Howard County Public School System Essential Curriculum for Middle School Science

(Adapted from the Maryland Voluntary State Curriculum for Science 6-8)

GRADE 7

Life Science – The students will use scientific skills and processes to explain the dynamic nature of living things, their interactions, and the results from the interactions that occur over time.

DURING THE GRADE 7 SCIENCE COURSE, THE EXPECTATION IS THAT ALL STUDENTS WILL HAVE A MEANINGFUL WATERSHED EXPERIENCE THAT RELATES TO THE CHESAPEAKE BAY OR STREAM HEALTH PER THE CHESAPEAKE BAY 2000 AGREEMENT.

UNIT I: Investigating the Nature of Living Things

Goal 1. Gather and organize data to defend or argue the proposition that all living things are cellular (composed of cells) and that cells carry out the basic life functions.

a. Use microscopes or other magnifying instruments to observe, describe, and compare the cellular composition of different body tissues and organs in a variety of organisms (animals and plants).
- Describe the technological advancements in the microscope that have improved our ability to investigate unicellular and multicellular organisms.
- Demonstrate competency in the use of the microscope and the preparation of a wet mount slide.
- Describe the contributions of selected people (i.e., Janssen, Hooke, and Leeuwenhoek) who were involved with the development of the microscope.
- Explain and give examples of the components of the cell theory as it developed.
- Describe the contributions of selected people (i.e., Hooke, Schleiden, Schwann) who were involved with the development of the cell theory.
- Compare and contrast the structures and functions of the compound light microscope, Scanning Electron Microscope, and Transmission Electron Microscope. **[G/T]**

b. Based on data from readings and designed investigations, cite evidence to illustrate that the life functions of multicellular organisms (plant and animal) are carried out within complex systems of different tissues, organs and cells.
- Describe how living organisms perform the following functions:
  - Extracting energy from food
  - Getting rid of wastes
  - Making new materials.
- List characteristics common to all living organisms.
- Identify the parts and general functions of cell structures visible with the light microscope including cell wall, membranes, nucleus, cytoplasm, chloroplasts, vacuoles, and chromosomes as well as mitochondria.

- Design a model of the cell and discuss the strengths and limitations of the model.
- Compare plant and animal cells emphasizing how they are more alike than different.
- Recognize unicellular organisms such as Euglena and algae and compare them to plant and animal cells.

c. Based on research and examples from video technology, explain that the repeated division of cells enables organisms to grow and make repairs.
- Cite examples of how various living organisms, including single-celled organisms, grow, reproduce (i.e., mitosis), and make repairs.

d. Collect data from investigations using single celled organisms, such as yeast or algae to explain that a single cell carries out all the basic life functions of a multicellular organism.
- Reproducing
- Extracting energy from food
- Getting rid of wastes

e. Based on data compiled from a number of lessons completed, take and defend a position on the statement "The way in which cells function is the same in all organisms."

Goal 2. Explain that the transfer and transformation of matter and energy links organisms to one another and to their physical setting.

a. Cite evidence from research and observations that food provides molecules that serve as fuel and building materials for all organisms.
- Identify and describe that food molecules such as proteins, carbohydrates, and fats are rearranged in order to provide a source of energy for plant and animal cells.

b. Cite evidence from research and observations that organisms that eat plants or animals break down what they have consumed (food) to produce the materials and energy they need to survive or store for later use.
- Compare how plants and animals obtain the energy from food sources needed for life functions from proteins, carbohydrates, and fats.
- Recognize and describe that both plant and animal cells use cellular respiration to release energy for the work their cells do.

c. Investigate and describe the processes that enable plants to use the energy from light to make sugars (food) from carbon dioxide and water.
- Identify photosynthesis as a process that captures energy.

d. Provide evidence from research to explain how plants can use the food they make immediately for fuel or stored for later use.
- Identify cell respiration as the process that releases energy.

