Scientific Inquiry

Missouri Grade-Level Expectations (or other standards)

ETS1.A.1 - Analyze a major global challenge to specify qualitative and quantitative criteria and constraints for solutions that account for societal needs and wants.
ETS1.A.2 - Design a solution to a complex real-world problem by breaking it down into smaller, more manageable problems that can be solved through engineering.
ETS1.B.1 - Evaluate a solution to a complex real-world problem based on prioritized criteria and trade-offs that account for a range of constraints, including cost, safety, reliability, and aesthetics as well as possible social, cultural, and environmental impacts.
ETS1.B.2. - Use a computer simulation to model the impact of proposed solutions to a complex real-world problem with numerous criteria and constraints on interactions within and between systems relevant to the problem.

Learning Goal	Proficiency Scales
Students will be able to solve real world problems by using scientific method and engineering design process	4: Student demonstrates an in-depth inference or advanced application or innovates with the learning goal. 3: Student demonstrates mastery with the learning goal as evidenced by: ● Formulate a testable hypothesis ● Identify constants and variables in an investigation ● Determine the appropriate tools and techniques to collect, analyze, and interpret data ● Determine scientific conclusion based on observations ● Identify factors required to make investigative results reliable ● Analyze quantitative data ● Design scientific investigations consisting of at least three steps ● Explain why accurate records and replications are essential for experimental credibility (includes peer review) ● Communicate procedures and results of investigations 2: Student demonstrates he/she is nearing proficiency by: ● Select appropriate investigation methods (techniques

	only) ● Use data to formulate an explanation ● Calculate average/mean for sets of data ● Identify possible effects of errors in data collection and calculations ● Identify a valid conclusion in an experiment ● Use simple tools to measure length, mass, and volume ● Communicate basic information from an experiment ● Construct a simple graph of independent variable versus dependent variable from given data 1: Student demonstrates a limited understanding or skill with the learning goal.

Photosynthesis/Cellular Respiration

Missouri Grade-Level Expectations (or other standards)

LS1.C.1 - Use a model to demonstrate how photosynthesis transforms light energy into stored chemical energy.
LS1.C.2 - Use a model to demonstrate that cellular respiration is a chemical process whereby the bonds of molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy.

Overarching standards:
LS2.B.1 - Construct and revise an explanation based on evidence that the processes of photosynthesis, chemosynthesis, and aerobic and anaerobic respiration are responsible for the cycling of matter and flow of energy through ecosystems and that environmental conditions restrict which reactions can occur.

Learning Goal	Proficiency Scales
Students will be able to explain how energy is transferred via chemical reactions of photosynthesis and respiration within the cell's organelles.	4: Student demonstrates an in-depth inference or advanced application or innovates with the learning goal. 3: Student demonstrates mastery with the learning goal as evidenced by: ● Explain the chemical and physical interactions between organelles as they carry out life processes

	● Explain interrelationships between photosynthesis and respiration (reactant and product only) ● Determine factors that affect the processes of photosynthesis and respiration (excludes light intensity) 2: Student demonstrates he/she is nearing proficiency by: ● Identify and describe cell structures and functions ● Define organelles by their functions 1: Student demonstrates a limited understanding or skill with the learning goal.

Macromolecules

Missouri Grade-Level Expectations (or other standards)
LS1.C.3 - Construct and revise an explanation based on evidence that organic macromolecules are primarily composed of six elements, where carbon, hydrogen, and oxygen atoms may combine with nitrogen, sulfur, and phosphorus to form large carbon-based molecules.

Learning Goal	Proficiency Scales
Students will be able to use the atomic to molecular scale to explain how biological structures and chemical reactions take place.	4: Student demonstrates an in-depth inference or advanced application or innovates with the learning goal. 3: Student demonstrates mastery with the learning goal as evidenced by: ● Explain how the carbon, hydrogen, and oxygen atoms found in sugar molecules can be rearranged to create other large carbon-based molecules. 2: Student demonstrates he/she is nearing proficiency by: ● Identify that sugars, amino acids, and other complex

	carbon-based molecules are composed largely of carbon, hydrogen, and oxygen atoms. 1: Student demonstrates a limited understanding or skill with the learning goal.

