GRADE 9: FOUNDATIONS FOR AP SCIENCES BIOLOGY CURRICULUM FRAMEWORKS

UNIT 1: CHEMISTRY OF LIFE

Big Questions	Formative/ Summative Assessments Formative and summative assessments created by teachers/teams
1. What are the defining characteristics of life? 2. What are the features of water that are important to life? 3. What are the characteristics of the macromolecules found in living things? 4. How does an enzyme catalyze biological reactions?	Options include, but are not limited to: • Unit Test • Lab Evaluations • Paper on "First You Build a Cloud"

Substrand/Standard	Curriculum Benchmark	MCA III Test Item Specifications	Standards of Proficiency Description of what students must show to demonstrate proficiency (created by teachers/teams)	Resources/ Activities
Substrand: Structure and Function of Living Systems Standard: Understand that organisms use the interaction of cellular processes as well as tissues and organ systems to maintain homeostasis.	Explain how cell processes are influenced by internal and external factors, such as pH and temperature, and how cells and organisms respond to changes in their environment to maintain homeostasis. *(Standard LS: 9.4.1.1.1)*	• Internal and external factors or stimuli include pH, temperature, light, gravity and concentration. • A cell's response to maintain homeostasis may include single-celled organisms or individual cells of organisms. • An organism's response to maintain homeostasis may include responses such as gravitropism and phototropism in plants and shivering or sweating in animals. • Items may address both voluntary and involuntary responses. • Items will NOT address the mechanisms of specific organ systems. • Items will NOT require students to distinguish between innate and learned behaviors.		• Miller & Levine, *Biology*, Chapter 2 • Enzyme Jello Lab
Substrand: Structure and Function of Living Systems Standard: Understand that cells and cell structures have specific functions that allow an organism to grow, survive and reproduce.	Recognize that cells are composed primarily of a few elements (carbon, hydrogen, oxygen, nitrogen, phosphorus, and sulfur), and describe the basic molecular structures and the primary functions of carbohydrates, lipids, proteins, and nucleic acids. *(Standard LS: 9.4.1.2.1)*	• Items may require students to know the elemental symbols for carbon, hydrogen, oxygen, nitrogen, phosphorus and sulfur.		• Miller & Levine, *Biology*, Chapter 2 • Unhappy Meal Lab
Substrand: Structure and Function of Living Systems Standard: Understand that cells and cell structures have specific functions that allow an organism to grow, survive and reproduce.	Recognize that the work of the cell is carried out primarily by proteins, most of which are enzymes, and that protein function depends on the amino acid sequence and the shape it takes as a consequence of the interactions between those amino acids. *(Standard LS: 9.4.1.2.2)*	• Items may require students to analyze the effect of a change in the amino acid sequence on protein shape and resulting function. • Items addressing enzymes are limited to understanding that enzymes are catalysts in reactions, are specific to particular molecules and are affected by pH and temperature. • Items will NOT assess the roles of specific enzymes. • Items will NOT use the term activation energy. • Items assessing this benchmark may also assess 9.4.3.1.3.		• Miller & Levine, *Biology*, Chapter 2 • Enzyme Jello Lab

GRADE 9: FOUNDATIONS FOR AP SCIENCES BIOLOGY CURRICULUM FRAMEWORKS

UNIT 1: CHEMISTRY OF LIFE (continued)				
Substrand/Standard	**Curriculum Benchmark**	**MCA III Test Item Specifications**	**Standards of Proficiency** Description of what students must show to demonstrate proficiency (created by teachers/teams)	**Resources/ Activities**
Substrand: The Practice of Science Standard: Understand that scientific inquiry uses multiple interrelated processes to investigate and explain the natural world.	Formulate a testable hypothesis, design and conduct an experiment to test the hypothesis, analyze the data, consider alternative explanations, and draw conclusions supported by evidence from the investigation. *(Standard NSE: 9.1.1.2.1)*	• Context of items should demonstrate all appropriate safety considerations. • Items may address part or all of the benchmark. • Hypothesis is defined as "a testable statement about the natural world that can be used to build more complex inferences and explanations" (National Academy of Sciences, Teaching About Evolution and the Nature of Science, [National Academy Press, 1988], 5). • Items will NOT require students to define the term hypothesis. • Items may require students to evaluate or draw an accurate conclusion based on presented evidence. • Items may require students to identify which variables were changed, kept the same and measured in a given experiment. • Items will NOT use the terms independent variable, dependent variable, manipulated variable or responding variables.		• Milk Color Movement Lab
Substrand: The Practice of Science Standard: Understand that science is a way of knowing about the natural world and is characterized by empirical criteria, logical argument and skeptical review.	Describe how changes in scientific knowledge generally occur in incremental steps that include and build on earlier knowledge. *(Standard NSE: 9.1.1.1.6)*	• Items may require students to show how one scientific understanding leads to another (e.g., show how new evidence or analysis led to further development of the theory of evolution, germ theory or theory of inheritance). • Items assessing this benchmark may also assess benchmarks 9.1.3.2.1 and 9.4.4.1.3.		• Reading from *First You Build a Cloud* by Cole