e. Ask and seek answers to questions about the fact that transfer of matter between organisms continues indefinitely because organisms are decomposed after death to return food materials to the environment.

f. Provide evidence that supports the premise "In the flow of matter system the total amount of matter remains constant even though its form and location change."
- Carbon cycle
- Nitrogen cycle
- Food chains and food webs

Unit II: Investigating Human Biology

Goal 1. Recognize and provide examples that human beings, like other organisms, have complex body systems of cells, tissues and organs that interact to support an organism's growth and survival.

a. Describe and explain that the complex set of systems found in multicellular organisms are made up of different kinds of tissues and organs which are themselves composed of differentiated cells.
- List, explain, and give examples of the levels of cellular organization found in living organisms.
- Describe how similar cells function as tissues.
- Describe how tissues interact as organs.
- Describe how organs serve the needs of cells by providing nutrients and removing wastes.
- Describe how cells, tissues, and organs interrelate to form systems and explain how the systems serve the organism as a whole.
- Relate the form and function of various cells, tissues, organs, and organ systems.

b. Select several body systems and explain the role of cells, tissues, and organs that effectively carry out a vital function for the organism, such as:
- Obtaining food and providing energy (digestive, circulatory, respiratory)
- Defense (nervous, endocrine, circulatory, muscular, skeletal, immune)
- Reproduction (reproductive, endocrine, circulatory)
- Waste removal (excretory, respiratory, circulatory)
- Breathing (respiratory, circulatory)

c. Develop a response that explains the meaning of the statement, "The specialization of cells serves the operation of the organs, and the organs serve the needs of the cells."

d. Investigate ways in which the various organs and tissues function to serve the needs of cells for food, air, and waste removal.
- Describe the structures of the integumentary system (i.e., skin, hair, nails). Explain the function of each structure and relate structure to function.
- Describe the structures of the muscular-skeletal system (i.e., bones, joints, muscles, tendons, ligaments, and cartilage). Explain how these structures work together to enable human movement and relate structure to function.
- Describe the structures of the digestive system (i.e., mouth, esophagus, stomach, small intestine, large intestine, rectum, anus, salivary glands, liver, gall bladder, and pancreas). Explain the function of each structure in human digestion and relate structure to function.
    - Give examples of how specific vitamins and minerals enable the human body to function properly. (e. g., scurvy, osteoporosis)
- Describe the structures of the circulatory system (i.e., heart, arteries, veins, capillaries, plasma, red blood cells, white blood cells, and platelets). Explain the function of each structure in human circulation and relate structure to function.
- Describe the structures of the respiratory system (i.e., nose, pharynx, larynx, trachea, lungs, bronchi, alveoli, and diaphragm). Explain the function of each structure in human respiration and relate structure to function.
- Describe the structures of the excretory system (i.e., kidneys, ureters, bladder, and urethra). Explain the function of each structure in human excretion and relate structure to function.

- Describe the structures of the nervous system (i.e., brain, spinal cord, nerves, neurons, eyes, ears, skin, nose, and tongue). Explain how the nervous system regulates and coordinates life functions and relate structure to function.
- Describe the structures of the endocrine system (i.e., hypothalamus, pituitary gland, thyroid gland, adrenal gland, and pancreas). Explain how hormones regulate functions such as growth, development, metabolism, and response to danger.
- Describe the structures of the immune/lymphatic system (i.e., white blood cells, thymus, spleen, tonsils, and lymph nodes). Explain how the human body mounts an immune response and relate structure to function.
    - Identify the contributions of Pasteur and others in changing attitudes about the causes of disease.
    - Identify the contributions of Pasteur and others in changing practices to prevent disease (i.e. e., pasteurization, aseptic surgical techniques).
    - Explain how sanitary practices (e. g., hand washing, proper storage of food) prevent disease and enable people to stay healthy.
    - Explain how vaccinations prevent disease.
    - Discuss HIV and its effect on the immune system.
- Explain how the systems work together to enable organisms to carry out certain life functions (i.e., maintenance, repair, growth, and activity level). Pose "What If?" questions such as "What might happen if the lungs weren't there or weren't working?"
- Develop a response that explains the meaning of the statement, "The specialization of cells serves the operation of the organs, and the organs serve the needs of the cells."
- Analyze the interactions among three selected human body systems. **[G/T]**
- Describe the processes that occur in human organisms when the supply of food, water, or air is eliminated. **[G/T]**

