape meaning that it can no longer perform its function.
* I will discuss the characteristics of enzymes (specificity and reusability) and demonstrate these characteristics in a laboratory setting.
 | Biology Handbook:* Module 2 (Cellular Chemistry)

Essential Labs and Activities Manual:* Characteristics of Enzymes
* Enzyme Activity Stations

Common Core Performance Tasks:* Enzyme
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| Cell Structure/Reproduction and Microscopy: Module #3 & 5 |
| Essential Standard:Bio 1.1 Understand the relationship between the structures and functions of cells and their organellesBio 1.2 Analyze the cell as a living system |
| Clarifying Objectives:Bio.1.1.1Summarize the structure and function of organelles in eukaryotic cells (including the nucleus, plasma membrane, cell wall, mitochondria, vacuoles, chloroplasts, and ribosomes) and ways that these organelles interact with each other to perform the function of the cell. Bio.1.1.2 Compare prokaryotic and eukaryotic cells in terms of their general structures (plasma membrane and genetic material) and degree of complexity. Bio.1.1.3 Explain how instructions in DNA lead to cell differentiation and result in cells specialized to perform specific functions in multicellular organisms. Bio 1.2.2 Analyze how cells grow and reproduce in terms of interphase, mitosis, and cytokinesis |
| Unpacking – What does this standard mean a child will know, understand, and be able to do?Bio.1.1.1 • Identify these cell organelles in diagrams of plant and animal cells. (middle school review) • Explain how the structure of the organelle determines it function. (Example: folded inner membrane in mitochondria increases surface area for energy production during aerobic cellular respiration). • Summarize how these organelles interact to carry out functions such as energy production and use, transport of molecules, disposal of waste, and synthesis of new molecules. (Example: DNA codes for proteins which are assembled by the ribosomes and used as enzymes for energy production at the mitochondria). Bio.1.1.2 • Proficiently use proper light microscopic techniques as well as determine total power magnification. The purpose is to use microscopes to observe a variety of cells with particular emphasis on the differences between prokaryotic and eukaryotic as well as plant and animal cells. While students are not expected to understand how scanning and electron transmission microscopes work, they should recognize that they reveal greater detail about eukaryotic and prokaryotic cell differences. • Infer that prokaryotic cells are less complex than eukaryotic cells. • Compare the structure of prokaryotic and eukaryotic cells to conclude the following:  ▪ Presence of membrane bound organelles – mitochondria, nucleus, vacuole, and chloroplasts are not present in prokaryotes.  ▪ Ribosomes are found in both.  ▪ DNA and RNA are present in both, but are not enclosed by a membrane in prokaryotes.  ▪ Contrasts in chromosome structure – circular DNA strands called plasmids are characteristic of prokaryotes.  ▪ Contrasts in size – prokaryotic cells are smaller. Bio.1.1.3 • Compare a variety of specialized cells and understand how the functions of these cells vary. (Possible examples could include nerve cells, muscle cells, blood cells, sperm cells, xylem and phloem.) • Explain that multicellular organisms begin as undifferentiated masses of cells and that variation in DNA expression and gene activity determines the differentiation of cells and ultimately their specialization.  ▪ During the process of differentiation, only specific parts of the DNA are activated; the parts of the DNA that are activated determine the function and specialized structure of a cell.  ▪ Because all cells contain the same DNA, all cells initially have the potential to become any type of cell; however, once a cell differentiates, the processcannot be reversed.  ▪ Nearly all of the cells of a multicellular organism have exactly the same chromosomes and DNA.  ▪ Different parts of the genetic instructions are used in different types of cells, influenced by the cell's environment and past history. • Recall that chemical signals may be released by one cell to influence the development and activity of another cell. Bio.1.2.2 • Outline the cell cycle – Growth1, Synthesis, Growth2, Mitosis, and Cytokinesis. • Recognize mitosis as a part of asexual reproduction. (middle school review) • Organize diagrams of mitotic phases and describe what is occurring throughout the process. Note: *When students learn about meiosis (Bio.3.2.1), they should compare it to the process of mitosis.*  |
| Key Vocabulary:3rd Tier Words: unicellular, multicellular, prokaryotic, eukaryotic, chromosome, DNA, plasmid, nucleus, cell/plasma membrane, phospholipid bilayer, selectively permeable, cell wall, cytoplasm, organelle, mitochondria, chloroplast, vacuole, ribosome, stem cell, differentiation, specialization, cell communication, junction, synapse, compound light microscope, ocular lens, objective lens, diaphragm, electron microscope, magnification, cell cycle, interphase, Growth1(G1), Synthesis(S), DNA replication, chromatin, chromatid, centromere, doubled chromosome, Growth2(G2), Mitosis, nuclear membrane, spindle fibers, Cytokinesis, asexual reproduction, clone, binary fission, budding, vegetative propagation, regeneration, sporulation, cancer, neurotransmitters, hormones, receptor protein, field of view, somatic cell, specimen2nd Tier Words: precede, procedure, subsequent, template, fragment, complex, simple, combat, distort, arrangement, surface area, maintain, specific, influence, focus, inverted, resolution |
| Common Misconceptions: * Cells of living organisms do not make molecules for their own growth and repair.
* Animal cells do not eliminate their own wastes.
* All cells are the same size and shape, i.e., there is a generic cell.
* There are no single-celled organisms.
* Animal cells do not carry out essential life functions for themselves.
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| **Essential Questions** | **Criteria for Success: “I Will”** | **Suggested Resources / Activities** |
| **1.1.1**What are the parts of a living cell?How do life functions (STERNGRR) occur at a cellular level? | * I will identify organelles in prokaryotic and eukaryotic (plant and animal) cells.
* I will describe the function of the major cell organelles.
* I will compare functions of the cellular organelles to the STERNGRR life processes.
* I will explain how an organelle’s structure is related to its function.
 | Biology Handbook * Module 3(Cell Structure)

Essential Labs & Activities Manual:* Cell construction
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| **1.1.2**How can cells and cell parts be observed?How are the cells of various organisms different? | * I will use a compound light microscope to observe various types of cells.
* I will compare and contrast prokaryotic and eukaryotic cells.
* I will compare and contrast plant and animal cells.
* I will distinguish between prokaryotic/eukaryotic cells and plant/animal cells when viewed using a microscope.
* I will observe images produced using an electron microscope and describe how they are different from those produced using a compound light microscope.
 | Biology Handbook * Module 3(Cell Structure)

Essential Labs & Activities Manual:* Which Cell Is It?

