High School Core Learning Goals
BIOLOGY

Core Learning Goals for:

- Skills and Processes
- Concepts

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Maryland State Department of Education
Achievement Matters Most

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GOAL 1: SKILLS AND PROCESSES FOR BIOLOGY ASSESSMENT

The student will demonstrate ways of thinking and acting inherent in the practice of science. The student will use the language and instruments of science to collect, organize, interpret, calculate, and communicate information.

1. ***<u>Expectation</u>: The student will explain why curiosity, honesty, openness, and skepticism are highly regarded in science.***

<u>Assessment Limits/Indicators</u>

(1) The student will recognize that real problems have more than one solution and decisions to accept one solution over another are made on the basis of many issues.

(2) The student will modify or affirm scientific ideas according to accumulated evidence.

(3) The student will critique arguments that are based on faulty, misleading data or on the incomplete use of numbers.

(4) The student will recognize data that are biased.

(5) The student will explain factors that produce biased data (incomplete data, using data inappropriately, conflicts of interest, etc.).

2. ***<u>Expectation</u>: The student will pose scientific questions and suggest investigative approaches to provide answers to questions.***

<u>Assessment Limits/Indicators</u>

(1) The student will identify meaningful, answerable scientific questions.

(2)[NTB] The student will pose meaningful answerable scientific questions.

(3) The student will formulate a working hypothesis.

(4) [NTB] The student will test a working hypothesis.

(5) The student will select appropriate instruments and materials to conduct an investigation.

(6) The student will identify appropriate methods for conducting an investigation (independent and dependent variables, proper controls, repeat trials, appropriate sample size, etc.).

(7) The student will use relationships discovered in the lab to explain phenomena observed outside the laboratory.

(8) The student will defend the need for verifiable data.

3. ***<u>Expectation</u>: The student will carry out scientific investigations effectively and employ the instruments, systems of measurement, and materials of science appropriately.***

<u>Assessment Limits/Indicators</u>

(1) [NTB] The student will develop and demonstrate skills in using lab and field equipment to perform investigative techniques.

(2) The student will recognize safe laboratory procedures.

(3) [NTB] The student will demonstrate safe handling of the chemicals and materials of science.

(4) [NTB] The student will learn the use of new instruments and equipment by following instructions in a manual or from oral direction.

4. ***<u>Expectation</u>: The student will demonstrate that data analysis is a vital aspect of the process of scientific inquiry and communication.***

<u>Assessment Limits/Indicators</u>

(1) The student will organize data appropriately using techniques such as tables, graphs, and webs. (for graphs: axes labeled with appropriate quantities, appropriate units on axes, axes labeled with appropriate intervals, independent and dependent variables on correct axes, appropriate title)

(2) The student will analyze data to make predictions, decisions, or draw conclusions.

(3) The student will use experimental data from various investigators to validate results.

(4) The student will determine the relationships between quantities and develop the mathematical model that describes these relationships.

(5) The student will check graphs to determine that they do not misrepresent results.

(6) The student will describe trends revealed by data.

(7) The student will determine the sources of error that limit the accuracy or precision of experimental results.

(8) [NTB] The student will use models and computer simulations to extend his/her understanding of scientific concepts.

(9) The student will use analyzed data to confirm, modify, or reject a hypothesis.

5. ***<u>Expectation</u>: The student will use appropriate methods for communicating in writing and orally the processes and results of scientific investigation.***

<u>Assessment Limits/Indicators</u>

(1) The student will demonstrate the ability to summarize data (measurements/observations).

(2) The student will explain scientific concepts and processes through drawing, writing, and/or oral communication.

(3) [NTB] The student will use computers and/or graphing calculators to produce the visual materials (tables, graphs, and spreadsheets) that will be used for communicating results.

(4) The student will use tables, graphs, and displays to support arguments and claims in both written and oral communication.

(5) The student will create and/or interpret graphics. (scale drawings, photographs, digital images, field of view, etc.)

(6) The student will read a technical selection and interpret it appropriately.

(7) The student will use, explain, and/or construct various classification systems.

(8) The student will describe similarities and differences when explaining concepts and/or principles.

(9) The student will communicate conclusions derived through a synthesis of ideas.

6. ***<u>Expectation</u>: The student will use mathematical processes.***

<u>Assessment Limits/Indicators</u>

(1) The student will use ratio and proportion in appropriate situations to solve problems.

(2) [NTB] The student will use computers and/or graphing calculators to perform calculations for tables, graphs, or spreadsheets.