GRADE 9: FOUNDATIONS FOR AP SCIENCES BIOLOGY CURRICULUM FRAMEWORKS

UNIT 2: MOVEMENT THROUGH THE MEMBRANE

Big Questions	Formative/ Summative Assessments Formative and summative assessments created by teachers/teams
1. What is the structure and function of the plasma membrane? 2. How do substances move across the plasma membrane?	Options include, but are not limited to: • Unit Test • Lab Evaluations

Substrand/Standard	Curriculum Benchmark	MCA III Test Item Specifications	Standards of Proficiency Description of what students must show to demonstrate proficiency (created by teachers/teams)	Resources/ Activities
Substrand: Structure and Function of Living Systems Standard: Understand that organisms use the interaction of cellular processes as well as tissues and organ systems to maintain homeostasis.	Explain how cell processes are influenced by internal and external factors, such as pH and temperature, and how cells and organisms respond to changes in their environment to maintain homeostasis. *(Standard LS: 9.4.1.1.1)*	• Internal and external factors or stimuli include pH, temperature, light, gravity and concentration. • A cell's response to maintain homeostasis may include single-celled organisms or individual cells of organisms. • An organism's response to maintain homeostasis may include responses such as gravitropism and phototropism in plants and shivering or sweating in animals. • Items may address both voluntary and involuntary responses. • Items will NOT address the mechanisms of specific organ systems. • Items will NOT require students to distinguish between innate and learned behaviors.		• Miller & Levine, *Biology*, Chapters 7 and 10 • Diffusion in Dialysis Tubing Lab • Osmosis in Dialysis Tubing Lab • Why are Cells so Small? Lab • Reading: *Cells: A Short History of Nearly Everything* by Bryson
Substrand: Structure and Function of Living Systems Standard: Understand that cells and cell structures have specific functions that allow an organism to grow, survive and reproduce.	Compare and contrast passive transport (including osmosis and facilitated transport) with active transport such as endocytosis and exocytosis. *(Standard LS: 9.4.1.2.5)*	• Active transport is limited to endocytosis and exocytosis. • Passive transport is limited to diffusion, osmosis and facilitated transport. • Additional vocabulary may include terms such as concentration gradient and selective barrier.		• Miller & Levine, *Biology*, Chapters 7 and 10 • Diffusion in Dialysis Tubing Lab • Osmosis in Dialysis Tubing Lab • Why are Cells so Small? Lab

GRADE 9: FOUNDATIONS FOR AP SCIENCES BIOLOGY CURRICULUM FRAMEWORKS

UNIT 3: CELL CYCLE AND REGULATION, DNA→RNA→PROTEIN, MEIOSIS, GENETICS, EVOLUTION

Big Questions	Formative/ Summative Assessments Formative and summative assessments created by teachers/teams
1. What occurs during the cell cycle, and how is it regulated? 2. What are the structures and functions of DNA and RNA? 3. How is DNA transcribed and RNA translated? 4. How does meiosis result in genetic variation? 5. How do you predict genotypes and phenotypes using laws of probability? 6. How is natural selection a mechanism for microevolution? 7. How can evolution be measured using the Hardy-Weinberg equilibrium equation? 8. How can we learn about organisms that are extinct?	Options include, but are not limited to: • Unit Test • Lab Evaluations • Paper on *Race for the Double Helix*

