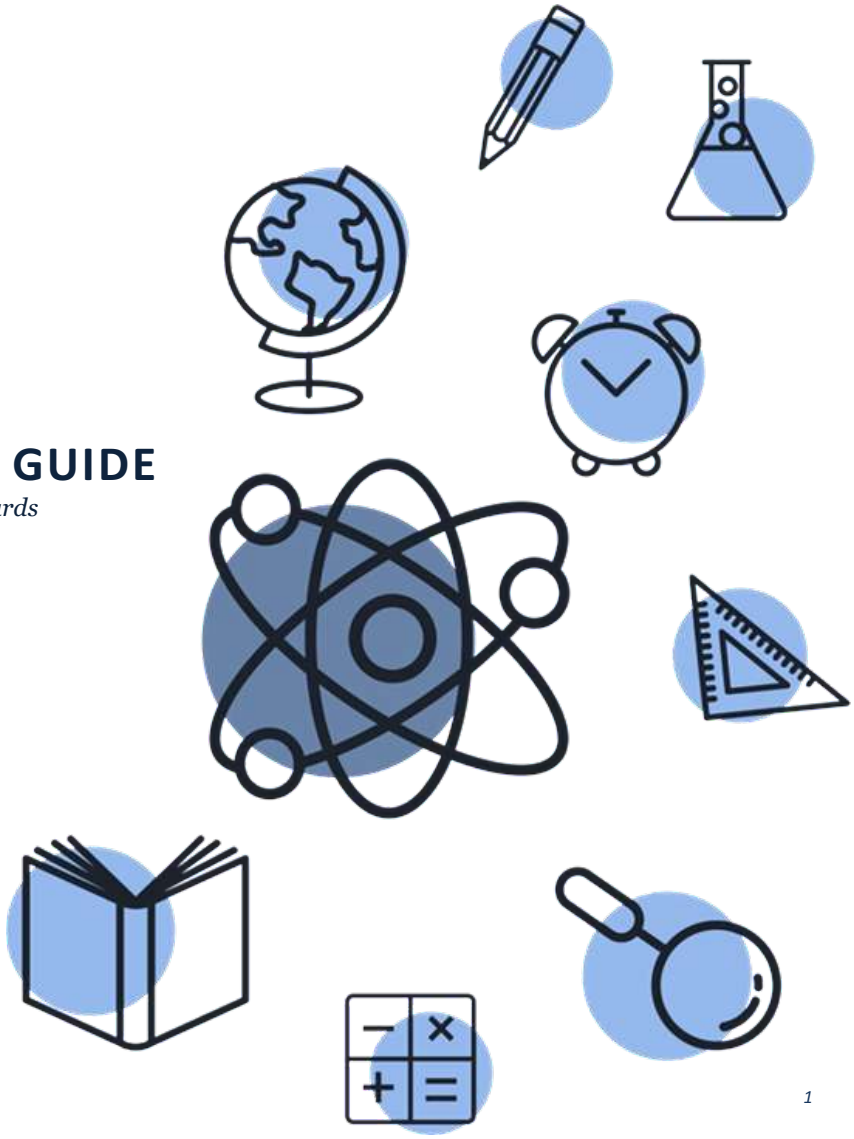
MISSISSIPPI DEPARTMENT OF EDUCATION

SUGGESTED
INSTRUCTIONAL PLANNING GUIDE

for the Mississippi College- and Career-Readiness Standards

▼ SCIENCE

BIOLOGY



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INTRODUCTION

The unprecedented, nationwide school closures in the spring of 2020 due to the COVID-19 pandemic have created a shift in how districts plan for school re-entry. Instead of the traditional brick-and-mortar planning, administrators are now identifying models that will support a variety of instructional delivery scenarios as they plan for school reopening. The traditional methods of planning and delivery are nearly impossible to implement as a stand-alone model; instead, innovative educators are developing and identifying strategies and resources to support a variety of distance learning scenarios as part of their plans. When using new models of delivery, it is important to recognize that the traditional approach to remediation—providing work better suited for earlier grades—may be insufficient. Instead, the conventional approach to remediation will likely compound the problem educators are trying to correct. According to a 2018 study, The Opportunity Myth[1], the approach of "meeting students where they are" while often well-intended, only widens the achievement gap. Instead of remediation, teachers and administrators are encouraged to look toward acceleration methods to support student growth and close the gaps.

