NORTH CAROLINA STANDARD COURSE OF STUDY
Crosswalk
Biology

The purpose of this document is to provide a general comparison of the 2023 Biology Standard Course of Study and the 2009 Biology Standard Course of Study. It provides initial insight into similarities and differences between these two sets of standards. This document is not intended to answer all questions about the nuances of the new 2023 standards versus the previous 2009 standards..

Biology Science Standards

Note: The 2023 Biology standards and objectives are not intended to be the curriculum, nor do they indicate the whole of a curriculum which will be written by a local public-school unit (PSU) or school. The standards for this course have been developed to serve as the framework which will guide each PSU in the development of the curriculum for Biology.

From Molecules to Organisms		
2023 Standards/Objectives	**2009 Essential Standards/Clarifying Objectives**	Notes
LS.Bio.1 Analyze how the relationship between structure and function supports life processes within organisms.	*Bio.1.1 Understand the relationship between the structures and functions of cells and their organelles.*	
LS.Bio.1.1 Construct explanations to illustrate relationships between structure and function of major macromolecules essential for life.	Bio.4.1.1 Compare the structures and functions of the major biological molecules (carbohydrates, proteins, lipids, and nucleic acids) as related to the survival of living organisms. *Bio.4.1 Understand how biological molecules are essential to the survival of living organisms.*	Students are not required to know the molecular structure of the major biological molecules.
LS.Bio.1.2 Carry out investigations to illustrate how enzymes act as catalysts for biochemical reactions and how environmental factors affect enzyme activity.	Bio.4.1.3 Explain how enzymes act as catalysts for biological reactions.	

LS.Bio.1.3 Use models to explain how the structure of organelles determines its function and supports overall cell processes.	Bio.1.1.1 Summarize the structure and function of organelles in eukaryotic cells (including: the nucleus, plasma membrane, cell wall, mitochondria, vacuoles, chloroplasts, and ribosomes) and ways that these organelles interact with each other and to perform the function of the cell.	
LS.Bio.1.4 Construct an explanation to compare prokaryotic and eukaryotic cells in terms of structures and degree of complexity.	Bio.1.1.2 Compare prokaryotic and eukaryotic cells in terms of their general structures (plasma membrane and genetic material) and degree of complexity.	
LS.Bio.1.5 Construct an explanation to summarize how DNA and RNA direct the synthesis of proteins.	Bio.3.1.1 Explain the double-stranded, complementary nature of DNA as related to its function in the cell.	
	Bio.3.1.2 Explain how DNA and RNA code for proteins and determine traits.	
	Bio.4.1.2 Summarize the relationship among DNA, proteins, and amino acids in carrying out the work of cells and how this is similar among all organisms.	
LS.Bio.2 Analyze the growth and development processes of organisms.	*Bio.1.2 Analyze the cell as a living system.*	
LS.Bio.2.1 Use models to illustrate how cellular division results in the reproduction, growth, and repair of organisms.	Bio.1.2.2 Analyze how cells grow and reproduce in terms of interphase, mitosis and cytokinesis.	
LS.Bio.2.2 Construct an explanation to illustrate that proteins regulate gene expression resulting in cellular differentiation, specialized cells with specific functions, and uncontrolled cell growth.	Bio.1.1.3 Explain how instructions in DNA lead to cell differentiation and result in cells specialized to perform specific functions in multicellular organisms.	
LS.Bio.3 Analyze the relationship between biochemical processes and energy use.	*Bio.4.2 Analyze the relationships between biochemical processes and energy use in the cell.*	
LS.Bio.3.1 Carry out investigations to explain how homeostasis is maintained through feedback mechanisms.	Bio.1.2.1 Explain how homeostasis is maintained in a cell and within an organism in various environments (including: temperature	

	and pH).	
LS.Bio.3.2 Use models to illustrate how photosynthesis transforms light energy into chemical energy.	Bio.4.2.1 Analyze photosynthesis and cellular respiration in terms of how energy is stored, released, and transferred within and between these processes in the cell.	
LS.Bio.3.3 Use models to illustrate how cellular respiration [aerobic and anaerobic] transforms chemical energy into ATP.	Bio.4.2.1 Analyze photosynthesis and cellular respiration in terms of how energy is stored, released, and transferred within and between these processes in the cell.	
	Bio.4.2.2 Explain ways that organisms use released energy for maintaining homeostasis (active transport).	