Substrand/Standard	Curriculum Benchmark	MCA III Test Item Specifications	Standards of Proficiency Description of what students must show to demonstrate proficiency (created by teachers/teams)	Resources/ Activities
Substrand: Structure and Function of Living Systems Standard: Understand that cells and cell structures have specific functions that allow an organism to grow, survive and reproduce.	Explain the process of mitosis in the formation of identical new cells and maintaining chromosome number during asexual reproduction. *(Standard LS: 9.4.1.2.6)*	• Items may require students to know that mitosis is part of the process that produces cells that are genetically identical with the same number of chromosomes. • Items addressing the process of mitosis may include knowing the sequence of events. • Items will NOT assess the terms haploid, diploid, interphase, prophase, metaphase, anaphase or telophase. • Items assessing this benchmark may also assess benchmark 9.4.4.2.5.		• Miller & Levine, *Biology*, Chapter 10 • Online Onion Mitosis Lab
Substrand: Evolution in Living Systems Standard: Understand that genetic information found in the cell provides information for assembling proteins, which dictate the expression of traits in an individual.	Explain the relationships among DNA, genes and chromosomes. *(Standard LS: 9.4.3.1.1)*	• Items will NOT include the terms histone, chromatin or chromatid.		• Miller & Levine, *Biology*, Chapter 12
Substrand: Evolution in Living Systems Standard: Understand that genetic information found in the cell provides information for assembling proteins, which dictate the expression of traits in an individual.	In the context of a monohybrid cross, apply the terms phenotype, genotype, allele, homozygous and heterozygous. *(Standard LS: 9.4.3.1.2)*	• Items may require students to understand a Punnett square. • Items may require students to understand dominant and recessive inheritance. • Items will NOT reference specific human genetic disorders. • Items will NOT use the terms or assess concepts of sex-linked, polygenic, incomplete dominance, codominance or multiple allele inheritance patterns.		• Miller & Levine, *Biology*, Chapter 11

GRADE 9: FOUNDATIONS FOR AP SCIENCES BIOLOGY CURRICULUM FRAMEWORKS

UNIT 3: CELL CYCLE AND REGULATION, DNA→RNA→PROTEIN, MEIOSIS, GENETICS, EVOLUTION (continued)				
Substrand/Standard	**Curriculum Benchmark**	**MCA III Test Item Specifications**	**Standards of Proficiency** Description of what students must show to demonstrate proficiency (created by teachers/teams)	**Resources/ Activities**
Substrand: Evolution in Living Systems Standard: Understand that genetic information found in the cell provides information for assembling proteins, which dictate the expression of traits in an individual.	Describe the process of DNA replication and the role of DNA and RNA in assembling protein molecules. *(Standard LS: 9.4.3.1.3)*	• Items may include the terms mRNA, tRNA, amino acids, Uracil in RNA and ribosomes. • Items may require students to know the location of replication, transcription and translation in addition to the role of DNA, mRNA and proteins (amino acids) in these processes. • Items may require students to understand DNA base pairing rules A=T and G=C. • Items may require students to understand RNA base pairing rules A=U and G=C. • Items will NOT reference specific human genetic disorders. • Items assessing this benchmark may also assess benchmark 9.4.1.2.2.		• Miller & Levine, *Biology*, Chapter 12
Substrand: Evolution in Living Systems Standard: Understand that variation within a species is the natural result of new inheritable characteristics occurring from new combinations of existing genes or from mutations of genes in reproductive cells.	Use concepts from Mendel's laws of segregation and independent assortment to explain how sorting and recombination (crossing over) of genes during sexual reproduction (meiosis) increases the occurrence of variation in a species. *(Standard LS: 9.4.3.2.1)*	• Items will NOT reference specific human genetic disorders. • The term recombination may be used to describe any event that results in new combinations of genetic material (e.g., crossing over, mutation, random fertilization). • Items may require students to know that the products of meiosis are cells that are genetically unique with half the number of chromosomes. • Items will NOT use the terms haploid or diploid. • Additional vocabulary may include terms such as gamete, egg and sperm. • Items assessing this benchmark may also assess 9.4.3.3.4.		• Miller & Levine, *Biology*, Chapter 11
Substrand: Evolution in Living Systems Standard: Understand that variation within a species is the natural result of new inheritable characteristics occurring from new combinations of existing genes or from mutations of genes in reproductive cells.	Use the processes of mitosis and meiosis to explain the advantages and disadvantages of asexual and sexual reproduction. *(Standard LS: 9.4.3.2.2)*	• Examples of advantages to sexual (meiosis) reproduction include genetic diversity. • Examples of disadvantages to sexual (meiosis) reproduction include expending increased energy and time. • Examples of advantages to asexual reproduction (mitosis) include no requirement of a mate and the organism may reproduce more rapidly. • Examples of disadvantages to asexual reproduction (mitosis) include decreased genetic variation. • Items will NOT use the terms haploid or diploid. • Additional vocabulary may include terms such as gamete, egg and sperm.		• Miller & Levine, *Biology*, Chapter 11