Common Core Performance Tasks:* Cell Compare
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| **1.1.3**What controls the differentiation and specialization of cells?How are different cell types produced by a multicellular organism?How do cells in a multicellular organism communicate with one another? | * I will explain that every cell of a multicellular organism contains a complete copy of the organism’s DNA and that the DNA is the same in all cells.
* I will explain that cells can be differentiated by the parts of the DNA that are “turned on” in the cell.
* I will observe examples of various types of cells in a multicellular organism and compare form to function.
* I will identify and describe methods of short distance (junctions, synapses) and long distance (hormones) cell communication.
 | Biology Handbook* Module 3 (Cell Structure)
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| **1.2.2**How are new cells produced?How does reproduction relate to cell division? | * I will name reasons that cells need to divide including size limits, growth, repair, and asexual reproduction
* I will identify several types of asexual reproduction
* I will explain the need for a process of nuclear division in eukaryotic cells
* I will describe what is occurring in each stage of the cell cycle, including changes in the DNA as it is replicated (chromatin, chromatid, doubled chromosome)
* I will sequence diagrams of cells in various stages of the cell cycle and explain what is happening in each
 | Biology Handbook * Module 5 (Cell Reproduction)

Essential Labs and Activities Manual* The Chromosomes of a Frimpanzee

Common Core Performance Tasks* The Cell Cycle
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| Cell Physiology [Transport and Energy]: Module #4 |
| Essential Standard:Bio 1.2 Analyze the Cell as a Living SystemBio 4.2 Analyze the relationships between biochemical processes and energy use in the cell |
| Clarifying Objectives:Bio 1.2.1 Explain how homeostasis is maintained in a cell and within an organism in various environments (including temperature and pH)Bio.4.2.1 Analyze photosynthesis and cellular respiration in terms of how energy is stored, released, and transferred within and between these systems. Bio 4.2.2 Explain ways that organisms use released energy for maintaining homeostasis (active transport).  |
| Unpacking – What does this standard mean a child will know, understand, and be able to do?Bio.1.2.1 • Explain how cells use buffers to regulate cell pH and how cells can respond to maintain temperature, glucose levels, and water balance in organisms. • Compare the mechanisms of active vs. passive transport (diffusion and osmosis). • Conclude how the plasma membrane structure functions. • Explain changes in osmotic pressure that occurs when cells are placed in solutions of differing concentrations. Bio.4.2.1 • Analyze overall reactions including reactants and products for photosynthesis and cellular respiration and factors which affect their rates (amounts of reactants, temperature, pH, light, etc.). • Compare these processes with regard to efficiency of ATP formation, the types of organisms using these processes, and the organelles involved. (Anaerobic respiration should include lactic acid and alcoholic fermentation.) Note: *(1) Instruction should include the comparison of anaerobic and aerobic organisms. (2) Glycolysis, Kreb’s Cycle, and Electron Transport Chain are not addressed.* Bio 4.2.2 Conclude that energy production by organisms is vital for maintaining homeostasis and that maintenance of homeostasis is necessary for life. Examples: Active transport of needed molecules or to rid the cell of toxins; movement to avoid danger or to find food, water, and or mates; synthesizing needed molecules.   |
| Key Vocabulary:3rd Tier Words: homeostasis, passive transport, diffusion, facilitated diffusion, osmosis, cell (plasma) membrane, selectively permeable, phospholipid bilayer, pores, transport proteins, concentration gradient, osmotic/turgor pressure, equilibrium, active transport, photosynthesis, cellular respiration, reactant, product, ADP/ATP, phosphate group, energy, aerobic, anaerobic, fermentation (lactic acid / alcoholic), chloroplast, mitochondria, cytolysis, plasmolysis, sodium-potassium pump, dynamic equilibrium, fluid mosaic model, polarity, hydrophilic, hydrophobic, tonicity, solute, solvent, ions, protein channel, transport protein, exocytosis, endocytosis, pinocytosis, phagocytosis, distilled water, hypotonic, isotonic, hypertonic, concentration, bond, exothermic, endothermic, digestion, light independant, light dependent reactions2nd Tier Words: pigment, recycled, affect, effect, expand, control, collect, inflate, produce, interact, span, interior, exterior, barrier, submerge, distributed, maintain, net movement, shrivel, turgid, flaccid, wilt, steep, composed |
| Common Misconceptions: * Plants get organic food substances such as starch and sugar or protein from the soil.
* Water is food for plants.
* Particles move from high to low concentration because they tend to move until the two areas are isotonic and then theparticles stop moving.
* There are too many particles crowded into one area, therefore they move to an area with more room.
* Exocytosis is the same as active transport.
* Light dependent reactions occur in the presence of light while light independent reaction occurs in the dark.
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| **Essential Questions** | **Criteria for Success: “I Will”** | **Suggested Resources / Activities** |
| **1.2.1**How do cells maintain conditions suitable for life in different environments?How do materials get in/out of cells? | * I will describe examples of maintaining homeostasis in living cells
* I will describe how the structure of the cell membrane allows for the transport of materials
* I will explain the mechanisms of passive transport
* I will predict what will happen to cells that are placed in different environments when given numerical or descriptive data
* I will explain the mechanism of active transport and compare/contrast to passive transport
 | Biology Handbook* Module 4 (Cell Transport)

Essential Labs and Activities Manual* Diffusion Demo
* Potato Osmosis

Common Core Performance Tasks* Mechanism of Diffusion Across a Membrane
* Cell Transport
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| **4.2.1**How does energy from the sun become energy for life?Are food and energy the same thing? | * I will summarize the goal of photosynthesis (to produce food) and the goal of cellular respiration (to use food to produce energy for cells).
* I will explain the equation for photosynthesis, identifying reactants and products.
* I will discuss the need for organisms to break down the food that they have produced (autotrophs) or have taken in (heterotrophs) in order to produce an energy molecule that cells can use for energy.
* I will explain the equation for cellular respiration, identifying the reactants and products.
* I will identify the organelles in cells where photosynthesis and cellular respiration occur.
* I will differentiate between aerobic and anaerobic respiration (fermentation) and will explain that more energy (ATP) is produced in aerobic respiration.
* I will discuss the types of living organisms that are likely to carry out aerobic vs. anaerobic respiration.
* I will discuss the types of organisms that produce lactic acid vs. alcohol when using anaerobic respiration.
* I will analyze graphs/information about factors that affect the rate of photosynthesis or cellular respiration, including amounts of reactants, temperature, light, and pH.
* I will explain that the energy in ATP is stored in a chemical bond, and that ATP can be recycled.
 | Biology Handbook:* Module 4 (Cellular Physiology)