[1] https://tntp.org/assets/documents/TNTP_The-Opportunity-Myth_Web.pdf

PURPOSE

The purpose of the Suggested Mississippi College- and Career-Readiness Standards Instructional Planning Guide is to provide teachers with an assistive tool for planning units of instruction. This tool will provide suggested standards grouping that should facilitate a coherent and logical delivery of related science concepts. Suggested planning sources and tools are included to assist teachers with curating instructional materials, designing and implementing effective lessons and activities, and building content knowledge and pedagogical practices. This tool encourages instructors to maintain a focus on preparing students to master skills and acquire knowledge at their current grade level.

DEVELOPMENT

The following suggested Instructional Planning Guide was developed with a focus on the subsequent key areas, Conceptual Connections, Real-World Connections and Phenomena, Embedded Science and Engineering Practices and Crosscutting Concepts, and Core Vocabulary. The standards are grouped into suggested units based on their underlying conceptual relationships. A list of real-world connections and/or phenomena is associated with each unit group. Their purpose is to give teachers and students researchable opportunities that lead to an in-depth and authentic quest for conceptual understanding. The embedded Science and Engineering Practices (SEPs) and Crosscutting Concepts (CCCs) are extracted from the grouped performance objectives and should encourage students to act and think like scientists. The included list of SEPs and CCCs does not indicate that other SEPs and CCCs are not relevant to the respective standard and performance objectives. Core vocabulary terms are included to emphasize terminology that is essential to the conceptual understandings captured in the standards and performance objectives. It is suggested that instructors pace themselves based on student assessment performance and demonstration of skill mastery and knowledge comprehension.

RESOURCES for CONSIDERATION

The resources listed below may be referenced to support classroom teachers in the development of lesson plans and instruction at the local level. This list is not meant to be exhaustive, rather it represents consultative resources that align with the Units/Themes provided in the Instructional Planning Guides. Educators are encouraged to use these resources in addition to those curriculum materials that meet the needs of the students they serve.

High-Quality Instructional Material (HQIM)	Planning and Instruction Resources	Assessment Resources	Professional Development Resources
Adopted Science Texts	5 E Science Instructional Model	MS MAAP Program	MDE Professional Development
STEM Teaching Tools	The Concord Consortium	MS MAAP-A Program	The Teaching Channel
	PBS Learning Media	Access for All Guidance	California Academy of Sciences
	Teacher Tube	Problem-Attic	Teacher Tube
	Next Generation Science Standards	EDInformatics	Knowles Teacher Short Courses
	Phenomena for Next Generation Science	STEM Teaching Tools for Assessments	STEM Teaching Tools OER PD
	Khan Academy	Next Generation Science Assessment (Middle Focus)	
	OpenSciEd		
	Science Buddies		
	PhET Interactive Simulations		
	Phenomenal GRC Lessons		

BIOLOGY

UNIT OF STUDY (REAL-WORLD CONNECTIONS and PHENOMENA) ▼	SCIENCE FOUNDATION STANDARDS ▼	SCIENCE AND ENGINEERING PRACTICES SCIENCE CROSSCUTTING CONCEPTS ▼	VOCABULARY TERMS CORE ACADEMIC ▼