GRADE 9: FOUNDATIONS FOR AP SCIENCES BIOLOGY CURRICULUM FRAMEWORKS

UNIT 3: CELL CYCLE AND REGULATION, DNA→RNA→PROTEIN, MEIOSIS, GENETICS, EVOLUTION (continued)				
Substrand/Standard	**Curriculum Benchmark**	**MCA III Test Item Specifications**	**Standards of Proficiency** Description of what students must show to demonstrate proficiency (created by teachers/teams)	**Resources/ Activities**
Substrand: Evolution Living Systems Standard: Understand that evolution by natural selection is a scientific explanation for the history and diversity of life on Earth.	Describe how evidence led Darwin to develop the theory of natural selection and common descent to explain evolution. *(Standard LS: 9.4.3.3.1)*	• Items may require students to connect evidence to the development of Darwin's ideas.		• Miller & Levine, *Biology*, Chapters 15, 16 • Video: "Darwin's Dangerous Idea"
Substrand: Evolution Living Systems Standard: Understand that evolution by natural selection is a scientific explanation for the history and diversity of life on Earth.	Use scientific evidence, including the fossil record, homologous structures, and genetic and/or biochemical similarities, to show evolutionary relationships among species. *(Standard LS: 9.4.3.3.2)*	• Items may illustrate the concept of analogous structures but will NOT use the term. • Items may require understanding a graphical illustration of the relationships between organisms such as a cladogram or a phylogenetic tree but will NOT use these terms. • Items will NOT use specific terms involved in geological time scales. • Additional vocabulary may include terms such common ancestor, relatedness and anatomical evidence.		• Miller & Levine, *Biology*, Chapter 11 • Video: "Darwin's Dangerous Idea" • Lab: What did T. rex taste like?
Substrand: Evolution Living Systems Standard: Understand that evolution by natural selection is a scientific explanation for the history and diversity of life on Earth.	Recognize that artificial selection has led to offspring through successive generations that can be very different in appearance and behavior from their distance ancestors. *(Standard LS: 9.4.3.3.3)*	None.		• Miller & Levine, *Biology*, Chapters 15, 16 • Lab: Micro-evolution in a Species • Lab: What did T. rex taste like?
Substrand: Evolution Living Systems Standard: Understand that evolution by natural selection is a scientific explanation for the history and diversity of life on Earth.	Explain why genetic variation within a population is essential for evolution to occur. *(Standard LS: 9.4.3.3.4)*	• Items assessing this benchmark may also assess benchmark 9.4.3.2.1.		• Miller & Levine, *Biology*, Chapters 11, 15, 16 • Lab: Micro-evolution in a Species

GRADE 9: FOUNDATIONS FOR AP SCIENCES BIOLOGY CURRICULUM FRAMEWORKS

UNIT 3: CELL CYCLE AND REGULATION, DNA→RNA→PROTEIN, MEIOSIS, GENETICS, EVOLUTION (continued)				
Substrand/Standard	**Curriculum Benchmark**	**MCA III Test Item Specifications**	**Standards of Proficiency** Description of what students must show to demonstrate proficiency (created by teachers/teams)	**Resources/ Activities**
Substrand: Evolution Living Systems Standard: Understand that evolution by natural selection is a scientific explanation for the history and diversity of life on Earth.	Explain how genetic variation between two populations of a given species is due, in part, to different selective pressures acting independently on each population and how, over time, these differences can lead to the development of new species. *(Standard LS: 9.4.3.3.6)*	• Items may refer to the concept of directional, disruptive or stabilizing selection but will NOT use these terms. • Items may address the following processes and terms: divergence, convergence, adaptive radiation and co-evolution. • Items will NOT address the concept of bottlenecks, founder effects or genetic drift. • Contexts for items will use examples of Minnesota ecosystems when appropriate.		• Miller & Levine, *Biology*, Chapters 11, 15, 16 • Lab: Micro-evolution in a Species
Substrand: The Practice of Science Standard: Understand that science is a way of knowing about the natural world and is characterized by empirical criteria, logical argument and skeptical review.	Understand that scientists conduct investigations for a variety of reasons, including: to discover new aspects of the natural world, to explain observed phenomena, to test the conclusions of prior investigations, or to test the predictions of current theories. *(Standard NSE: 9.1.1.1.2)*	None.		• Video: "Race for the Double Helix"