(3) The student will express and/or compare small and large quantities using scientific notation and relative order of magnitude.

(4) The student will manipulate quantities and/or numerical values in algebraic equations.

(5) The student will judge the reasonableness of an answer

7. ***<u>Expectation</u>: The student will show that connections exist both within the various fields of science and among science and other disciplines including mathematics, social studies, language arts, fine arts, and technology.***

<u>Assessment Limits/Indicators</u>

(1) The student will apply the skills, processes and concepts of biology, chemistry, physics, or earth science to societal issues.

(2) The student will identify and evaluate the impact of scientific ideas and/or advancements in technology on society.

(3) [NTB] The student will describe the role of science in the development of literature, art, and music.

(4) [NTB] The student will recognize mathematics as an integral part of the scientific process.

(5) [NTB] The student will investigate career possibilities in the various areas of science.

(6) The student will explain how development of scientific knowledge leads to the creation of new technology and how technological advances allow for additional scientific accomplishments.

GOAL 3: CONCEPTS OF BIOLOGY

The student will demonstrate the ability to use the scientific skills and processes (Core Learning Goal 1) and major biological concepts to explain the uniqueness and interdependence of living organisms, their interactions with the environment, and the continuation of life on earth.

1. ***Expectation:*** ***The student will be able to explain the correlation between the structure and function of biologically important molecules and their relationship to cell processes.***

Indicators of Learning

(1) The student will be able to describe the unique characteristics of chemical substances and macromolecules utilized by living systems.

Assessment limits

- *water (inorganic molecule, polarity, density, and solvent properties)*
- *carbohydrates (organic molecule; monosaccharides are building blocks; supplier of energy and dietary fiber; structural component of cells: cell wall, cellulose)*
- *lipids (organic molecule; component of cell membranes; stored energy supply)*
- *proteins (organic molecule; amino acids are building blocks; structural and functional role, including enzymes)*
- *nucleic acids (organic molecule; nucleotides are building blocks - sugar, phosphate, & nitrogen bases; DNA is a double helix, RNA is a single strand; DNA replication;DNA role in storage of genetic information)*
- *minerals (inorganic substances essential for cellular processes)*
- *vitamins (organic molecule; role in human body: C – wound healing, K – blood clotting, D – bone growth)*

(2) The student will be able to discuss factors involved in the regulation of chemical activity as part of a homeostatic mechanism.

Assessment limits

- *osmosis (predicting water flow across a membrane based on the cell's environment; explain role in living systems)*
- *temperature (effect upon enzyme activity and metabolic rate; effect upon rate of diffusion and states of matter)*
- *pH (pH scale: relative values for acids and bases; effect on living systems: cellular, organismal)*
- *enzyme regulation (effect of temperature, pH, and enzyme/substrate concentration on enzyme activity)*

(3) The student will be able to compare the transfer and use of matter and energy in photosynthetic and non-photosynthetic organisms.

Assessment limits

- *water cycle (movement of water between living systems and the environment)*
- *carbon cycle (movement of carbon between living systems and the environment, cyclic relationship between photosynthesis and respiration)*
- *nitrogen cycle (roles of bacteria; human impact)*
- *photosynthesis (energy conversion: light, chemical; basic molecules involved)*
- *cellular respiration (distinctions between aerobic and anaerobic, energy released, use of oxygen; basic molecules involved in aerobic)*
- *chemosynthesis (from inorganic compounds)*
- *ATP (energy carrier molecule)*

2. Expectation: The student will demonstrate an understanding that all organisms are composed of cells which can function independently or as part of multicellular organisms.

Indicators of Learning

(1) The student will explain processes and the function of related structures found in unicellular and multicellular organisms.

Assessment limits

- *transportation of materials (role of cellular membranes; role of vascular tissues in plants and animals; role of circulatory systems)*
- *waste disposal (role of cellular membrane; role of excretory and circulatory systems)*
- *movement (cellular – flagella, cilia, pseudopodia; interaction between skeletal and muscular systems)*
- *feedback (maintaining cellular and organismal homeostasis – water balance, pH, temperature, role of endocrine system)*
- *asexual (binary fission, budding, vegetative, mitosis: role in growth and repair, chromosome number remains the same) and sexual reproduction (angiosperms, mammals)*
- *control of structures (cellular organelles and human systems) and related functions (role of nucleus, role of sensory organs and nervous system)*
- *capture and release of energy (chloroplasts, mitochondria)*
- *protein synthesis (ribosomes)*

(2) The student will conclude that cells exist within a narrow range of environmental conditions and changes to that environment, either naturally occurring or induced, may cause changes in the metabolic activity of the cell or organism.