Evolution

Missouri Grade-Level Expectations (or other standards)

LS4.A.1 - Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.
LS4.A.2 - Analyze displays of pictorial data to compare patterns of similarities in the embryological development across multiple species to identify relationships not evident in the fully formed anatomy.
LS4.B.1 - Construct an explanation based on evidence that the process of evolution primarily results from four factors: (1) the potential for a species to increase in number, (2) the heritable genetic variation of individuals in a species due to mutation and sexual reproduction, (3) competition for limited resources, and (4) the proliferation of those organisms that are better able to survive and reproduce in the environment.
LS4.B.2 - Apply concepts of statistics and probability to support explanations that organisms with an advantageous heritable trait tend to increase in proportion to organisms lacking this trait.
LS4.C.1 - Construct an explanation based on evidence for how natural selection leads to adaptation of populations.
LS4.C.2 - Evaluate the evidence supporting claims that changes in environmental conditions may result in (1) increases in the number of individuals of some species, (2) the emergence of new species over time, and (3) the extinction of other species.

Overarching standards:
LS4.C.3 - Create or revise a model to test a solution to mitigate adverse impacts of human activity on biodiversity.

Learning Goal	Proficiency Scales
Students will be able to use biological evidence to understand and support the concept that the process of natural selection leads to adaptations.	4: Student demonstrates an in-depth inference or advanced application or innovates with the learning goal. 3: Student demonstrates mastery with the learning goal as evidenced by: ● Explain the natural and/or human factors that may lead to the extinction of a species ● Given a scenario describing an environmental change,

	hypothesize why a given species was unable to survive 2: Student demonstrates he/she is nearing proficiency by: ● Explain how environmental factors can be agents of natural selection ● Explain the importance of reproduction to the survival of a species ● Identify the impact a natural environmental event may have on the diversity of different species in an ecosystem 1: Student demonstrates a limited understanding or skill with the learning goal.

Ecology

Missouri Grade-Level Expectations (or other standards)

LS2.A.1 - Explain how various biotic and abiotic factors affect the carrying capacity and biodiversity of an ecosystem using mathematical and/or computational representations.
LS2.B.1 - Construct and revise an explanation based on evidence that the processes of photosynthesis, chemosynthesis, and aerobic and
anaerobic respiration are responsible for the cycling of matter and flow of energy through ecosystems and that environmental
conditions restrict which reactions can occur.
LS2.B.2 - Communicate the pattern of the cycling of matter and the flow of energy among trophic levels in an ecosystem.
LS2.B.3 - Use a model that illustrates the roles of photosynthesis, cellular respiration, decomposition, and combustion to explain the cycling of carbon in its various forms among the biosphere, atmosphere, hydrosphere, and geosphere.
LS2.C.1 - Evaluate the claims, evidence, and reasoning that the interactions in ecosystems maintain relatively consistent populations of species while conditions remain stable, but changing conditions may result in new ecosystem dynamics.
LS2.C.2 - Design, evaluate, and/or refine solutions that positively impact the environment and biodiversity.
LS4.C.3 - Create or revise a model to test a solution to mitigate adverse impacts of human activity on biodiversity.

Overarching standards:
LS1.A.3 - Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.
LS1.C.2 - Use a model to demonstrate that cellular respiration is a chemical process whereby the bonds of molecules are broken and the bonds in new compounds are formed resulting in a net transfer of energy.
LS1.C.3 - Construct and revise an explanation based on evidence that organic macromolecules are primarily composed

of six elements, where carbon, hydrogen, and oxygen atoms may combine with nitrogen, sulfur, and phosphorus to form large carbon-based molecules.

