



Biology Pacing Guide

Biology should investigate the chemistry and role of cells in life processes, genetics, evolution and the diversity of life. Students should learn about the world through the study of behavioral relationships, ecology, and the global impact of ecological issues. Biology should continue to educate the student in the nature of science. Students should be expected to spend time viewing and classifying life forms. Field studies should be an integral part of the course as well as the process of collecting and analyzing data. Instruction and assessment should include both appropriate technology and the safe use of laboratory equipment. Students should be engaged in hands-on laboratory experiences at least 20% of the instructional time.

First Nine Weeks

1. Enduring Understanding: Science is a systematic inquiry process where conclusions are derived from questions through appropriate and accurate investigative techniques.

1a. Essential Question: What steps do scientists use to investigate problems?

NS.10.B.1	Explain why science is limited to natural explanations of how the world works
NS.10.B.2	Compare and contrast <i>hypotheses</i> , <i>theories</i> , and <i>laws</i>
NS.10.B.3	Distinguish between a scientific <i>theory</i> and the term “ <i>theory</i> ” used in general conversation
NS.10.B.4	Summarize the guidelines of science:
	<i>explanations</i> are based on observations, evidence, and testing
	<i>hypotheses</i> must be testable
	understandings and/or conclusions may change with additional empirical data
	scientific knowledge must have peer review and verification before acceptance

1b. Essential Question: What guidelines must be followed to design and conduct a scientific investigation?

NS.11.B.1	Develop and explain the appropriate procedure, controls, and variables (dependent and independent) in scientific experimentation
NS.11.B.2	Research and apply appropriate safety precautions (refer to ADE Guidelines) when designing and/or conducting scientific investigations
NS.11.B.3	Identify sources of bias that could affect experimental outcome
NS.11.B.4	Gather and analyze data using appropriate summary statistics
NS.11.B.5	Formulate valid conclusions without bias
NS.11.B.6	Communicate experimental results using appropriate reports, figures, and tables
NS.12.B.1	Recognize that theories are scientific explanations that require empirical data, verification, and peer review
NS.12.B.2	Understand that scientific theories may be modified or expanded based on additional empirical data, verification, and peer review

1c. Essential Question: How can technology be appropriately used in solving and communicating life science problems?	
NS.12.B.7	Research current events and topics in biology
NS.13.B.1	Collect and analyze scientific data using appropriate mathematical calculations, figures, and tables
NS.13.B.2	Use appropriate equipment and <i>technology</i> as tools for solving problems (e.g., microscopes, centrifuges, flexible arm cameras, computer software and hardware)
NS.13.B.3	Utilize <i>technology</i> to communicate research findings
1d. Essential Question: What are the connections between pure science and science applied to the real world?	
NS.14.B.1	Compare and contrast biological concepts in <i>pure science</i> and <i>applied science</i>
NS.14.B.2	Discuss why scientists should work within ethical parameters
NS.14.B.3	Evaluate long-range plans concerning resource use and by-product disposal for environmental, economic, and political impact
NS.14.B.4	Explain how the cyclical relationship between science and <i>technology</i> results in reciprocal advancements in science and <i>technology</i>
NS.15.B.1	Research and evaluate science careers using the following criteria:
	educational requirements
	salary
	availability of jobs
	working conditions
2. Enduring Understanding: Chemistry is essential to understanding the life process.	
2a. Essential Question: How do the properties and importance of water effect life?	
MC.1.B.3	Investigate the properties and importance of water and its significance for life:
	surface tension
	<i>adhesion</i>
	<i>cohesion</i>
	<i>polarity</i>
	<i>pH</i>

2b. Essential Question: How do the structure and function of organic molecules effect living systems?

MC.1.B.1	Describe the structure and function of the major organic molecules found in living systems:
	<i>carbohydrates</i>
	<i>proteins</i>
	<i>enzymes</i>
	<i>lipids</i>
	<i>nucleic acids</i>
MC.1.B.2	Describe the relationship between an enzyme and its substrate molecule(s)

2c. Essential Question: What is the role of energy in the chemical reactions of living things?

MC.1.B.4	Explain the role of energy in chemical reactions of living systems:
	<i>activation energy</i>
	<i>exergonic reactions</i>
	<i>endergonic reactions</i>

3. Enduring Understanding: The structure and function of cells determines the foundation for all living things.

3. Essential Question: What is cell theory and how does it relate to the hierarchy of life?

NS.12.B.4	Relate the development of the cell theory to current trends in cellular biology
MC.2.B.1	Construct a hierarchy of life from cells to ecosystems

Second Nine Weeks

1. Enduring Understanding: The structure and function of cells determines the foundation for all living things.

1a. Essential Question: What are the similarities and differences of animal and plant cells and their organelles?