e. Recognize and explain how disease disrupts the structure and function of living organisms.

- Give examples of acquired factors (e. g., dietary deficiencies, toxins, and pathogens) that can result in poor health.
- Give examples of environmental factors (e. g., lead, mercury, high levels of ozone in the air, ultraviolet radiation) that can be harmful to humans, and suggest steps that can be taken to avoid and/or reduce exposure.
- Classify communicable diseases by their causative agents (i.e., viruses, bacteria, fungi, and parasites).
- Distinguish between a treatment and a cure for a disease (e. g., insulin is a treatment, not a cure for diabetes).
- Cite examples of diseases that modern medicine can treat but not cure.
- Cite examples of how the state of medical technology (e. g., sterilizers, artificial joints and limbs, dialysis machines, X-rays, MRIs) influenced the life of people in the past and continues to do so.

UNIT III: Investigating Genetics

Goal 1. Explain the ways that genetic information is passed from parent to offspring in different organisms.

a. Investigate and explain that in some kinds of organisms, all the genes come from a single parent, whereas in organisms that have sexes, typically half of the genes come from each parent.
   - Distinguish among genes, chromosomes, and traits.
   - Compare inherited traits (eye color, shape of ear), acquired traits (taillessness in mice), and traits that are the result of an interaction between genes and the environment (e. g., height, weight, skin color).
   - Give examples of inherited conditions (e. g., sickle cell anemia, cystic fibrosis, Type I diabetes) that can result in poor health.

b. Investigate and explain that in sexual reproduction, a single specialized cell from a female (egg) merges with a specialized cell from a male (sperm) and the fertilized egg now has genetic information from each parent, that multiplies to form the complete organism composed of about a trillion cells, each of which contains the same genetic information.

c. Investigate organisms that reproduce asexually to identify what traits they receive from the parent.
   - Justify why some organisms reproduce both asexually and sexually at different times (e. g., some plants use sexual reproduction in favorable environmental conditions, but develop spores to survive in hostile conditions). **[G/T]**

d. Use information about how the transfer of traits from parent or parents to offspring occurs, to explain how selective breeding for particular traits has resulted in new varieties of cultivated plants and domestic animals.

e. Identify evidence to support the idea that there is greater variation among offspring of organisms that reproduce sexually than among those that reproduce asexually.
   - Apply basic knowledge of Punnett squares to predict possible traits in offspring (i.e., genotype and phenotype).
   - Explain why offspring are not identical to the parents in sexually reproducing organisms.

UNIT IV: Investigating Evidence of Change

Goal 1. Compile evidence to verify the claim of biologists that the features of organisms connect or differentiate them—these include external and internal structures (features) and processes.

a. Provide examples and explain that organisms sorted into groups share similarities in external structures as well as similarities in internal anatomical structures and processes which can be used to infer the degree of relatedness among organisms.
   - Vascular – non-vascular plants
   - Closed – open circulatory systems
   - Asexual – sexual reproduction
   - Respiration (lungs-gills-skin)
   - Digestion

b. Identify general distinctions among organisms that support classifying some things as plants, some as animals, and some that do not fit neatly into either group.
   - Animals consume food
   - Plants make food

c. Use analogies, models, or drawings to represent that animals and plants have a great variety of body plans and internal structures that define the way they live, grow, survive, and reproduce.