Essential Labs and Activities Manual* It’s Not Easy Being Green – A Photosynthesis Lab
* Factors Affecting Respiration

Common Core Performance Tasks:* Photosynthesis-Respiration
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| **4.2.2**Why do organisms need energy? | * I will evaluate an organism’s need for energy and relate to the STERNGRR life processes (synthesis of molecules, transport of materials, growth, reproduction)
* I will explain that in order for an organism to maintain homeostasis, energy is required for the STERNGRR life processes (synthesis, excretion, regulation).
* I will provide examples of maintaining homeostasis and relate to STERNGRR and the need for energy.
 | Biology Handbook:* Module 4 (Cellular Physiology)
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| DNA and Protein Synthesis: Module #6 |
| Essential Standard:Bio 1.1 Understand the relationship between structures and functions of cells and their organellesBio 3.1 Explain how traits are determined by the structure and of DNABio 4.1 Understand how biological molecules are essential to the survival of living organisms |
| Clarifying Objectives:Bio.1.1.3 Explain how instructions in DNA lead to cell differentiation and result in cells specialized to perform specific functions in multicellular organisms. Bio.3.1.1 Explain the double-stranded, complementary nature of DNA as related to its function in the cell. Bio.3.1.2 Explain how DNA and RNA code for proteins and determine traits. Bio.3.1.3 Explain how mutations in DNA that result from interactions with the environment (i.e. radiation and chemicals) or new combinations in existing genes lead to changes in function and phenotype. Bio 4.1.2 Summarize the relationship among DNA, proteins and amino acids in carrying out the work of cells and how this is similar in all organisms |
| Unpacking – What does this standard mean a child will know, understand, and be able to do?Bio 1.1.3• Explain that multicellular organisms begin as undifferentiated masses of cells and that variation in DNA expression and gene activity determines the differentiation of cells and ultimately their specialization.  ▪ During the process of differentiation, only specific parts of the DNA are activated; the parts of the DNA that are activated determine the function and specialized structure of a cell.  ▪ Because all cells contain the same DNA, all cells initially have the potential to become any type of cell; however, once a cell differentiates, the process cannot be reversed.  ▪ Nearly all of the cells of a multicellular organism have exactly the same chromosomes and DNA.  ▪ Different parts of the genetic instructions are used in different types of cells, influenced by the cell's environment and past history. Bio.3.1.1 • Develop a cause-and-effect model relating the structure of DNA to the functions of replication and protein synthesis:  ▪ The structure of DNA is a double helix or “twisted ladder” structure. The sides are composed of alternating phosphate-sugar groups and  “rungs of the DNA ladder” are composed of complementary nitrogenous base pairs (always adenine, A, to thymine, T, and cytosine, C, to guanine, G) joined by weak hydrogen bonds.  ▪ The sequence of nucleotides in DNA codes for proteins, which is central key to cell function and life.  ▪ Replication occurs during the S phase of the cell cycle and allows daughter cells to have an exact copy of parental DNA.  ▪ Cells respond to their environments by producing different types and amounts of protein.  ▪ With few exceptions, all cells of an organism have the same DNA but differ based on the expression of genes. • Infer the advantages (injury repair) and disadvantages (cancer) of the overproduction, underproduction or production of proteins at the incorrect times. Bio.3.1.2 • Explain the process of protein synthesis:  ▪ Transcription that produces an RNA copy of DNA, which is further modified into the three types of RNA  ▪ mRNA traveling to the ribosome (rRNA)  ▪ Translation – tRNA supplies appropriate amino acids  ▪ Amino acids are linked by peptide bonds to form polypeptides. Polypeptide chains form protein molecules. Proteins can be structural  (forming a part of the cell materials) or functional (hormones, enzymes, or chemicals involved in cell chemistry). • Interpret a codon chart to determine the amino acid sequence produced by a particular sequence of bases. • Explain how an amino acid sequence forms a protein that leads to a particular function and phenotype (trait) in an organism. Bio.3.1.3 • Understand that mutations are changes in DNA coding and can be deletions, additions, or substitutions. Mutations can be random and spontaneous or caused by radiation and/or chemical exposure. • Develop a cause and effect model in order to describe how mutations change amino acid sequence, protein function, and phenotype. Only mutations in sex cells (egg and sperm) or in the gamete produced from the primary sex cells can result inheritable changes. Bio.4.1.2 • Recall that the sequence of nucleotides in DNA codes for specific amino acids which link to form proteins. • Identify the five nitrogenous bases (A, T, C, G and U) found in nucleic acids as the same for all organisms. • Summarize the process of protein synthesis. Note: *Students are not expected to memorize the names and/or structures or characteristics of the 20 amino acids. The focus should be on the fact that side chains are what make each of the amino acids different and determine how they bond and fold in proteins.(Relate to Bio.3.1.2)*  |
| Key Vocabulary:3rd Tier Words: DNA, chromosomes, heredity, trait/phenotype, double helix, nucleic acid, nucleotide, deoxyribose sugar, phosphate, nitrogen bases, adenine, guanine, cytosine, thymine, complementary base pairing, hydrogen bonds, DNA replication, protein synthesis, gene, protein, codon, transcription, messenger RNA, ribose, uracil, translation, ribosomal RNA, transfer RNA, anticodon, amino acid, peptide bond, polypeptide, gene expression, differentiation, gene regulation, point mutation (substitution), frameshift mutation (deletion/insertion), neutral mutation, lethal mutation, gamete, somatic cell, mutagen, structural protein, functional protein, supercoil, anti-parallel, leading strand, lagging strand2nd Tier Words: segment, linked, portion, origin, coil, exposed, free floating, fold, synthesized, motify, sequence, template, fragment, inheritable, assemble, unzip, facilitate, interpret, activate, mutate, abnormal, premature, variation, random, attach  |
| Common Misconceptions: * Genes are proteins.
* The actions of protein molecules do not affect an organism's behaviors.
* The actions of protein molecules do not affect a human's behaviors.
* The actions of protein molecules do not affect an insect's behaviors.
* The actions of protein molecules do not affect a bird's behaviors.
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| **Essential Questions** | **Criteria for Success: “I Will”** | **Suggested Resources / Activities** |
| **1.1.3**What controls the differentiation and specialization of cells?How are different cell types produced by a multicellular organism? | * I will explain that every cell of a multicellular organism contains a complete copy of the organism’s DNA and that the DNA is the same in all cells.
* I will explain that cells can be differentiated by the parts of the DNA that are “turned on” in the cell.
 | Biology Handbook* Module 6 (DNA and Protein Synthesis)
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| **3.1.1**What is the structure of DNA?How is DNA copied so that newly produced cells have a copy?What makes the DNA of various species (or individuals within a species) different?How does the structure of an organism’s DNA code for that organism’s traits? | * I will label the components of a model of DNA
* I will determine the complementary nitrogen base sequence when given the sequence of one strand
* I will compare/contrast the DNA structure of two different species or individuals
* I will explain the stages of DNA replication
* I will explain that a “gene” is a section of DNA that codes for the production of a protein and that proteins determine an organism’s traits
* I will explain that all (most) cells of an organism contains the same DNA, but that different cells produce different proteins because different genes are expressed
* I will describe examples of the results of overproduction and underproduction of protein
 | Biology Handbook * Module 6 (DNA and Protein Synthesis)