MC.3.B.1	Compare and contrast the structure and function of <i>mitochondria</i> and <i>chloroplasts</i>
MC.2.B.2	Compare and contrast <i>prokaryotes</i> and <i>eukaryotes</i>
MC.2.B.3	Describe the role of sub-cellular structures in the life of a cell:
	<i>organelles</i>
	<i>ribosomes</i>
	<i>cytoskeleton</i>
MC.2.B.4	Relate the function of the <i>plasma (cell) membrane</i> to its structure
MC.2.B.5	Compare and contrast the structures of an animal cell to a plant cell

1b. Essential Question: How do active and passive transport effect balance within an organism?	
MC.2.B.7	Compare and contrast <i>active transport</i> and <i>passive transport mechanisms</i> :
	<i>diffusion</i>
	<i>osmosis</i>
	<i>endocytosis</i>
	<i>exocytosis</i>
	<i>phagocytosis</i>
	<i>pinocytosis</i>
MC.2.B.11	Discuss <i>homeostasis</i> using <i>thermoregulation</i> as an example
1c. Essential Question: How do cells obtain and use energy?	
MC.2.B.6	Compare and contrast the functions of <i>autotrophs</i> and <i>heterotrophs</i>
MC.3.B.2	Describe and model the conversion of stored energy in organic molecules into usable cellular energy (ATP):
	<i>glycolysis</i>
	<i>citric acid cycle</i>
	<i>electron transport chain</i>
MC.3.B.3	Compare and contrast <i>aerobic</i> and <i>anaerobic respiration</i> :
	<i>lactic acid fermentation</i>
	<i>alcoholic fermentation</i>
MC.3.B.4	Describe and model the conversion of light energy to chemical energy by photosynthetic organisms:
	<i>light dependent</i> reactions
	<i>light independent</i> reactions
MC.3.B.5	Compare and contrast <i>cellular respiration</i> and <i>photosynthesis</i> as energy conversion pathways
2. Enduring Understanding: DNA is the molecular basis of genetics and the continuation of life.	
2a. Essential Question: What is the structure of DNA and RNA?	
HE.5.B.1	Model the components of a <i>DNA nucleotide</i> and an <i>RNA nucleotide</i>
HE.5.B.2	Describe the Watson-Crick <i>double helix model</i> of <i>DNA</i> , using the <i>base-pairing rule</i> (<i>adenine-thymine</i> , <i>cytosine-guanine</i>)
HE.5.B.3	Compare and contrast the structure and function of <i>DNA</i> and <i>RNA</i>
2b. Essential Question: How does DNA control the activities of a cell?	
HE.5.B.4	Describe and model the processes of replication, <i>transcription</i> , and <i>translation</i>
HE.5.B.5	Compare and contrast the different types of <i>mutation</i> events, including <i>point mutation</i> , <i>frameshift mutation</i> , <i>deletion</i> , and <i>inversion</i>

Third Nine Weeks

1. Enduring Understanding: DNA is the molecular basis of genetics and the continuation of life.

1. Essential Question: What are the events of the cell cycle?

MC.2.B.8	Describe the main events in the <i>cell cycle</i> , including the differences in plant and animal cell division:
	<i>interphase</i>
	<i>mitosis</i>
	<i>cytokinesis</i>
MC.2.B.9	List in order and describe the stages of <i>mitosis</i> :
	<i>prophase</i>
	<i>metaphase</i>
	<i>anaphase</i>
	<i>telophase</i> .
MC.2.B.10	Analyze the meiotic maintenance of a constant <i>chromosome</i> number from one generation to the next

2. Enduring Understanding: Heredity is determined by genetics.

2a. Essential Question: What are historical and current findings in genetics?

HE.4.B.5	Analyze the historically significant work of prominent geneticists
NS.12.B.6	Relate the <i>chromosome theory of heredity</i> to recent findings in genetic research (e.g., <i>Human Genome Project-HGP</i> , <i>chromosome therapy</i>)

2b. Essential Question: How do the laws of genetics apply to determining heredity?