COURSE INTRODUCTION Biology, a one-credit course, is a laboratory-based course that is designed to build a life science foundation emphasizing patterns, processes, and interactions among organisms. Students are expected to master conceptual understandings based on both individual investigations and the investigations conducted by others. Individual learning experiences are used to support claims and engage in evidence-based arguments. In this way, students explore the organization of life; the interdependence between organisms and their environment; the chemical composition of life; the role of DNA, RNA, and protein in cellular structure and function; inheritance; and evolution. Local resources coupled with external resources, including evidence-based literature, will be used to extend and increase the complexity of these core ideas. As a laboratory-based course, students are expected to utilize science and engineering practices to design and conduct investigations using appropriate equipment, measurement (SI units), and safety procedures. Students should also design data tables and draw conclusions using mathematical computations and/or graphical analysis. The recommendation is that students should be actively engaged in inquiry activities, lab experiences, and scientific research (projects) for a minimum of 30% of class time.	**FOUNDATION STANDARDS** ☐ Identify and select appropriate science and engineering tools to collect, analyze, and communicate science and engineering data and information. ☐ Demonstrate effective questioning and observation skills ☐ Communicate science and engineering data using appropriate SI units of measurement ☐ Identify and discuss science and engineering practices ☐ Identify and discuss Crosscutting Concepts **OVERARCHING (start to finish) SEPs for INQUIRY EXTENSION of LABS** Ask questions to generate hypotheses for scientific investigations based on empirical evidence and observations and/or ask questions to clarify or refine models, explanations, or designs. Plan and conduct controlled scientific investigations to produce data to answer questions, test hypotheses and predictions, and develop explanations or evaluate design solutions, which require the following: ☐ Identify dependent and independent variables and appropriate controls ☐ Select and use appropriate tools or instruments to collect data and represent data in an appropriate form ☐ Analyze and interpret various types of data sets, using appropriate mathematic to verify or refute hypothesis or determine an optimal design solution ☐ Construct an explanation of observed relationships between variables ☐ Communicate scientific and/or technical information in various formats.	**SCIENCE and ENGINEERING PRACTICES** ☐ Ask Question and Define Problems ☐ Develop and Use Models ☐ Analyze and Interpret Data ☐ Plan and Conduct Investigations ☐ Use Mathematical and Computational Thinking ☐ Construct Explanations and Design Solutions ☐ Engage in Scientific Argument from Evidence ☐ Obtain, Evaluate, and Communicate Information **SCIENCE CROSSCUTTING CONCEPTS** ☐ Patterns ☐ Cause and Effect *(Mechanism and Explanation)* ☐ Scale, Proportion, and Quantity ☐ Systems and System Models ☐ Energy and Matter *(Flows, Cycles, Conservation)* ☐ Structure and Function ☐ Stability and Change	Argument Change Concepts Data Dependent Variable Engineering Evaluate Evidence Gram Independent Variable Interpret Investigation Liter Meter Observation Patterns Quantity Science SI Units of Measurement Stability