Common Core Performance Tasks* DNA Structure
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| **3.1.2**How are proteins made from the DNA code?Why do proteins determine the traits of an organism? | * I will describe the differences in DNA and RNA structure, including the three types of RNA
* I will analyze the parts of the cell that are related to protein synthesis and evaluate the need to first copy a gene (in the nucleus) and then produce the protein (at the ribosome)
* I will explain the process of transcription, including complementary base pairing of DNA and mRNA nucleotides
* I will explain the process of translation, including interpretation of a mRNA codon chart to determine amino acid sequences
* I will describe the formation of a protein, from amino acids, to polypeptide chain, to 3 dimensional structure with a specific function
* I will explain that proteins are structural and functional materials of an organism and thus determine the physical and physiological traits
 | Biology Handbook * Module 6 (DNA and Protein Synthesis)

Essential Labs and Activities Manual* An Analysis of Alien DNA
* DNA to Disease

Common Core Performance Tasks* DNA to RNA
* mRNA to tRNA
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| **3.1.3**What happens when DNA replication goes wrong?How do mutations affect an organism? | * I will explain that mutations occur during DNA replication or transcription (protein synthesis) and may be random or a result of environmental agents
* I will identify examples of point(substitution) and frameshift (addition/deletion) mutations
* I will analyze the amino acid produced from a “normal” and a mutated strand of DNA
* I will explain that only mutations in gametes can be passed on to an organism’s offspring
 | Biology Handbook * Module 6 (DNA and Protein Synthesis)

Essential Labs and Activities Manual* An Analysis of Alien DNA
* DNA to Disease
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| **4.1.2**How are DNA and proteins related? | * I will explain that DNA is a code for making proteins and that the code is found in the sequence of nitrogen bases.
* I will identify the nitrogen bases that are found in DNA vs. those found in RNA.
* I will explain that a sequence of 3 nitrogen bases forms a DNA triplet/RNA codon and that a codon codes for one amino acid.
* I will summarize the process of protein synthesis – transcription and translation (see 3.1.2).
* I will explain that amino acids link together to form a polypeptide chain which then folds to form a 3D shape which determines its function.
 | Biology Handbook:* Module 6 (DNA and Protein Synthesis)

Common Core Performance Tasks:* mRNA to tRNA
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| Biotechnology: Module #7 |
| Essential Standard:Bio 3.3 Understand the application of DNA technologyBio 1.1 Understand the relationship between the structures and functions of cells and their organelles |
| Clarifying Objectives:Bio.3.3.1 Interpret how DNA is used for comparison and identification of organisms. Bio.3.3.2 Summarize how transgenic organisms are engineered to benefit society. Bio.3.3.3 Evaluate some of the ethical issues surrounding the use of DNA technology (including cloning, genetically modified organisms, stem cell research, and Human Genome Project). Bio 1.1.3 Explain how instructions in DNA lead to cell differentiation and result in cells specialized to perform specific functions in multicellular organisms |
| Unpacking – What does this standard mean a child will know, understand, and be able to do?Bio.3.3.1 • Summarize the process of gel electrophoresis as a technique to separate molecules based on size. Students should learn the general steps of gel electrophoresis – using restrictions enzymes to cut DNA into different sized fragments and running those fragments on gels with longer fragments moving slower than faster ones.• Interpret or “read” a gel. • Exemplify applications of DNA fingerprinting - identifying individuals; identifying and cataloging endangered species. Bio.3.3.2 • Generalize the applications of transgenic organisms (plants, animals, & bacteria) in agriculture and industry including pharmaceutical applications such as the production of human insulin. • Summarize the steps in bacterial transformation (insertion of a gene into a bacterial plasmid, getting bacteria to take in the plasmid, selecting the transformed bacteria, and producing the product). Bio.3.3.3 • Identify the reasons for establishing the Human Genome Project. • Recognize that the project is useful in determining whether individuals may carry genes for genetic conditions and in developing gene therapy. • Evaluate some of the science of gene therapy. (e.g. Severe Combined Immunodeficiency and Cystic Fibrosis) • Critique the ethical issues and implications of genomics and biotechnology (stem cell research, gene therapy and genetically modified organisms)Bio.1.1.3Identify stem cells as unspecialized cells that continually reproduce themselves and have, under appropriate conditions, the ability to differentiate into one or more types of specialized cells.  ▪ Embryonic cells which have not yet differentiated into various cell types are called embryonic stem cells.  ▪ Stem cells found in organisms, for instance in bone marrow, are called adult stem cells.  ▪ Scientists have recently demonstrated that stem cells, both embryonic and adult, with the right laboratory culture conditions, differentiate into specialized cells.  |
| Key Vocabulary:3rd Tier Words: DNA fingerprint, gel electrophoresis, restriction enzyme, genetic engineering, bacterial transformation, transgenic organism /GMO (genetically modified organism), recombinant DNA, plasmid, vector, host, Human Genome Project, genetic screening, gene therapy, stem cell, splice, genetic marker, insulin, desired trait, cystic fibrosis, Severe Combined Immunodeficiency, surrogate, somatic, cleave, foreign DNA2nd Tier Words: simulate, function, analyze, interpret, insert, produce, discard, isolate, benefit, faulty, drawback, fragment, abnormal, condition, disorder, artificial, fused, implanted, applications, agriculture, industry, pharmaceutical  |
| Common Misconceptions: * Genetic modification of food is new.
* GMOs are just a modern version of selective breeding.
* There is solid evidence that GMO foods cause cancer.
* Almost all crops today are GMOs.
* GMOs are unlabeled and impossible to avoid
* GMO crops are dangerous since they contain toxic substances.
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| **Essential Questions** | **Criteria for Success: “I Will”** | **Suggested Resources / Activities** |
| **3.3.1**How is a DNA fingerprint different from an actual fingerprint?How is a DNA fingerprint made and used? | * I will explain the production of a DNA fingerprint from DNA extraction, to restriction digestion, to gel electrophoresis
* I will model the process of producing a DNA fingerprint (online or paper/pencil)
* I will interpret a DNA fingerprint in crime scene and paternity applications
 | Biology Handbook* Module 7 (DNA Technology)