HE.4.B.1	Summarize the outcomes of Gregor Mendel's experimental procedures
HE.4.B.2	Differentiate among the <i>laws and principles of inheritance</i> :
	<i>dominance</i>
	<i>segregation</i>
	<i>independent assortment</i>
HE.4.B.3	Use the <i>laws of probability</i> and <i>Punnett squares</i> to predict <i>genotypic</i> and <i>phenotypic ratios</i>

2c. Essential Question: What factors effect the expressions of genetic traits?	
HE.4.B.4	Examine different modes of inheritance:
	<i>sex linkage</i>
	<i>codominance</i>
	<i>crossing over</i>
	<i>incomplete dominance</i>
<i>multiple alleles</i>	
HE.4.B.6	Evaluate <i>karyotypes</i> for abnormalities:
	monosomy
	trisomy
HE.5.B.6	Identify effects of changes brought about by <i>mutations</i> :
	beneficial
	harmful
	neutral
3. Enduring Understanding: Biological evolution is the change in the population of organisms over generations.	
3. Essential Question: What evidence supports the theory of evolution?	
NS.12.B.3	Summarize <i>biological evolution</i>
HE.6.B.1	Compare and contrast Lamarck's explanation of <i>evolution</i> with Darwin's <i>theory of evolution by natural selection</i>
HE.6.B.2	Recognize that <i>evolution</i> involves a change in allele frequencies in a <i>population</i> across successive generations
HE.6.B.3	Analyze the effects of <i>mutations</i> and the resulting <i>variations</i> within a <i>population</i> in terms of <i>natural selection</i>
HE.6.B.4	Illustrate <i>mass extinction</i> events using a time line
HE.6.B.5	Evaluate <i>evolution</i> in terms of evidence as found in the following:
	fossil record
	<i>DNA</i> analysis
	<i>artificial selection</i>
	morphology
	embryology
	viral <i>evolution</i>
	geographic distribution of related <i>species</i>
<i>antibiotic</i> and <i>pesticide resistance</i> in various organisms	
HE.6.B.6	Compare the processes of <i>relative dating</i> and <i>radioactive dating</i> to determine the age of fossils
HE.6.B.7	Interpret a <i>Cladogram</i>

Fourth Nine Weeks

1. Enduring Understanding: Ecosystems are effected by the relationships between living and non living parts of an environment.

1a. Essential Question: How do matter and energy move through the biosphere?

EBR.8.B.1	Cite examples of abiotic and <i>biotic factors</i> of <i>ecosystems</i>
EBR.8.B.2	Compare and contrast the characteristics of <i>biomes</i>
EBR.8.B.3	Diagram the carbon, nitrogen, phosphate, and water cycles in an <i>ecosystem</i>
EBR.8.B.4	Analyze an <i>ecosystem's</i> energy flow through food chains, food webs, and <i>energy pyramids</i>

1b. Essential Question: What are the relationships between living things in an environment?

EBR.8.B.5	Identify and predict the factors that control <i>population</i> , including <i>predation</i> , <i>competition</i> , crowding, water, nutrients, and shelter
EBR.8.B.6	Summarize the symbiotic ways in which individuals within a <i>community</i> interact with each other:
	<i>commensalism</i>
	<i>parasitism</i>
	<i>mutualism</i>

1c. Essential Question: How do ecosystems change over time?

EBR.8.B.7	Compare and contrast <i>primary succession</i> with <i>secondary succession</i>
EBR.8.B.8	Identify the properties of each of the five levels of <i>ecology</i> :
	organism
	<i>population</i>
	<i>community</i>
	<i>ecosystem</i>
	<i>biosphere</i>

1d. Essential Question: How do humans impact the environment?	
EBR.9.B.1	Analyze the effects of human <i>population</i> growth and <i>technology</i> on the environment/ <i>biosphere</i>
EBR.9.B.2	Evaluate long range plans concerning resource use and by-product disposal in terms of their environmental, economic, and political impact
EBR.9.B.3	Assess current world issues applying scientific themes (e.g., global changes in climate, <i>epidemics</i> , <i>pandemics</i> , ozone depletion, UV radiation, natural resources, use of <i>technology</i> , and public policy)
2. Enduring Understanding: Diverse organisms are classified into major kingdoms.	
2. Essential Question: How are organisms classified and named?	
CDL.7.B.1	Differentiate among the different <i>domains</i> :
	Bacteria
	Archaea
	Eukarya
CDL.7.B.2	Differentiate the characteristics of the six kingdoms:
	Eubacteria
	Archaea
	Protista
	<i>Fungi</i>
	Plantae
CDL.7.B.3	Identify the seven major taxonomic categories:
	kingdom
	phylum
	class
	order
	family
	<i>genus</i>
<i>species</i>	
CDL.7.B.4	Classify and name organisms based on their similarities and differences applying <i>taxonomic nomenclature</i> using <i>dichotomous keys</i>
CDL.7.B.5	Investigate Arkansas' <i>biodiversity</i> using appropriate tools and <i>technology</i>