TERM 1

UNIT OF STUDY (REAL-WORLD CONNECTIONS and PHENOMENA) ▼	MS CCR STANDARDS ▼	SCIENCE AND ENGINEERING PRACTICES SCIENCE CROSSCUTTING CONCEPTS ▼	VOCABULARY TERMS CORE ACADEMIC ▼
CELLS and a SYSTEM: **Cell Theory and Living Things** **REAL-WORLD CONNECTIONS and PHENOMENA** Model and discuss what is seen when samples of substances (fruits, plants leaves, cheek swab) are viewed under a microscope. Research making organs with 3D Printing.	**BIO.1A Students will demonstrate an understanding of the characteristics of life and biological organization.** **BIO.1A.**1 Develop criteria to differentiate between living and non-living things. **BIO.1A.2** Describe the tenets of cell theory and the contributions of Schwann, Hooke, Schleiden, and Virchow. **BIO.1A.3** Using specific examples, explain how cells can be organized into complex tissues, organs, and organ systems in multicellular organisms. **BIO.1A.4** Use evidence from current scientific literature to support whether a virus is living or non-living.	**EMBEDDED SCIENCE and ENGINEERING PRACTICES** Ask Question and Define Problems Develop and Use Models Engage in Scientific Argument from Evidence Obtain, Evaluate, and Communicate Information **EMBEDDED CROSSCUTTING CONCEPTS** Patterns Scale, Proportion, and Quantity Systems and System Models Structure and Function	Cell Organelle Cell Theory Eukaryote Homeostasis Law Prokaryote Scientific Claim Virus Bacteria
CELLS and a SYSTEM: **Cell Structures and Functions** **REAL-WORLD CONNECTIONS and PHENOMENA** Research viruses and explain how they function in comparison to animal and plant cells. While viewing cells using science tools or various forms of media, you recognize organelles. Discuss their actions and roles in sustaining the cell.	**BIO.1C Students will relate the diversity of organelles to a variety of specialized cellular functions.** **BIO.1C.1** Develop and use models to explore how specialized structures within cells (e.g., nucleus, cytoskeleton, endoplasmic reticulum, ribosomes, Golgi apparatus, lysosomes, mitochondria, chloroplast, centrosomes, and vacuoles) interact to carry out the functions necessary for organism survival. **BIO.1C.2** Investigate to compare and contrast prokaryotic cells and eukaryotic cells, and plant, animal, and fungal cells. **BIO.1C.3** Contrast the structure of viruses with that of cells and explain why viruses must use living cells to reproduce.	**EMBEDDED SCIENCE and ENGINEERING PRACTICES** Ask Question and Define Problems Develop and Use Models Plan and Conduct Investigations **EMBEDDED CROSSCUTTING CONCEPTS** Patterns Cause and Effect *(Mechanism and Explanation)* Structure and Function Stability and Change	Cell Membrane Cell Wall Mitochondria Chloroplast Nucleus Organelle Ribosome Vacuole Golgi Body Lysosome Endoplasmic Reticulum
CELLS and a SYSTEM: **Essential Macromolecules** **REAL-WORLD CONNECTIONS and PHENOMENA** Research the importance and the impact of regulating triglycerides (lipids) levels Research Gaucher Disease and Enzyme Replacement Therapy.	**BIO.1B Students will analyze the structure and function of the macromolecules that make up cells.** **BIO.1B.1** Develop and use models to compare and contrast the structure and function of carbohydrates, lipids, proteins, and nucleic acids (DNA and RNA) in organisms. **BIO.1B.2** Plan and conduct investigations to determine how enzymes react given various environmental conditions (i.e., pH, temperature, and concentration). Analyze, interpret, graph, and present data to explain how those changing conditions affect the enzyme activity and the rate of the reactions that take place in biological organisms.	**EMBEDDED SCIENCE and ENGINEERING PRACTICES** Develop and Use Models Analyze and Interpret Data Plan and Conduct Investigations **EMBEDDED CROSSCUTTING CONCEPTS** Patterns Cause and Effect *(Mechanism and Explanation)* Structure and Function Stability and Change	Carbohydrate Enzyme Fatty Acids Lipid Monomer Nucleic Acid Polymer Protein
CELLS and a SYSTEM: **Cellular Transport** **REAL-WORLD CONNECTIONS and PHENOMENA** Observe wilted celery in water and discuss osmotic flow of water. Examine media or investigate results of salt solutions and increased salinity in soils on plant life	**BIO.1D Students will describe the structure of the cell membrane and analyze how the structure is related to its primary function of regulating transport in and out of cells to maintain homeostasis.** **BIO.1D.1** Plan and conduct investigations to prove that the cell membrane is a semi-permeable, allowing it to maintain homeostasis with its environment through active and passive transport processes. **BIO.1D.2** Develop and use models to explain how the cell deals with imbalances of solute concentration across the cell membrane (i.e., hypertonic, hypotonic, and isotonic conditions, sodium/potassium pump).	**EMBEDDED SCIENCE and ENGINEERING PRACTICES** Ask Question and Define Problems Develop and Use Models Plan and Conduct Investigations **EMBEDDED CROSSCUTTING CONCEPTS** Cause and Effect *(Mechanism and Explanation)* Structure and Function Stability and Change	Active Transport Diffusion Homeostasis Metabolism Osmosis Passive Transport Semi-Permeable (selectively permeable)