Essential Labs and Activities Manual* Modeling DNA Fingerprinting
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| **3.3.2**How can the DNA of an organism be modified to change its traits?How is changing DNA of plants and other organisms useful to humans? | * I will explain the production of a transgenic organism containing a desired gene
* I will model the process of producing a transgenic organism (online or cut/paste)
* I will describe the applications of genetic engineering in agriculture, industry and medicine
 | Biology Handbook* Module 7 (DNA Technology)

Essential Labs and Activities Manual* Genetic Engineering Activity
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| **3.3.3**How do we know where human genes are located on chromosomes?Will scientists ever be able to develop “cures” for genetic disorders?Should we (humanity) be manipulating the natural DNA of organisms? | * I will describe the purpose of the Human Genome Project as locating and sequencing genes on human chromosomes
* I will explain how the HGP has led to genetic screening and the development of gene therapy for certain genetic disorders
* I will evaluate the benefits and drawbacks of genetic engineering, gene therapy, and stem cell research
 | Biology Handbook* Module 7 (DNA Technology)
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| **1.1.3**How are different cell types produced by a multicellular organism? | * I will describe the differentiation and specialization of cell types in a multicellular organism, beginning with stem cells.
* I will compare and contrast embryonic and adult stem cells.
 | Biology Handbook* Module 7 (Stem Cells)
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| Meiosis / Genetic Variation and Genetics: Module #5 & 8 |
| Essential Standard:Bio 3.2 Understand how the environment, and/or the interaction of alleles, influences the expression of genetic traits |
| Clarifying Objectives:Bio.3.2.1 Explain the role of meiosis in sexual reproduction and genetic variationBio.3.2.2 Predict offspring ratios based on a variety of inheritance patterns (including dominance, co-dominance, incomplete dominance, multiple alleles, and sex-linked traits)Bio.3.2.3 Explain how the environment can influence the expression of genetic traits |
| Unpacking – What does this standard mean a child will know, understand, and be able to do?Bio.3.2.1 • Recall the process of meiosis and identify process occurring in diagrams of stages. (middle school review) Note: Students are not expected to memorize the names of the steps or the order of the step names. • Infer the importance of the genes being on separate chromosomes as it relates to meiosis. • Explain how the process of meiosis leads to independent assortment and ultimately to greater genetic diversity. • Exemplify sources of genetic variation in sexually reproducing organisms including crossing over, random assortment of chromosomes, gene mutation, nondisjunction, and fertilization. • Compare meiosis and mitosis including type of reproduction (asexual or sexual), replication and separation of DNA and cellular material, changes in chromosome number, number of cell divisions, and number of cells produced in a complete cycle. Bio.3.2.2 • Interpret Punnett squares (monohybrid only) to determine genotypic and phenotypic ratios. Understand that dominant alleles mask recessive alleles. • Determine parental genotypes based on offspring ratios. • Recognize a variety of intermediate patterns of inheritance (codominance and incomplete dominance). • Recognize that some traits are controlled by more than one pair of genes and that this pattern of inheritance is identified by the presence of a wide range of phenotypes (skin, hair, and eye color). • Solve and interpret codominant crosses involving multiple alleles including blood typing problems. (Blood Types: A, B, AB and O and Alleles: IA, IB, and i). Students should be able to determine if parentage is possible based on blood types. • Understand human sex chromosomes and interpret crosses involving sex-linked traits (color-blindness and hemophilia). Students should understand why males are more likely to express a sex-linked trait.Bio.3.2.3Develop a cause-and-effect relationship between environmental factors and expression of a particular genetic trait. All traits depend both on genetic and environmental factors. Heredity and environment interact to produce their effects. This means that the way genes are expressed depends on the environment in which they act. |
| Key Vocabulary:3rd Tier Words: Sexual reproduction, gamete, zygote, meiosis, diploid, haploid, reduction division, genetic variation, genetic stability, mutation, crossing over, random/ independent assortment, nondisjunction, random fertilization, homologous chromosome pairs, allele, dominant, recessive, genotype, phenotype, homozygous/pure (true) breeding, heterozygous/hybrid, Mendel’s laws [dominance, segregation, independent assortment], Punnett square, monohybrid cross, intermediate inheritance [codominance, incomplete dominance], multiple alleles, polygenic, autosomal, sex-linked, tetrad, somatic, chromatid, chromosome, centromere, heredity, ratio, probability, P generation, F1 generation, F2 generation, progeny2nd Tier Words: sort, exchange, identical, blend, mask, express |
| Common Misconceptions: * Genes are traits.
* A gene and the expression of the gene as a characteristic or trait are the same thing.
* Amino acids are the subunits that make up DNA.
* Only animals have DNA; plants and mushrooms do not have DNA.
* Genes are sequences of amino acids.
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| **Essential Questions** | **Criteria for Success: “I Will”** | **Suggested Resources / Activities** |
| **3.2.1**Why is there a different mechanism to produce sex cells (gametes) vs. body (somatic) cells?How does meiosis reduce the chromosome number by one half?How does sexual reproduction lead to genetic variation? | * I will explain that meiosis is a mechanism to produce gametes and reduces the chromosome number by ½ to allow for fertilization
* I will differentiate between diploid and haploid cells pertaining to homologous chromosome pairs
* I will explain that sexual reproduction begins with meiosis to produce the gametes, continues with fertilization to produce a zygote which divides by mitosis for growth
* I will compare /contrast mitosis and meiosis
* I will identify and describe several sources of genetic variation in sexual reproduction
* I will illustrate the process of crossing over, recognize that it occurs during meiosis, and determine differences in gametes produced with and without crossing over
 | Biology Handbook * Module 5 (Cell Reproduction)

