Howard County Public School System
Curriculum for High School Science

Grade 10: Biology

Overview:

High school Biology will equip students to address the following essential questions as identified within the Next Generation Science Standards:

1. How do organisms live and grow?
2. How are characteristics of one generation passed to the next? How can individuals of the same species and even siblings have different characteristics?
3. What evidence shows that different species are related?
4. How and why do organisms interact with their environment, and what are the effects of those interactions?

The high school Performance Expectations (PEs) in the life sciences address essential questions about life and build on middle school ideas and experiences. They blend Disciplinary Core Ideas (DCI) with Scientific and Engineering Practices (SEP) and Crosscutting Concepts (CCC) to support students in developing usable knowledge to explain real-world phenomena in the life sciences. In Biology, students regularly engage in asking scientific questions that drive their investigations and lead to increasingly sophisticated evaluation of data and their presentation. Students also have opportunities to learn and apply engineering-specific practices such as designing solutions to identified problems. Read the full NGSS storyline for Life Science.

The learning sequence in Biology is organized around a series of driving questions that provide the context and motivation for learning. While exploring each driving question, students engage in unique learning experiences that are carefully designed to immerse them in the SEPs as they construct their understanding of important concepts. These experiences are carefully sequenced so that students encounter ideas that are developmentally and cognitively appropriate. By the end of the learning experiences, students will be able to meet the NGSS performance expectations and address the driving questions.

Performance Expectations:

The Next Generation Science Standards (NGSS), adopted as the Maryland Science Standards (MSS), are very different than previous standards documents. NGSS purposely combines the three dimensions of science learning into single, target statements for student learning known as Performance Expectations (PE). The three dimensions of science learning are: Science and Engineering Practices (SEP), Crosscutting Concepts (CCC), and Disciplinary Core Ideas (DCI).

Earlier science standards treated the three dimensions as separate and distinct. This treatment led to assessment and instruction that emphasized one dimension preferentially over the others. The combination of SEP, CCC, and DCI in each PE is not intended to limit instruction. Instead, the PEs are designed to guide assessment of student learning. The performance expectations for High School Biology support student learning in four main areas: *From Molecules to Organisms, Heredity, Biological Evolution,* and *Ecosystems.* The performance expectations for high school Biology are listed below:

HS-LS1 From Molecules to Organisms: Structures and Processes

Students who demonstrate understanding can:

HS-LS1-1.	**Construct an explanation based on evidence for how the structure of DNA determines the structure of proteins, which carry out the essential functions of life through systems of specialized cells.**
HS-LS1-2.	**Develop and use a model to illustrate the hierarchical organization of interaction systems that provide specific functions within multicellular organisms**
HS-LS1-3.	**Plan and conduct an investigation to provide evidence that feedback mechanisms maintain homeostasis.**
HS-LS1-4.	**Use a model to illustrate the role of cellular division (mitosis) and differentiation in producing and maintaining complex organisms.**
HS-LS1-5.	**Use a model to illustrate how photosynthesis transforms light energy into stored chemical energy.**
HS-LS1-6.	**Construct and revise an explanation based on evidence for how carbon, hydrogen, and oxygen from sugar molecules may combine with other elements to form amino acids and/or other large carbon-based molecules.**
HS-LS1-7.	**Use a model to illustrate that cellular respiration is a chemical process whereby the bonds of food molecules and oxygen molecules are broken and the bonds in new compounds are formed, resulting in a net transfer of energy.**

HS-LS2 Ecosystems: Interactions, Energy, and Dynamics

Students who demonstrate understanding can:

HS-LS2-1.	**Use mathematical and/or computational representations to support explanations of factors that affect carrying capacity of ecosystems at different scales.**
HS-LS2-2.	**Use mathematical representations to support and revise explanations based on evidence about factors affecting biodiversity and populations in ecosystems of different scales.**
HS-LS2-3.	**Construct and revise an explanation based on evidence for the cycling of matter and**

	flow of energy in aerobic and anaerobic conditions.
HS-LS2-4.	**Use mathematical representations to support claims for the cycling of matter and flow of energy among organisms in an ecosystem.**
HS-LS2-5.	**Develop a model to illustrate the role of photosynthesis and cellular respiration in the cyclin of carbon among the biosphere, atmosphere, hydrosphere, and geosphere.**
HS-LS2-6.	**Evaluate claims, evidence, and reasoning that the complex interactions in ecosystems maintain relatively consistent numbers and types of organisms in stable conditions, but changing conditions may result in a new ecosystem.**
HS-LS2-7.	**Design, evaluate, and refine a solution for reducing the impacts of human activities on the environment and biodiversity.**
HS-LS2-8	**Evaluate evidence for the role of group behavior on individual and species' chances to survive and reproduce.**

HS-LS3 Heredity: Inheritance and Variation of Traits

Students who demonstrate understanding can:

HS-LS3-1.	**Ask questions to clarify relationships about the role of DNA and chromosomes in coding the instructions for characteristic traits passed from parents to offspring.**
HS-LS3-2.	**Make and defend a claim based on evidence that inheritable genetic variations may result from (1) new genetic combinations through meiosis, (2) viable errors occurring during replication, and/or (3) mutations caused by environmental factors.**
HS-LS3-3.	**Apply concepts of statistics and probability to explain the variation and distribution of expressed traits in a population.**

HS-LS4 Biological Evolution: Unity and Diversity

Students who demonstrate understanding can:

HS-LS4-1	**Communicate scientific information that common ancestry and biological evolution are supported by multiple lines of empirical evidence.**
HS-LS4-2	**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.**

HS-LS4-3	**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.**
HS-LS4-4	**Construct an explanation based on evidence for how natural selection leads to adaptation of populations.**
HS-LS4-5	**Evaluate the evidence supporting claims that changes in environmental conditions may result in (1) increases in the number of individual of some species, (2) the emergence of new species over time, and (3) the extinction of other species.**
HS-LS4-6	**Create or revise a simulation to test a solution to mitigate adverse impacts of human activity on biodiversity.**

HCPSS Learning Sequence:

Students will continue to develop their understanding of the four disciplinary core ideas in the biological sciences throughout the school year. The high school performance expectations in Biology allow high school students to explain more in-depth phenomena central not only to the biological sciences, but to Earth and space sciences and the physical sciences as well. These performance expectations blend the core ideas with scientific and engineering practices and crosscutting concepts to support students in developing useable knowledge to explain ideas across the science disciplines. While the performance expectations shown in high school Biology couple particular practices with specific disciplinary core ideas, instruction will include the use of many science and engineering practices that lead to the performance expectations.

The Biology course is organized into four units:

Unit 1:	Unit 2:	Unit 3:	Unit 4:
From Molecules to Organisms: Structures and Processes	**Heredity: Inheritance and Variation of Traits**	**Biological Evolution: Unity and Diversity**	**Ecosystems: Interactions, Energy, and Dynamics** ***EL***

EL *indicates that Maryland Environmental Literacy Standards are including within this learning sequence.*

Students develop understanding of a wide range of topics in Biology by using the science and engineering practices and crosscutting concepts. In Unit 1: *From Molecules to Organisms*, students will use investigations to gather evidence to support explanations of cell function. They will develop understanding of the role of proteins in cells and living systems. Students will

also use models to explain photosynthesis, respiration, and the cycling of matter and the flow of energy in living systems.

In Unit 2: *Heredity*, students will use science and engineering practices to explain the genetic variation in a population and why individuals of the same species vary in how they look, function, and behave. Students will explain the mechanism of genetic inheritance and describe the environmental and genetic causes of gene mutation and the alteration of gene expressions.

In Unit 3: *Biological Evolution*, students will use the science and engineering practices to explain the processes of natural selection and evolution. They will be able to communicate how multiple lines of evidence support the explanations for these processes. Students will understand the role of genetic variation in natural selection and use probability to explain trends in populations with respect to advantageous heritable traits in specific environments.

In Unit 4: *Ecosystems*, students will use science and engineering practices to demonstrate understanding of fundamental ecological concepts including carrying capacity, biodiversity, the cycling of matter, and the flow of energy in an ecosystem. Students will also develop design solutions for reducing the impact of human activities in the environment and maintaining biodiversity.