TERM 2

UNIT OF STUDY (REAL-WORLD CONNECTIONS and PHENOMENA) ▼	MS CCR STANDARDS ▼	SCIENCE AND ENGINEERING PRACTICES SCIENCE CROSSCUTTING CONCEPTS ▼	VOCABULARY TERMS CORE ACADEMIC ▼
ENERGY TRANSFER: **Photosynthesis and Cellular Respiration** **REAL-WORLD CONNECTIONS and PHENOMENA** ☐ Research and explain the fermenting process as it relates to rotting or spoiling fruits and how might this impact the environment. **BIO.2.5 Enrichment:** Investigate variables (e.g., nutrient availability, temperature) that affect anaerobic respiration and current real-world applications of fermentation. **BIO.2.6 Enrichment:** Use an engineering design process to manipulate factors involved in fermentation to optimize energy production. * **All SEPs and CCCs are applicable.**	**BIO.2 Students will explain that cells transform energy through the processes of photosynthesis and cellular respiration to drive cellular functions.** **BIO.2.1** Use models to demonstrate that ATP and ADP are cycled within a cell as a means to transfer energy. **BIO.2.2** Develop models of the major reactants and products of photosynthesis to demonstrate the transformation of light energy into stored chemical energy in cells. Emphasize the chemical processes in which bonds are broken and energy is released, and new bonds are formed and energy is stored. **BIO.2.3** Develop models of the major reactants and products of cellular respiration (aerobic and anaerobic) to demonstrate the transformation of the chemical energy stored in food to the available energy of ATP. Emphasize the chemical processes in which bonds are broken and energy is released, and new bonds are formed, and energy is stored. **BIO.2.4** Conduct scientific investigations or computer simulations to compare aerobic and anaerobic cellular respiration in plants and animals, using real world examples.	**EMBEDDED SCIENCE and ENGINEERING PRACTICES** ☐ Ask Question and Define Problems ☐ Develop and Use Models ☐ Plan and Conduct Investigations **EMBEDDED CROSSCUTTING CONCEPTS** ☐ Patterns ☐ Cause and Effect *(Mechanism and Explanation)* ☐ Energy and Matter *(Flows, Cycles, Conservation)* ☐ Structure and Function ☐ Stability and Change	Adenosine Triphosphate Aerobic Cellular Respiration Anaerobic Cellular Respiration Cellular Respiration Electron Transport Chain Glucose Glycolysis Krebs Cycle Light-Dependent Reactions Light-Independent Reactions (Calvin Cycle) Photosynthesis Reactant
CELL as a SYSTEM: **Cellular Growth and Division** **REAL-WORLD CONNECTIONS and PHENOMENA** ☐ Research epimorphic regeneration in amphibians and gather information on studies in mammals **BIO.1E.4 Enrichment:** Use an engineering design process to investigate the role of stem cells in regeneration and asexual reproduction, then develop applications of stem cell research to solve human medical conditions. * **All SEPs and CCCs are applicable.**	**BIO.1E Students will develop and use models to explain the role of the cell cycle during growth, development, and maintenance in multicellular organisms.** **BIO.1E.1** Develop models to explain how the processes of cell division and cell differentiation produce and maintain complex multicellular organisms. **BIO.1E.2** Identify and describe the changes that occur in a cell during replication. Explore problems that might occur if the cell does not progress through the cycle correctly (cancer). **BIO.1E.3** Relate the processes of cellular reproduction to asexual reproduction in simple organisms (i.e., budding, vegetative propagation, regeneration, binary fission). Explain why the DNA of the daughter cells is the same as the parent cell.	**EMBEDDED SCIENCE and ENGINEERING PRACTICES** ☐ Ask Question and Define Problems ☐ Develop and Use Models ☐ Analyze and Interpret Data ☐ Plan and Conduct Investigations **EMBEDDED CROSSCUTTING CONCEPTS** ☐ Patterns ☐ Cause and Effect *(Mechanism and Explanation)* ☐ Structure and Function ☐ Stability and Change	Anaphase Binary Fission Cancer Cell Cycle Cytokinesis DNA Replication Interphase Metaphase Mitosis Prophase Somatic Cell Stem Cell Telophase
REPRODCUCTION and HEREDITY: **Meiosis** **REAL-WORLD CONNECTIONS and PHENOMENA** ☐ Research and investigate genetic conditions such as genetically related diseases. ☐ Obtain and evaluate statistical data that give insight on the types and kinds of genetic diseases in Mississippi and discuss what current works are being done to combat such conditions.	**BIO.3A Students will develop and use models to explain the role of meiosis in the production of haploid gametes required for sexual reproduction.** **BIO.3A.1** Model sex cell formation (meiosis) and combination (fertilization) to demonstrate the maintenance of chromosome number through each generation in sexually reproducing populations. Explain why the DNA of the daughter cells is different from the DNA of the parent cell. **BIO.3A.2** Compare and contrast mitosis and meiosis in terms of reproduction. **BIO.3A.3** Investigate chromosomal abnormalities (e.g., Down syndrome, Turner Syndrome, and Klinefelter syndrome) that might arise from errors in meiosis (nondisjunction) and how these abnormalities are identified (karyotypes).	**EMBEDDED SCIENCE and ENGINEERING PRACTICES** ☐ Ask Question and Define Problems ☐ Develop and Use Models ☐ Plan and Conduct Investigations ☐ Obtain, Evaluate, and Communicate Information **EMBEDDED CROSSCUTTING CONCEPTS** ☐ Patterns ☐ Cause and Effect *(Mechanism and Explanation)* ☐ Structure and Function ☐ Stability and Change	Allele Cell Cycle Chromosome Crossing Over Diploid Gametes Genetic Modification Haploid Meiosis Mutation Spore Trait