Essential Labs and Activities Manual* The Chromosomes of a Frimpanzee
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| **3.2.2**How can I predict the outcome of a cross between parents with a particular trait?Are different traits inherited differently? | * I will solve dominant/recessive (Mendelian) genetics problems involving one trait and analyze the genotype and phenotype ratios of the offspring to answer questions about probability
* I will solve intermediate inheritance (codominance, incomplete dominance) genetics problems involving one trait and analyze the genotype and phenotype ratios of the offspring to answer questions about probability
* I will solve multiple allele (blood type) genetics problems and analyze the genotype and phenotype ratios of the offspring to answer questions about probability
* I will solve sex-linked genetics problems involving one trait and analyze the genotype and phenotype ratios of the offspring to answer questions about probability
 | Biology Handbook * Module 8 (Genetics)

Essential Labs and Activities Manual* Dragon Genetics

Common Core Performance Tasks* Punnett Squares
* Incomplete Dominance
* Colorblind Scenario
* Calico and Gender
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| **3.2.3**How do environmental factors play a role in the expression of traits?Why are identical twins not always “identical”? | * I will explain the idea of nature vs. nurture
* I will evaluate examples of nature vs. nurture in the expression of traits (ie. twin studies)
 | Biology Handbook* Module 8 (Genetics)
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| Human Genetics: Module #9 |
| Essential Standard:Bio 3.2 Understand how the environment, and/or the interaction of alleles, influences the expression of genetic traits |
| Clarifying Objectives:Bio.3.2.2 Predict offspring ratios based on a variety of inheritance patterns (including dominance, co-dominance, incomplete dominance, multiple alleles, and sex-linked traitsBio.3.2.3 Explain how the environment can influence the expression of genetic traits  |
| Unpacking – What does this standard mean a child will know, understand, and be able to do?Bio.3.2.2 • Interpret karyotypes (gender, and chromosomal abnormalities). • Interpret autosomal inheritance patterns: sickle cell anemia including the relationship to malaria (incomplete dominance), cystic fibrosis (recessive heredity), and Huntington’s disease (dominant heredity). • Understand human sex chromosomes and interpret crosses involving sex-linked traits (color-blindness and hemophilia). Students should understand why males are more likely to express a sex-linked trait.• Interpret phenotype pedigrees to identify the genotypes of individuals and the type of inheritance. Bio.3.2.3 Develop a cause-and-effect relationship between environmental factors and expression of a particular genetic trait. All traits depend both on genetic and environmental factors. Heredity and environment interact to produce their effects. This means that the way genes are expressed depends on the environment in which they act.*in cell produces sp* |
| Key Vocabulary:3rd Tier Words: karyotype, trisomy, aneuploidy, Down syndrome, Turner syndrome, Klinefelter syndrome, pedigree, cystic fibrosis, Huntington’s disease, sickle-cell anemia, color blindness, hemophilia, PKU, nature vs. nurture, monosomy, nondisjunction, carrier, autosome, sex-chromosome, XX, XY, autosomal dominant, autosomal recessive, malaria, inheritance2nd Tier Words: factors, disorder, transmit, descent, separate, abnormal, gender, interpret, superscript, affected, clot, spectrum, extended |
| Common Misconceptions: * In sexually reproducing organisms, half of the organism's body cells contain DNA from the mother and half contain DNA from the father.
* Each parent contributes genetic information for certain characteristics and not others (e.g. a child has his father's nose and his mother's eyes).
* A fertilized sex cell has the same number of chromosomes as an unfertilized sex cell. A normal karyotype guarantees a normal phenotype.
* Dominant traits are the most common traits in a population. All mutations are harmful.
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| **Essential Questions** | **Criteria for Success: “I Will”** | **Suggested Resources / Activities** |
| **3.2.2**Are different traits inherited differently?How are genetic disorders inherited?What tools do genetic counselors use to advise patients? | * I will solve sex-linked genetics problems involving one trait and analyze the genotype and phenotype ratios of the offspring to answer questions about probability
* I will describe the pattern of inheritance of various genetic disorders
* I will differentiate between the inheritance of gene disorders and chromosomal disorders
* I will interpret a karyotype to identify gender and chromosomal abnormalities
* I will analyze pedigrees showing dominant, recessive, and sex-linked traits to identify genotypes and pattern of inheritance
 | Biology Handbook * Module 9 (Human Genetics)