Ecosystems- Interactions, Energy, and Dynamics		
2023 Standards/Objectives	**2009 Essential Standards/Clarifying Objectives**	Notes
LS.Bio.4 Analyze the relationships between matter and energy within ecosystems.	*Bio. 2.1 Analyze the interdependent relationships of living organisms within their environments.*	
LS.Bio.4.1 Use models to illustrate how processes in organisms contribute to the flow of energy and the cycling of matter within an ecosystem.	Bio.2.1.1 Compare the flow of energy and cycling of matter, such as water, carbon, nitrogen and oxygen, through ecosystems relating the significance of each to maintaining the health and sustainability of an ecosystem.	
LS.Bio.4.2 Use models to explain the relationship between the flow of energy and cycling of matter among organisms in an ecosystem.	Bio.2.1.1 Compare the flow of energy and cycling of matter, such as water, carbon, nitrogen and oxygen, through ecosystems relating the significance of each to maintaining the health and sustainability of an ecosystem.	
LS.Bio.5 Understand ecosystem dynamics, functioning, and resilience.	*Bio.2.1.3 Explain various ways organisms interact with each other (including predation,*	

	competition, parasitism, mutualism) and with their environments resulting in stability within ecosystems.	
LS.Bio.5.1 Use mathematics and computational thinking to explain how interactions between organisms (predator/prey, competition) affect carrying capacity and maintain stability in an ecosystem.	Bio.2.1.4 Explain why ecosystems can be relatively stable over hundreds or thousands of years, even though populations may fluctuate (emphasizing availability of food, availability of shelter, number of predators and disease).	
LS.Bio.5.2 Engage in argument from evidence to evaluate various solutions to reduce the impact of human activities on biodiversity and ecosystem health.	*Bio.2.2 Understand the impact of human activities on the environment (one generation affects the next).* Bio.2.2.1 Infer how human activities (including population growth, pollution, global warming, burning of fossil fuels, habitat destruction and introduction of nonnative species) may impact the environment. Bio.2.2.2 Explain how the use, protection and conservation of natural resources by humans impact the environment from one generation to the next.	

Heredity- Inheritance and Variation of Traits		
2023 Standards/Objectives	**2009 Essential Standards/Clarifying Objectives**	Notes
LS.Bio.6 Understand genetic mechanisms for variation.	*Bio.3.1 Explain how traits are determined by the structure and function of DNA.*	
LS.Bio.6.1 Use models to explain how DNA is passed from parents to offspring through the processes of meiosis and fertilization in sexual reproduction.	Bio.3.1.2 Explain how DNA and RNA code for proteins and determine traits.	