TERM 2

UNIT OF STUDY (REAL-WORLD CONNECTIONS and PHENOMENA) ▼	MS CCR STANDARDS ▼	SCIENCE AND ENGINEERING PRACTICES SCIENCE CROSSCUTTING CONCEPTS ▼	VOCABULARY TERMS CORE ACADEMIC ▼
REPRODCUCTION and HEREDITY: **The Central Dogma and DNA Technology** **REAL-WORLD CONNECTIONS and PHENOMENA** ☐ Discuss instances of genetic modification in animals and humans. Explore the CRISPR-Cas9 technology and the associated ethical and beneficial aspects. **BIO.3C.5 Enrichment:** Investigate current biotechnological applications in the study of the genome (e.g., transcriptome, proteome, individualized sequencing, and individualized gene therapy). **All SEPs and CCCs are applicable.**	**BIO.3C Students will construct an explanation based on evidence to describe how the structure and nucleotide base sequence of DNA determines the structure of proteins or RNA that carry out essential functions of life.** **BIO.3C.1** Develop and use models to explain the relationship between DNA, genes, and chromosomes in coding the instructions for the traits transferred from parent to offspring. **BIO.3C.2** Evaluate the mechanisms of transcription and translation in protein synthesis. **BIO.3C.3** Use models to predict how various changes in the nucleotide sequence (e.g., point mutations, deletions, and additions) will affect the resulting protein product and the subsequent inherited trait. **BIO.3C.4** Research and identify how DNA technology benefits society. Engage in scientific argument from evidence over the ethical issues surrounding the use of DNA technology (e.g., cloning, transgenic organisms, stem cell research, and the Human Genome Project, gel electrophoresis).	**EMBEDDED SCIENCE and ENGINEERING PRACTICES** ☐ Ask Question and Define Problems ☐ Develop and Use Models ☐ Plan and Conduct Investigations ☐ Obtain, Evaluate, and Communicate Information **EMBEDDED CROSSCUTTING CONCEPTS** ☐ Patterns ☐ Cause and Effect *(Mechanism and Explanation)* ☐ Structure and Function ☐ Stability and Change	Adenine Chromosome Codon Cytosine Double Helix Frameshift Mutation Gene Genetic Disorder Guanine Histone Messenger RNA (mRNA) Mutagen Nitrogen Base Nucleic Acid Nucleotide Peptide Bond Phosphate Point Mutation Ribosomal RNA Thymine Transcription Transfer RNA (tRNA) Translation Uracil