3. Enduring Understanding: Plants are multicellular organisms that produce their own food.

3. Essential Question: How are plants classified by their structures, functions, uses, and life cycles?

CDL.7.B.15	Differentiate between <i>vascular</i> and <i>nonvascular plants</i>
CDL.7.B.16	Differentiate among cycads, gymnosperms, and angiosperms
CDL.7.B.17	Describe the structure and function of the major parts of a plant:
	roots
	stems
	leaves
CDL.7.B.18	Relate the structure of plant tissue to its function
	epidermal
	ground
	vascular
CDL.7.B.19	Evaluate the medical and economic importance of plants
CDL.7.B.8	Compare and contrast life cycles of familiar organisms:
	sexual reproduction
	asexual reproduction
	metamorphosis
	<i>alternation of generations</i>

4. Enduring Understanding: Bacteria and viruses effect the balance of the ecosystems.

4a. Essential Question: How do the characteristics and adaptations of bacteria effect society?

CDL.7.B.9	Classify <i>bacteria</i> according to their characteristics and adaptations
CDL.7.B.10	Evaluate the medical and economic importance of <i>bacteria</i>
NS.12.B.5	Describe the relationship between the <i>germ theory of disease</i> and our current knowledge of immunology and control of infectious diseases

4b. Essential Question: How do the characteristics and adaptations of viruses effect society?

CDL.7.B.6	Compare and contrast the structures and characteristics of <i>viruses</i> (<i>lytic</i> and <i>lysogenic cycles</i>) with non-living and living things
CDL.7.B.7	Evaluate the medical and economic importance of <i>viruses</i>
NS.12.B.5	Describe the relationship between the <i>germ theory of disease</i> and our current knowledge of immunology and control of infectious diseases

5. Enduring Understanding: Protists are a group of uniquely diverse organisms.

5. Essential Question: How do the characteristics, uses, and life cycles of protists relate to other organisms?

CDL.7.B.11	Describe the characteristics used to classify protists:
	plant-like
	animal-like
	<i>fungus-like</i>
CDL.7.B.12	Evaluate the medical and economic importance of protists
CDL.7.B.8	Compare and contrast life cycles of familiar organisms:
	sexual reproduction
	asexual reproduction
	metamorphosis
	<i>alternation of generations</i>

6. Enduring Understanding: Fungi are eukaryotic organisms that absorb their nutrients.

6. Essential Question: How are fungi classified based on their characteristics, uses, and life cycle?

CDL.7.B.13	Compare and contrast <i>fungi</i> with other eukaryotic organisms
CDL.7.B.14	Evaluate the medical and economic importance of <i>fungi</i>
CDL.7.B.8	Compare and contrast life cycles of familiar organisms:
	sexual reproduction
	asexual reproduction
	metamorphosis
	<i>alternation of generations</i>

7. Enduring Understanding: Invertebrates are a distinct division of the animal kingdom that lack a true backbone.	
7. Essential Question: How are the characteristics of body systems, symmetry, and life cycle used to classify invertebrates?	
CDL.7.B.20	Identify the symmetry of organisms:
	radial
	bilateral
	asymmetrical
CDL.7.B.21	Compare and contrast the major invertebrate classes according to their nervous, respiratory, excretory, circulatory, and digestive systems
CDL.7.B.8	Compare and contrast life cycles of familiar organisms:
	sexual reproduction
	asexual reproduction
	metamorphosis
	<i>alternation of generations</i>
8. Enduring Understanding: Vertebrates are a distinct division of the animal kingdom that exhibit a true backbone.	
8. Essential Question: How are the body systems and life cycle used to classify vertebrates?	
CDL.7.B.22	Compare and contrast the major vertebrate classes according to their nervous, respiratory, excretory, circulatory, digestive, reproductive and integumentary systems
CDL.7.B.8	Compare and contrast life cycles of familiar organisms:
	sexual reproduction
	asexual reproduction
	metamorphosis
	<i>alternation of generations</i>