GRADE 9: FOUNDATIONS FOR AP SCIENCES BIOLOGY CURRICULUM FRAMEWORKS

UNIT 4: BIOENERGETICS AND CELLS

Big Questions	Formative/ Summative Assessments Formative and summative assessments created by teachers/teams
1. How do photosynthesis and cellular respiration support the first law of thermodynamics? 2. How do the structures within a cell influence its function?	Options include, but are not limited to: • Unit Test • Lab Evaluations

Substrand/Standard	Curriculum Benchmark	MCA III Test Item Specifications	Standards of Proficiency Description of what students must show to demonstrate proficiency (created by teachers/teams)	Resources/ Activities
Substrand: Structure and Function of Living Systems Standard: Understand that cells and cell structures have specific functions that allow an organism to grow, survive and reproduce.	Describe how viruses, prokaryotic cells, and eukaryotic cells differ in relative size, complexity and general structure. *(Standard LS: 9.4.1.2.3)*	• Viral structures are limited to genetic material and protein coat. • Examples of differences between viruses, eukaryotic cells and prokaryotic cells are limited to relative sizes, the presence of nuclei, the presence of other organelles, and that multi-cellular organisms are composed of eukaryotic cells. • Items will use the terms cell parts for general structures.		• Miller & Levine, *Biology*, Chapter 7
Substrand: Structure and Function of Living Systems Standard: Understand that cells and cell structures have specific functions that allow an organism to grow, survive and reproduce.	Explain the function and importance of cell organelles for prokaryotic and/or eukaryotic cells as related to the basic cell processes of respiration, photosynthesis, protein synthesis and cell reproduction. *(Standard LS: 9.4.1.2.4)*	• Cell organelles will be referred to in test items as cell parts. • The cell part related to respiration in eukaryotes is limited to the mitochondria (transforms energy to a usable form for the cell). • The cell part related to photosynthesis is limited to the chloroplast (converts light energy to chemical energy). • Cell parts related to protein synthesis in eukaryotes are limited to nucleus (site of transcription) and ribosomes (site of Translation). • Structures related to protein synthesis in prokaryotes are limited to genetic material (site of transcription) and ribosomes (site of translation). • Cell parts related to cell reproduction in eukaryotes are limited to the nucleus (site of replication), genetic material (DNA), nuclear membrane (nuclear barrier), cell membrane (cytoplasmic barrier) and cell wall (cytoplasmic division). • Cell parts related to cell reproduction in prokaryotes are limited to genetic material (DNA) and cell membrane (cytoplasmic barrier). • Items will NOT address prokaryotic respiration or photosynthesis. • Cell division in prokaryotes is limited to binary fission. • Items may use other cell parts not listed here as distractors.		• Miller & Levine, *Biology*, Chapter 9 • Plant Pigment Chromatography Lab