TERM 3

UNIT OF STUDY (REAL-WORLD CONNECTIONS and PHENOMENA) ▼	MS CCR STANDARDS ▼	SCIENCE AND ENGINEERING PRACTICES SCIENCE CROSSCUTTING CONCEPTS ▼	VOCABULARY TERMS CORE ACADEMIC ▼
REPRODCUCTION and HEREDITY: **Genetic Probability and Variation** **REAL-WORLD CONNECTIONS and PHENOMENA** ☐ Research sex-linked conditions, cataracts, male-pattern baldness, colorblindness, for example. Trace genetic condition in one's own pedigree if possible. ☐ Research variation in animal offspring. Discuss variations by evaluating phenotypes of parents and offspring. ☐ Explore the idea of designer pets and how this lends to a conversation about designing people. Discuss ethical considerations.	**BIO.3B Students will analyze and interpret data collected from probability calculations to explain the variation of expressed traits within a population.** **BIO.3B.1** Demonstrate Mendel's law of dominance and segregation using mathematics to predict phenotypic and genotypic ratios by constructing Punnett squares with both homozygous and heterozygous allele pairs. **BIO.3B.2** Illustrate Mendel's law of independent assortment using Punnett squares and/or the product rule of probability to analyze monohybrid crosses. **BIO.3B.3** Investigate traits that follow non-Mendelian inheritance patterns (e.g., incomplete dominance, codominance, multiple alleles in human blood types, and sex-linkage). **BIO.3B.4** Analyze and interpret data (e.g., pedigrees, family, and population studies) regarding Mendelian and complex genetic traits (e.g., sickle-cell anemia, cystic fibrosis, muscular dystrophy, color-blindness, and hemophilia) to determine patterns of inheritance and disease risk.	**EMBEDDED SCIENCE and ENGINEERING PRACTICES** ☐ Ask Question and Define Problems ☐ Develop and Use Models ☐ Analyze and Interpret Data ☐ Plan and Conduct Investigations ☐ Use Mathematical and Computational Thinking ☐ Engage in Scientific Argument from Evidence ☐ Obtain, Evaluate, and Communicate Information **EMBEDDED CROSSCUTTING CONCEPTS** ☐ Patterns ☐ Cause and Effect *(Mechanism and Explanation)* ☐ Scale, Proportion, and Quantity ☐ Systems and System Models ☐ Energy and Matter *(Flows, Cycles, Conservation)* ☐ Structure and Function ☐ Stability and Change	Allele Codominance Crossing Over Dihybrid Cross Diploid Genetic Modification Genotype Haploid Heterozygous Homozygous Incomplete Dominance Inheritance Monohybrid Cross Phenotype Polygenic Recessive Sex-linked Trait
ADAPTATIONS and EVOLUTION: **Common Ancestry and Evolution** **REAL-WORLD CONNECTIONS and PHENOMENA** ☐ Discuss current examples of evolution by examining information about antibiotic resistant bacteria. ☐ Review historical information or media to evaluate past and present versions of animals such as elephants, birds, and lizards. Discuss possible causes for changes in physical and genetic structure.	**BIO.4 Students will analyze and interpret evidence to explain the unity and diversity of life.** **BIO.4.1** Use models to differentiate between organic and chemical evolution, illustrating the steps leading to aerobic heterotrophs and photosynthetic autotrophs. **BIO.4.2** Evaluate empirical evidence of common ancestry and biological evolution, including comparative anatomy (e.g., homologous structures and embryological similarities), fossil record, molecular/biochemical similarities (e.g., gene and protein homology), and biogeographic distribution. **BIO.4.3** Construct cladograms/phylogenetic trees to illustrate relatedness between species.	**EMBEDDED SCIENCE and ENGINEERING PRACTICES** ☐ Ask Question and Define Problems ☐ Develop and Use Models ☐ Analyze and Interpret Data ☐ Engage in Scientific Argument from Evidence ☐ Obtain, Evaluate, and Communicate Information **EMBEDDED CROSSCUTTING CONCEPTS** ☐ Patterns ☐ Cause and Effect *(Mechanism and Explanation)* ☐ Structure and Function ☐ Stability and Change	Anatomical Homologies Ancestry Biogeography Developmental Homologies Evolution Fossil Record Gradualism Homology (homologies) Molecular Homologies Punctuated Equilibrium Speciation Stasis
ADAPTATIONS and EVOLUTION: **Natural Selection and Adaptation** **REAL-WORLD CONNECTIONS and PHENOMENA** ☐ Review and research instances where organisms adapt and survive such as the silent Hawaiian Cricket. ☐ Examine the relationship between skin color and geographic location and provide an explanation that relates to geographical segregation and adaptations. .	**BIO.4 Students will analyze and interpret evidence to explain the unity and diversity of life.** **BIO.4.4** Design models and use simulations to investigate the interaction between changing environments and genetic variation in natural selection leading to adaptations in populations and differential success of populations. **BIO.4.5** Use Darwin's Theory to explain how genetic variation, competition, overproduction, and unequal reproductive success acts as driving forces of natural selection and evolution. **BIO.4.6** Construct explanations for the mechanisms of speciation (e.g., geographic and reproductive isolation). **BIO.4.7 Enrichment:** Construct explanations for how various disease agents (bacteria, viruses, chemicals) can influence natural selection	**EMBEDDED SCIENCE and ENGINEERING PRACTICES** ☐ Ask Question and Define Problems ☐ Develop and Use Models ☐ Analyze and Interpret Data ☐ Plan and Conduct Investigations ☐ Engage in Scientific Argument from Evidence ☐ Obtain, Evaluate, and Communicate Information **EMBEDDED CROSSCUTTING CONCEPTS** ☐ Patterns ☐ Cause and Effect *(Mechanism and Explanation)* ☐ Stability and Change	Adaptation Biodiversity Biological Fitness Charles Darwin Genetic Variation Limiting Factor Natural Selection Overpopulation Population Reproductive Success Subspecies