Learning Goal	Proficiency Scales
Students will be able to analyze the interaction of biotic and abiotic factors, including human induced effects.	4: Student demonstrates an in-depth inference or advanced application or innovates with the learning goal. 3: Student demonstrates mastery with the learning goal as evidenced by: ● Identify and explain limiting factor that affect carrying capacity ● Describe how natural environmental events impact diversity ● Explain impact human activity on diversity of different species ● Predict energy flow in food web 2: Student demonstrates he/she is nearing proficiency by: ● Explain how interactions within ecosystems maintain balance ● Explain relationships predator/prey and symbiosis ● Define carrying capacity ● Explain importance of reproduction to survival. 1: Student demonstrates a limited understanding or skill with the learning goal.

DNA Structure and Protein Synthesis

Missouri Grade-Level Expectations (or other standards)

LS1.A.1 - Construct a model of how the structure of DNA determines the structure of proteins which carry out the essential functions of life through systems of specialized cells.

Learning Goal	Proficiency Scales
Students will be able to model how DNA structure determines protein structure and function.	4: Student demonstrates an in-depth inference or advanced application or innovates with the learning goal. 3: Student demonstrates mastery with the learning goal as evidenced by: ● Describe the chemical and structural properties of DNA ● Recognize that DNA codes for proteins, which are expressed as the heritable characteristics of an organism ● Identify the causes of mutations in DNA and explain the possible effects on the organism 2: Student demonstrates he/she is nearing proficiency by: ● Identify and describe cell structures and functions ● Define organelles by their functions ● Identify that all living organisms have DNA ● Identify that DNA carries inherited information 1: Student demonstrates a limited understanding or skill with the learning goal.

Cell Transport and Communication

Missouri Grade-Level Expectations (or other standards)

LS1.A.2 - Develop and use a model to illustrate the hierarchical organization of interacting systems that provide specific functions within multicellular organisms.
LS1.A.3 - Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.
LS1.B.1 - Develop and use models to communicate the role of mitosis, cellular division, and differentiation in producing and maintaining complex organisms. (*here focus on DIFFERENTIATION)*

Learning Goal	Proficiency Scales
Students will be able to develop and use models to communicate the role of mitosis, cell division, and differentiation in producing and maintaining the organ systems of complex organisms.	4: Student demonstrates an in-depth inference or advanced application or innovates with the learning goal. 3: Student demonstrates mastery with the learning goal as evidenced by: ● Identify cell differentiation ● Identify homeostasis and its effect on cellular activities 2: Student demonstrates he/she is nearing proficiency by: ● Explain how water is important to cells 1: Student demonstrates a limited understanding or skill with the learning goal.

Cell Division and Genetics

Missouri Grade-Level Expectations (or other standards)

LS1.B.1 - Develop and use models to communicate the role of mitosis, cellular division, and differentiation in producing and maintaining complex organisms. (*focus on MITOSIS within this unit).*
LS3.A.1 - Develop and use models to clarify relationships about how DNA in the form of chromosomes is passed from parents to offspring through the processes of meiosis and fertilization in sexual reproduction.
LS3.B.1 - Compare and contrast asexual and sexual reproduction with regard to genetic information and variation in offspring.
LS3.B.2 - Develop and use a model to describe why structural changes to genes (mutations) located on chromosomes may affect proteins and may result in harmful, beneficial, or neutral effects to the structure and function of the organism.
LS3.B.3 - Make and defend a claim that inheritable genetic variations may result from: (1) new genetic combinations through meiosis, (2) mutations occurring during replication, and/or (3) mutations caused by environmental factors.
LS3.B.4 - Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.

Learning Goal	Proficiency Scales
Students will be able to identify the	

processes of genetic inheritance and how genetic recombination and mutations create variation within a species.	4: Student demonstrates an in-depth inference or advanced application or innovates with the learning goal. 3: Student demonstrates mastery with the learning goal as evidenced by: ● Compare the processes of mitosis and meiosis (excludes identification of steps) ● Explain the advantages and disadvantages of sexual and asexual reproduction within a population ● Identify diploid and haploid chromosome number ● Explain how daughter cells compare to the original parent cell ● Explain how genotypes contribute to phenotypic variation within a species 2: Student demonstrates he/she is nearing proficiency by: ● Use a Punnett square to show a simple monohybrid cross ● Identify that DNA carries inherited information 1: Student demonstrates a limited understanding or skill with the learning goal.