GRADE 9: FOUNDATIONS FOR AP SCIENCES BIOLOGY CURRICULUM FRAMEWORKS

UNIT 4: BIOENERGETICS AND CELLS (continued)				
Substrand/Standard	**Curriculum Benchmark**	**MCA III Test Item Specifications**	**Standards of Proficiency** Description of what students must show to demonstrate proficiency (created by teachers/teams)	**Resources/ Activities**
Substrand: Interdependence Among Living Systems Standard: Understand that matter cycles and energy flows through different levels of organization of living systems and the physical environment, as chemical elements are combined in different ways.	Use words and equations to differentiate between the processes of photosynthesis and respiration in terms of energy flow, beginning reactants and end products. *(Standard LS: 9.4.2.2.1)*	• Items will refer to reactants and products of cellular respiration as oxygen, glucose, carbon dioxide, water, ATP. • Items will refer to reactants and products of photosynthesis as carbon dioxide, water, oxygen, glucose. • Molecular formulas will include labels, for example water (H_20). • Items will NOT require students to understand absorption spectra. • Items will NOT require students to recognize light reactions or the Calvin cycle. • Items will NOT include glycolysis, Krebs cycle, electron transport system or fermentation.		• Miller & Levine, *Biology*, Chapters 8, 9
Substrand: Interdependence Among Living Systems Standard: Understand that matter cycles and energy flows through different levels of organization of living systems and the physical environment, as chemical elements are combined in different ways.	Explain how matter and energy is transformed and transferred among organisms in an ecosystem, and how energy is dissipated as heat into the environment. *(Standard LS: 9.4.2.2.2)*	• Items may address the processes of photosynthesis, respiration and decomposition in recycling matter. • Items may include energy and matter cycling in food chains and food webs. • Items may address the conceptual cycling of matter in the carbon, nitrogen and oxygen cycles but will NOT require a detailed understanding of the mechanisms of these cycles. • Items will NOT include glycolysis, Krebs cycle, electron transport system, fermentation or entropy. • Contexts for items will use examples of Minnesota ecosystems when appropriate. • Additional vocabulary may include terms such as producer, primary consumer, secondary consumer, tertiary consumer, decomposer, autotroph, heterotroph, energy pyramid, trophic level.		• Miller & Levine, *Biology*, Chapters 8, 9

GRADE 9: FOUNDATIONS FOR AP SCIENCES BIOLOGY CURRICULUM FRAMEWORKS

READING IN THE CONTENT AREA FOR GRADES 9-10: (Taken from "Standard for Literacy in History/Social Studies, Science, and Technical Subjects")		
Minnesota Benchmark	**Activities**	**How Assessed**
Cite specific textual evidence to support analysis of technical texts, attending to the precise details of explanations or descriptions (9.13.1.1). (All units/All quarters)	Worksheets, experimental design/labs, essays	Homework, unit tests, labs
Determine the central ideas or conclusions of a text; trace the text's explanation or depiction of a complex process, phenomenon, or concept; provide an accurate summary of the text (9.13.2.2) (All units/All quarters)	Worksheets, experimental design/labs, essays	Homework, unit tests, labs
Follow precisely a complex multi-step procedure when carrying out experiments, designing solutions, taking measurements, or performing technical tasks, attending to special cases (constraints) or exceptions defined in the text (9.13.3.3). (All units/All quarters)	Experimental design/labs	Homework, unit tests, labs
Determine the meaning of symbols, equations, graphical representations, tabular representations, key terms and other domain-specific words and phrases as they are used in a specific technical context relevant to grades 9-10 texts and topics (9.13.4.4) (All units/All quarters)	Worksheets, experimental design/labs, essays	Homework, unit tests, labs
Analyze the structure of the relationships among concepts in a text, including relationships among key terms (e.g., force, friction, reaction force, energy) (9.13.5.5). (All units/All quarters)	Worksheets, experimental design/labs, essays	Homework, unit tests, labs
Analyze the author's purpose in describing phenomena, providing an explanation, describing a procedure, or discussing/reporting an experiment in a text, defining the question the author seeks to address (9.13.6.6) (All units/All quarters)	Worksheets, experimental design/labs, essays	Homework
Translate quantitative or technical information expressed in words in a text into visual form (e.g., a table or chart) and translate information expressed visually or mathematically (e.g., in an equation) into words (9.13.7.7). (All units/All quarters)	Worksheets, experimental design/labs, essays	Homework, unit tests, labs
Assess the extent to which the reasoning and evidence in a text support the author's claim or a recommendation for solving a technical problem (9.13.8.8). (All units/All quarters)	Worksheets, experimental design/labs, essays	Homework, labs
Compare and contrast findings presented in a text to those from other sources (including their own experiments), noting when the findings support or contradict previous explanations or accounts (9.13.9.9). (All units/All quarters)	Worksheets, experimental design/labs, essays	Homework, labs
By the end of grade 10, read and comprehend technical texts in the grades 9-10 text complexity band independently and proficiently (9.13.10.10).		