Essential Labs and Activities Manual* Genetic Counselor Training
* Karyotype Lab

Common Core Performance Tasks* Colorblind Scenario
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| **3.2.3**How do environmental factors play a role in the expression of traits? | * I will evaluate examples of nature vs. nurture in the expression of traits (ie. twin studies, PKU, heart disease)
 | Biology Handbook * Module 9 (Human Genetics)
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| Evolution: Module #10 |
| Essential Standard:Bio.3.4 Explain the theory of evolution by natural selection as a mechanism for how species change over time |
| Clarifying Objectives:Bio.3.4.1 Explain how fossil, biochemical, and anatomical evidence support the theory of evolution. Bio.3.4.2 Explain how natural selection influences the changes in species over time. Bio.3.4.3 Explain how various disease agents (bacteria, viruses, chemicals) can influence natural selection.  |
| Unpacking – What does this standard mean a child will know, understand, and be able to do?Bio.3.4.1 • Summarize the hypothesized early atmosphere and experiments that suggest how the first “cells” may have evolved and how early conditions affected the type of organism that developed (first anaerobic and prokaryotic, then photosynthetic, then eukaryotic, then multicellular). • Summarize how fossil evidence informs our understanding of the evolution of species and what can be inferred from this evidence. • Generalize what biochemical (molecular) similarities tell us about evolution. • Generalize what shared anatomical structures (homologies) tell us about evolution. Bio.3.4.2 • Develop a cause and effect model for the process of natural selection:  ▪ Species have the potential to increase in numbers exponentially.  ▪ Populations are genetically variable due to mutations and genetic recombination.  ▪ There is a finite supply of resources required for life.  ▪ Changing environments select for specific genetic phenotypes.  ▪ Those organisms with favorable adaptations survive, reproduce and pass on their alleles.  ▪ The accumulation and change in favored alleles leads to changes in species over time. • Illustrate the role of geographic isolation in speciation. Bio.3.4.3 Develop a cause and effect model for the role of disease agents in natural selection including evolutionary selection of resistance to antibiotics and pesticides in various species, passive/active immunity, antivirals and vaccines. |
| Key Vocabulary:3rd Tier Words: Abiogenesis, spontaneous generation, primordial soup, heterotroph hypothesis, endosymbiont hypothesis, biogenesis, natural selection, variation, overproduction, competition, survival of the fittest (best adapted), adaptation, gene pool, mutations, selection forces, stabilizing/directional/disruptive selection, speciation, geographic isolation, reproductive isolation, gradualism, punctuated equilibrium, fossil, relative dating, radioactive dating, biochemical evidence, homologous structures, vestigial structures, resistance, passive/active immunity, vaccine, genetic drift, selective advantage, favorable trait, fitness, evolve, use or disuse, acquired traits, variation, allele frequency, genetic equilibrium, founder effect, bottleneck effect, convergent evolution, divergent evolution (adaptive radiation), comparative anatomy, analogous structures, common ancestor, native, embryology, geographic distribution 2nd Tier Words: originate, condense, diverse, plentiful, diversity, influence, predict, abundance, change, significant, offspring, survive, range, finch, favorable, accumulate, component, simulate, acquire, finite, apparatus, archaic, modification, decent, rudimentary, resistance, susceptible, viable, migrate, barrier, sterile, abrupt, stable, rapid  |
| Common Misconceptions:* Species that have no apparent, obvious, or superficial similarities have no similarities at all.
* Individual organisms can deliberately develop new heritable traits because they need them for survival.
* Changes to the environment cannot lead to changes in the traits of species living in that environment.
* Humans do not share a common ancestor with other living organisms.
* Members of different species do not share a common ancestor.
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| **Essential Questions** | **Criteria for Success: “I Will”** | **Suggested Resources / Activities** |
| **3.4.1**How did the first cells come to be?How do we know that evolution (change in organisms) has occurred? | * I will describe the formation of the first cells according to the heterotroph hypothesis
* I will analyze experimental evidence that proves spontaneous generation could have occurred under early atmospheric conditions
* I will explain the formation of eukaryotic cells according to the endosymbiont hypothesis
* I will analyze the experiments of Redi and Pasteur that disprove spontaneous generation under current conditions
* I will explain examples of fossil evidence as it pertains to evidence for evolution (gradualism or punctuated equilibrium)
* I will analyze amino acid sequences of various organisms to identify evolutionary relationships (common ancestry)
* I will analyze homologous and vestigial structures to identify evolutionary relationships (common ancestry)
 | Biology Handbook* Module 10 (Evolution)
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| **3.4.2**How did all life on Earth come from a few cells?Why do organisms change over time? | * I will explain the process of natural selection including variation, overproduction, competition, and survival of the best adapted
* I will apply Darwin’s process of natural selection to the evolution of a favorable trait in a specific organism
* I will explain that mutation and sexual reproduction provide the variation necessary for the process of natural selection
* I will provide examples of structural, behavioral, and physiological adaptations that evolved due to natural selection
* I will explain that organisms with favorable adaptations survive, reproduce, and pass those adaptations to their offspring
* I will model the process of natural selection in a population of organisms (online or lab simulation)
* I will explain that evolution occurs when the gene pool of a population changes – not at the individual level
* I will describe examples of stabilizing, directional, and disruptive selection as a result of environmental conditions
* I will explain that geographic isolation may lead to reproductive isolation which may result in speciation
 | Biology Handbook* Module 10 (Evolution)

Essential Labs and Activities Manual* Monstrous Mutations
* Natural Selection of the WooleyBooger
* Changes in a Teddy Graham Population

Common Core Performance Tasks* Natural Selection
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| **3.4.3**Does evolution still happen today? | * I will describe the evolution of pesticide resistant insects and antibiotic resistant bacteria using Darwin’s theory of natural selection
* I will explain the selective advantage of viruses that are able to mutate quickly, making them more difficult to treat/prevent using antivirals or vaccines
* I will provide examples of passive vs. active immunity to viral infections
 | Biology Handbook* Module 10 (Evolution)
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| Classification: Module #11 |
| Essential Standard:Bio.3.5 Analyze how classification systems are developed upon speciation |
| Clarifying Objectives:Bio.3.5.1 Explain the historical development and changing nature of classification systems. Bio.3.5.2 Analyze the classification of organisms according to their evolutionary relationships (including dichotomous keys and phylogenetic trees). |
| Unpacking – What does this standard mean a child will know, understand, and be able to do?Bio.3.5.1 • Generalize the changing nature of classification based on new knowledge generated by research on evolutionary relationships and the history of classification system. Bio.3.5.2 • Classify organisms using a dichotomous key. • Compare organisms on a phylogenetic tree in terms of relatedness and time of appearance in geologic history. *a cell pic*  |
| Key Vocabulary:3rd Tier Vocab: Domain, kingdom, phylum, class, order, family, genus, species, taxa, binominal nomenclature, dichotomous key, phylogeny, phylogenetic tree, cladogram, shared trait/character, derived character, hierarchy2nd Tier Words: depicting, reconstruct, abbreviate, adjacent, primitive, classify, general, broad, specific, exclusive, inclusive |
| Common Misconceptions: * Taxonomy is only a small discipline in biology and is not really important.
* Organisms are only classified by physiological features such as form and function.
* Taxonomy is old and out of date.
* The Kingdom Animalia only has organisms that are vertebrates.
* Fungi are plants.
* There are only large organisms in Eukarya.
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| **Essential Questions** | **Criteria for Success: “I Will”** | **Suggested Resources / Activities** |
| **3.5.1**Is every living thing a plant or an animal?How are living things organized? | * I will explain the historical development of classification systems that moved from a 2 to 5 to 6 kingdom system of categorizing organisms
* I will identify the 6 kingdoms of living organisms and provide examples of organisms in each
* I will describe the 7 level (taxa) classification system for living organisms, including the progression from general to specific and the relationship of the levels to each other
* I will compare the 7 taxa classification scheme of different organisms in order to determine which are most closely related
* I will recognize an organism’s scientific name and identify that organism’s genus and species
 | Biology Handbook* Module 11 (Classification)
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| **3.5.2**How are known organisms identified?How are unknown organisms classified? | * I will use a dichotomous key to identify an organism
* I will explain the modern tools that scientists use to classify organisms including morphology, biochemical analysis, embryology, and evolutionary phylogeny
* I will interpret a phylogenetic tree / cladogram to identify evolutionary relationships of organisms
 | Biology Handbook* Module 11 (Classification)
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| Living Organisms: Adaptation, STERNGRR, and Behavior: Module #12-14 |
| Essential Standard:Bio 1.2 Analyze the cell as a living systemBio 2.1 Analyze the interdependence of living organisms within their environments |
| Clarifying Objectives:Bio.1.2.3 Explain how specific cell adaptations help cells survive in a particular environments (focus on unicellular organisms)Bio.2.1.2 Analyze the survival and reproductive success of organisms in terms of behavioral, structural, and reproductive adaptations. Bio.2.1.3 Explain various ways organisms interact with each other and with their environments resulting in stability within ecosystems. |
| Unpacking – What does this standard mean a child will know, understand, and be able to do?Bio.1.2.3 • Explain how various structures of unicellular organisms help that organism survive. Emphasis is on contractile vacuoles, cilia, flagella, pseudopods, and eyespots. • Summarize adaptive behaviors – examples include chemotaxis and phototaxis.Bio 2.1.2 Note: *The focus has moved away from an exhaustive study of classes of living things through comparative anatomy to emphasizing connections between organisms’ adaptations (behavioral, structural, and reproductive) and survival in their particular environment.*• Analyze how various organisms accomplish life functions through adaptations within particular environments (example: water or land) to ensure survival and reproductive success. • Relate prior understanding of survival and reproductive success to evidence of variations observed in species three areas: ▪ *behavioral adaptations –* suckling, taxes/taxis, migration, estivation, hibernation, habituation, imprinting, classical conditioning, and trial  and error learning* *structural adaptations –* nutrition, respiration, transport and excretion mechanisms, camouflage, movement
* *reproductive adaptations* – sexual vs. asexual, eggs, seeds, spores, placental, types of fertilization