TERM 4

UNIT OF STUDY (REAL-WORLD CONNECTIONS and PHENOMENA) ▼	MS CCR STANDARDS ▼	SCIENCE AND ENGINEERING PRACTICES SCIENCE CROSSCUTTING CONCEPTS ▼	VOCABULARY TERMS CORE ACADEMIC ▼
INTERDEPENDENCE of ORGANISMS and THEIR ENVIRONMENTS: **Cycling of Matter** **REAL-WORLD CONNECTIONS and PHENOMENA** Discuss the impact of nitrogen on the sustainability of organisms and their environments. Research how global warming is affecting various ecological and environmental aspects such as weather and climate, the ice lands.	BIO.5 **Students will Investigate and evaluate the interdependence of living organisms and their environment.** **BIO.5.1** Illustrate levels of ecological hierarchy, including organism, population, community, ecosystem, biome, and biosphere. **BIO.5.2** Analyze models of the cycling of matter (e.g., carbon, nitrogen, phosphorus, and water) between abiotic and biotic factors in an ecosystem and evaluate the ability of these cycles to maintain the health and sustainability of the ecosystem. **BIO.5.3** Analyze and interpret quantitative data to construct an explanation for the effects of greenhouse gases on the carbon dioxide cycle and global climate.	**EMBEDDED SCIENCE and ENGINEERING PRACTICES** Ask Question and Define Problems Develop and Use Models Analyze and Interpret Data Obtain, Evaluate, and Communicate Information **EMBEDDED CROSSCUTTING CONCEPTS** Patterns Cause and Effect *(Mechanism and Explanation)* Energy and Matter *(Flows, Cycles, Conservation)* Structure and Function Stability and Change	Atmosphere Biogeochemical Cycles Biosphere Carbon Cycle Carrying Capacity Climate Community (communities) Denitrification Ecosystem Geosphere Global Warming Greenhouse Gas Niche Nitrification Nitrogen Cycle Nitrogen Fixation Nutrient Cycle Stimuli Water Cycle
INTERDEPENDENCE of ORGANISMS and THEIR ENVIRONMENTS: **Flows of Energy and Relationships** **REAL-WORLD CONNECTIONS and PHENOMENA** Use media sources to observe interactions between various species of animals paying attention how resources are competed for and shared. Discuss how the removal of food sources from an ecosystem impact the system. How are food webs and food chains impacted?	BIO.5 **Students will Investigate and evaluate the interdependence of living organisms and their environment.** **BIO.5.**4 Develop and use models to describe the flow of energy and amount of biomass through food chains, food webs, and food pyramids. **BIO.5.5** Evaluate symbiotic relationships (e.g., mutualism, parasitism, and commensalism) and other co-evolutionary (e.g., predator-prey, mimicry, cooperation, and competition,) relationships within specific environments.	**EMBEDDED SCIENCE and ENGINEERING PRACTICES** Ask Question and Define Problems Develop and Use Models Analyze and Interpret Data Plan and Conduct Investigations Obtain, Evaluate, and Communicate Information **EMBEDDED CROSSCUTTING CONCEPTS** Patterns Cause and Effect *(Mechanism and Explanation)* Energy and Matter *(Flows, Cycles, Conservation)* Structure and Function Stability and Change	Food Chain Food Web Trophic Level Ecological Pyramid Primary Consumer Secondary Consumer Tertiary Consumer Quaternary Consumer Decomposer Autotrophic Heterotroph Producer Consumer Predator Prey Parasitism Parasite Host
INTERDEPENDENCE of ORGANISMS and THEIR ENVIRONMENTS: **Ecology and Interdependence** **REAL-WORLD CONNECTIONS and PHENOMENA** Research and discuss how increasing temperatures can limit ecological sustainability.	BIO.5 **Students will Investigate and evaluate the interdependence of living organisms and their environment.** **BIO.5.6** Analyze and interpret population data, both density-dependent and density-independent, to define limiting factors. Use graphical representations (growth curves) to illustrate the carrying capacity within ecosystems. **BIO.5.7** Investigate and evaluate factors involved in primary and secondary ecological succession using local, real world examples.	**EMBEDDED SCIENCE and ENGINEERING PRACTICES** Ask Question and Define Problems Develop and Use Models Analyze and Interpret Data Plan and Conduct Investigations Use Mathematical and Computational Thinking	Biodiversity Carrying Capacity Climax Community Community (communities) Ecosystem Emigration Habitat Destruction Homeostasis

TERM 4

UNIT OF STUDY (REAL-WORLD CONNECTIONS and PHENOMENA) ▼	MS CCR STANDARDS ▼	SCIENCE AND ENGINEERING PRACTICES SCIENCE CROSSCUTTING CONCEPTS ▼	VOCABULARY TERMS CORE ACADEMIC ▼
Use media to explore and investigate how human are using "sticky feet" characteristics of lizards to walk on wall. Discuss the potential benefits and consequences of such engineering designs.	**BIO.5.8 Enrichment:** Use an engineering design process to create a solution that addresses changing ecological conditions (e.g., climate change, invasive species, loss of biodiversity, human population growth, habitat destruction, biomagnification, or natural phenomena). * **BIO.5.9 Enrichment:** Use an engineering design process to investigate and model current technological uses of biomimicry to address solutions to real-world problems. * **All SEPs and CCCs are applicable.**	**EMBEDDED CROSSCUTTING CONCEPTS** Patterns Cause and Effect *(Mechanism and Explanation)* Scale, Proportion, and Quantity Energy and Matter *(Flows, Cycles, Conservation)* Stability and Change	Immigration Invasive Species Limiting Factor Natural Disaster Niche Pioneer Species Population Primary Succession Salinity Secondary Succession Succession