LS.Bio.6.2 Construct an explanation to summarize how inheritable genetic variations may result from: new genetic combinations in meiosis,mutations during replication, or mutations caused by environmental factors.	Bio.3.1.3 Explain how mutations in DNA that result from interactions with the environment (i.e. radiation and chemicals) or new combinations in existing genes lead to changes in function and phenotype. Bio.3.2.1 Explain the role of meiosis in sexual reproduction and genetic variation.	
LS.Bio.7 Understand types of inheritance and how the environment can influence traits.	*Bio.3.2 Understand how the environment, and/or the interaction of alleles, influences the expression of genetic traits.*	
LS.Bio.7.1 Use mathematics and computational thinking to predict the variation and distribution of expressed traits based on: Mendelian inheritance, co-dominance, incomplete dominance, multiple alleles, and sex-linked inheritance.	Bio.3.2.2 Predict offspring ratios based on a variety of inheritance patterns (including: dominance, co-dominance, incomplete dominance, multiple alleles, and sex-linked traits).	
LS.Bio.7.2 Analyze and interpret data to explain how polygenic traits result in a wide range of phenotypes.	Bio.3.2.2 Predict offspring ratios based on a variety of inheritance patterns (including: dominance, co-dominance, incomplete dominance, multiple alleles, and sex-linked traits).	
LS.Bio.7.3 Construct an explanation to summarize how traits result from interactions of genetic factors (multiple genes and/or alleles) and environmental factors.	Bio.3.2.3 Explain how the environment can influence the expression of genetic traits.	
LS.Bio.8 Understand applications of genetics and biotechnology.	*Bio.3.3 Understand the application of DNA technology.*	
LS.Bio.8.1 Analyze and interpret data to compare DNA samples.	Bio.3.3.1 Interpret how DNA is used for comparison and identification of organisms.	
LS.Bio.8.2 Obtain and communicate information that summarizes the impact of biotechnology applications on the individual, society, and the environment, including agriculture and medicine.	Bio.3.3.2 Summarize how transgenic organisms are engineered to benefit society. Bio.3.3.3 Evaluate some of the ethical issues surrounding the use of DNA technology	

	(including: cloning, genetically modified organisms, stem cell research, and Human Genome Project).	

Biological Evolution- Unity and Diversity		
2023 Standards/Objectives	**2009 Essential Standards/Clarifying Objectives**	Notes
LS.Bio.9 Understand natural selection as a mechanism for biological evolution.	*Bio.3.4 Explain the theory of evolution by natural selection as a mechanism of change over time in species.*	
LS.Bio.9.1 Analyze and interpret data to summarize how various factors such as geographic isolation, pesticide resistance, antibiotic resistance can influence natural selection.	Bio.1.2.3 Explain how specific cell adaptations help cells survive in particular environments (focus on unicellular organisms).	The focus on the adaptations of unicellular organisms has been deleted. This information is covered in middle school.
	Bio.2.1.2 Analyze the survival and reproductive success of organisms in terms of behavioral, structural, and reproductive adaptations.	
	Bio.3.4.1 Explain how fossil, biochemical, and anatomical evidence support the theory of evolution.	
	Bio.3.4.3 Explain how various disease agents (bacteria, viruses, chemicals) can influence natural selection.	
LS.Bio.9.2 Construct an explanation to illustrate how common ancestry and biological evolution are supported by multiple lines of empirical evidence.	Bio.3.4.1 Explain how fossil, biochemical, and anatomical evidence support the theory of evolution.	

LS.Bio.9.3 Use models to illustrate the conditions required for natural selection, including the overproduction of offspring, inherited variation, and the struggle to survive.	Bio.3.4.2 Explain how natural selection influences the changes in species over time.	
LS.Bio.9.4 Construct an explanation to explain how natural selection leads to adaptations within populations.	Bio.3.4.2 Explain how natural selection influences the changes in species over time.	
LS.Bio.10 Analyze evolutionary relationships among organisms.	*Bio.3.5 Analyze how classification systems are developed based upon speciation.*	
LS.Bio.10.1 Construct an explanation to illustrate how varying environmental conditions may result in: changes in the number of individuals of a species; the emergence of new species over time, or the extinction of other species.	*Bio.3.5 Analyze how classification systems are developed based upon speciation.* Bio.3.5.1 Explain the historical development and changing nature of classification systems.	Students are not required to know all the various classification systems from past to modern-day.
LS.Bio.10.2 Use models (including dichotomous keys, scientific nomenclature, cladograms, phylogenetic trees) to identify organisms and exemplify relationships.	Bio.3.5.2 Analyze the classification of organisms according to their evolutionary relationships (including: dichotomous keys and phylogenetic trees). Bio.3.5.1 Explain the historical development and changing nature of classification systems.	