Bio.2.1.3• Exemplify various forms of communication and territorial defense including communication within social structure using pheromones (Examples: bees, ants, termites), courtship dances, territorial defense (Example: fighting fish).  |
| Key Vocabulary:3rd Tier Words:*Protists*unicellular, adaptation, contractile vacuole, cilia, flagella, pseudopodia, eyespots, behavior, chemotaxis, phototaxis *Plants*(Synthesis/Nutrition): photosynthesis, leaves, succulent, roots, taproot, fibrous roots, root hairs (Transport/Excretion): non-vascular, osmosis, stem, vascular, xylem, phloem, stomata, guard cells, diffusion, transpiration, cuticle, epidermal cell (Regulation): hormone, tendrils (Reproduction): vegetative propagation, runners, spores, seed, embryo, cotyledon, gymnosperm, angiosperm, cone, stamen, anther, filament, pollen, pistil/carpel, stigma, style, ovary, ovule, pollination, pollen tube, fertilization, fruit (Growth/Development): germination, dormancy*Animals*(Synthesis) protein synthesis, (Transport) closed/open circulatory system, blood, oxygenated/deoxygenated, 4-chambered heart, atria, ventricle, blood vessel (Excretion) waste, nephridia, Malpighian tubules, kidneys, nephrons, urine, homeostasis (Respiration) diffusion, spiracles, tracheal tubes, gills, lungs, alveoli (Nutrition) mandibles, jaws, teeth, digestion, esophagus, stomach, enzyme, intestine, microvilli (Reproduction) fragmentation, regeneration, external vs. internal fertilization, hermaphroditism, binary fission (Growth/Development) zygote, egg, incomplete vs. complete metamorphosis, amniotic egg, pouch, monotreme, marsupial, placenta (Regulation) compound eye, tympanum, endotherm, ectotherm, antenna, nervous system, neuron, sensory structure, brain, endocrine system, hormone (Behavior) stimulus, response, adaptive value, innate, learned, reflex, fight-or-flight, instinct, suckling, courtship, territoriality, aggression, dominance hierarchy, orientation, taxis, circadian rhythm, migration, hibernation, estivation, motivation, habituation, classical conditioning, trial and error, insight/reasoning, imprinting, society, communication, pheromone2nd Tier Words: ventral, dorsal, horizontal, vertical, anterior, posterior, developed, dispersed, produce, cross section, interior, exterior, propel, locomotion, specimen, terrestrial, aquatic, chambered, nourishment, compound, contract, appendage, mature, represent |
| Common Misconceptions: * Plants cannot reproduce sexually.
* Everything that is unicellular is prokaryotic.
* There are no single-celled organisms.
* Cells of living organisms do not make molecules for their own growth and repair.
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| **Essential Questions** | **Criteria for Success: “I Will”** | **Suggested Resources / Activities** |
| **1.2.3**What adaptations do single-celled organisms have for survival? | * I will observe examples of living unicellular organisms such as amoeba, paramecium, and euglena (video or living specimens)
* I will observe and describe mechanisms for movement in unicellular organisms and relate to adaptive behaviors of chemotaxis and phototaxis
* I will evaluate the need for a contractile vacuole in a unicellular, freshwater organism
* I will explain how the eyespot relates to the adaptive behavior of phototaxis
 | Biology Handbook* Module 12 (Simple Organisms)

Essential Labs and Activities Manual* Are There Protists in my Pond?
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| **2.1.2**How do organisms from each kingdom of life accomplish the STERNGRR life processes?What adaptations do living organisms have that allow them to respond to environmental stimuli?How do adaptations of plants and animals lead to survival and reproductive success? | * I will recognize that synthesis of molecules occurs at the cellular level in all living organisms but that they may have adaptations that allow the reactants needed to be collected and utilized
* I will explain how various organisms gain the nutrition that they need through a variety of adaptations
* I will describe the connection between respiration and nutrition
* living things need to break down food in order to produce energy molecules for cells
* living organisms have a variety of mechanisms to obtain the oxygen needed for aerobic respiration
* I will compare/contrast transport and excretion mechanisms of simple organisms to multicellular plants and animals which have specific adaptations to get materials to and from cells
* I will compare /contrast reproductive mechanisms of simple organisms to multicellular plants and animals which have specific adaptations to ensure reproductive success
* I will compare/contrast the growth and development of multicellular organisms, including the process of metamorphosis and different types of development in mammals
* I will explain how various life processes/body systems interact to regulate the internal environment of an organism and maintain homeostasis
* I will describe adaptations of organisms that allow for responses to environmental stimuli, leading to characteristic behaviors
* I will explain that structural and behavioral adaptations have evolved through natural selection and have adaptive value for an organism
* I will differentiate between innate and learned behaviors and explain the type of organism that is likely to display each
* I will identify and describe various types of innate behaviors and evaluate the selective advantage
* I will identify and describe types of learned behaviors and evaluate the selective advantage
 | Biology Handbook:* Module 12 (Simple Organisms)
* Module 13 (Plants)
* Module 14 (Animals)

Essential Labs and Activities Manual:* Are There Protists in my Pond?
* Flowering Plant Reproduction
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| **2.1.3**In what ways are living organisms able to communicate with one another? | * I will describe several methods of communication including sight (territorial/aggressive, courtship behaviors), touch (grooming, honeybee waggle dance), chemicals (pheromones), and complex language
 | Biology Handbook:* Module 14 (Animals)
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