Assessment limits

- *pH*
- *temperature*
- *light*
- *water*
- *oxygen*
- *carbon dioxide*
- *radiation (role in cancer or mutations)*
- *toxic substances (natural, synthetic)*

3. Expectation: The student will analyze how traits are inherited and passed on from one generation to another.

Indicators of Learning

(1) The student will demonstrate that the sorting and recombination of genes during sexual reproduction has an effect on variation in offspring.

Assessment limits

- *meiosis (process that forms gametes; chromosome number reduced by one-half; crossing-over occurs; new gene combinations)*
- *fertilization (combination of gametes to form zygote)*

(2) The student will illustrate and explain how expressed traits are passed from parent to offspring.

Assessment limits

- *phenotypes (expression of inherited characteristics)*
- *dominant and recessive traits*
- *sex-linked traits (X-linked only; recessive phenotypes are more often expressed in the male)*
- *genotypes (represented by heterozygous and homozygous pairs of alleles)*
- *punnett square (use to predict and/or interpret the results of a genetic cross; translate genotypes into phenotypes - monohybrid only)*
- *pedigree (use to interpret patterns of inheritance within a family)*

(3) The student will explain how a genetic trait is determined by the code in a DNA molecule.

Assessment limits

- *definition of gene (a segment of DNA that codes for a protein or RNA)*
- *sequence of nitrogen bases directing protein formation (role of DNA, mRNA, tRNA, rRNA)*
- *proteins determine traits*

(4) The student will interpret how the effects of DNA alteration can be beneficial or harmful to the individual, society, and/or the environment.

Assessment limits

- *mutations*
- *chromosome number (abnormalities)*
- *genetic engineering (gene splicing, recombinant DNA, cloning)*

4. Expectation: The student will explain the mechanism of evolutionary change.

Indicators of Learning

(1) The student will explain how new traits may result from new combinations of existing genes or from mutations of genes in reproductive cells within a population.

Assessment limits

- *natural selection (definition; effects of environmental pressure)*
- *adaptations (effects on survival)*
- *variation (effects on survival and reproductive success)*

(2) The student will estimate degrees of relatedness among organisms or species.

Assessment limits

- *classification (recognize relationships among organisms; distinguish between prokaryotes and eukaryotes)*
- *anatomical similarities (evolutionary relationships; homologous structures)*
- *similarities of DNA base and/or amino acid sequence (including results from gel electrophoresis)*

5. ***<u>Expectation</u>: The student will investigate the interdependence of diverse living organisms and their interactions with the components of the biosphere.***

Indicators of Learning

(1) The student will analyze the relationships between biotic diversity and abiotic factors in environments and the resulting influence on ecosystems.

<u>Assessment limits</u>

<u>Abiotic/ Biotic Factors</u>

- *space*
- *soil*
- *water*
- *air*
- *temperature*
- *food*
- *light*
- *organisms*

<u>Relationships</u>

- *predator - prey*
- *parasite - host*
- *mutualism*
- *commensalism*
- *competition*

(2) The student will analyze the interrelationships and interdependencies among different organisms and explain how these relationships contribute to the stability of the ecosystem.

<u>Assessment limits</u>

- *diversity*
- *succession*
- *trophic level (producer; consumer: herbivore, carnivore, omnivore, scavenger; decomposer)*
- *niche(role of organism within an ecosystem)*
- *pyramid (energy, biomass)*

(3) The student will investigate how natural and man-made changes in environmental conditions will affect individual organisms and the dynamics of populations.

<u>Assessment limits</u>

- *depletion of food*
- *destruction of habitats*
- *disease*
- *natural disasters*
- *pollution*
- *population increase*
- *urbanization*

(4) The student will illustrate how all organisms are part of and depend on two major global food webs that are positively or negatively influenced by human activity and technology.

Assessment limits

- *oceanic food web*
- *terrestrial food web*

6. Expectation: The student will investigate a biological issue and develop an action plan.

Indicators of Learning

(1) [NTB] The student will analyze the consequences and/or trade-offs between technological changes and their effect on the individual, society, and the environment. They may select topics such as bioethics, genetic engineering, endangered species, or food supply.

(2) [NTB] The student will investigate a biological issue and be able to defend their position on topics such as animal rights, drug and alcohol abuse, viral diseases (e.g., AIDS), genetic engineering, bioethics, biodiversity, population growth, global sustainability, or origin of life.