Goal 2. Explain that in any particular environment, the growth and survival of organisms and species depend on the physical conditions.

a. Cite examples and describe that small differences between parents and offspring can accumulate (through selective breeding) in successive generations so that descendants are very different from their ancestors**.**
   - Define variation as differences within a trait within members of a single species.
   - Describe the variation of a single trait within a group of organisms.

b. Explain that in all environments - freshwater, marine, forest, desert, grassland, mountain, and others - organisms with similar needs may compete with one another for resources, including food, space, water, air, and shelter**.**

c. Explain that in any particular environment individual organisms with certain traits are more likely than others to survive and have offspring**.**
   - Explain how traits (e. g., color and pattern) can affect the survival of an organism.

d. Explain, with examples, ways that people control some characteristics of plants and animals they raise by selective breeding.

e. Describe ways in which changes in environmental conditions can affect the survival of individual organisms and entire species.

f. Describe how sediments of sand and smaller particles (sometimes containing the remains of organisms) are gradually buried and are cemented together by dissolved minerals to form solid rock; and describe that such fossils provide evidence for the long history of changing life forms whose remains are found in the rocks**.**

g. Explain that the more recently deposited rock layers are likely to contain fossils resembling existing species**.**
   - Use the evidence in sedimentary rock layers to develop a model of the subdivisions of the Earth's geologic past.
   - Trace the evolutionary history of a plant or animal. Explain that the more recently deposited rock layers are likely to contain fossils resembling existing species.
   - Infer the relationship between the Earth's environmental conditions and life forms present during each of the geological time periods.
   - Explain the effect that dramatic climate changes, such as glaciation, have had upon determination of species' survival and adaptation. **[G/T]**

Goal 3. Recognize and describe that evolutionary change in species over time occurs as a result of natural variation in organisms and environmental changes.

a. Recognize and describe that gradual (climatic) and sudden (floods and fires) changes in environmental conditions affect the survival of organisms and populations**.**

b. Recognize that adaptations may include variations in structures, behaviors, or physiology, such as spiny leaves on a cactus, birdcalls, and antibiotic resistant bacteria.

c. Recognize and describe that adaptation and speciation involve the selection of natural variations in a population.
   - Explain the theory of natural selection that in any particular environment individual organisms with certain traits are more likely than others to survive and have offspring. Include Darwin's contributions.
   - Provide evidence of how adaptations lead to evolution.
   - Give examples and explain that in addition to similarities in external features among organisms there are similarities in internal anatomical features that can be used to infer the degree of relatedness among organisms.

d. Recognize and describe that extinction occurs when the adaptive traits of a population do not support its survival.
e. Recognize that evolution accounts for the diversity of species.

UNIT V: Investigating Ecology

Goal 1. Give reasons supporting the fact that the number of organisms an environment can support depends on the physical conditions and resources available.

a. Explain that populations increase or decrease relative to the availability of resources and the conditions of the environment.
- Define ecosystem.
- Describe the components of an ecosystem, including biotic and abiotic factors such as pH, salinity, temperature range, soil composition, and quantity of light.
- Identify the various types of niches (i.e., producer, consumer, decomposer, scavenger) that exist within any ecosystem.
- Discuss how organisms within an ecosystem depend on one another.
- Predict an ecosystem's stability when one factor (abiotic or biotic) is changed.
- Diagram the carbon dioxide-oxygen, water, and nitrogen cycles.
- Describe various ways that matter is cycled through nature, but that the amount of matter remains the same (i.e. e., how minerals such as calcium are cycled through living things).

b. Identify and describe factors that could limit populations within any environment, such as disease, introduction of a nonnative species, depletion of resources, etc.
- Distinguish among population, community, and biome.
- Explain carrying capacity and limiting factors such as available resources, number of predators, disease, and climatic fluctuations.
- Compare various land and water biomes in terms of carrying capacity and limiting factors.
- Predict future population patterns based on environmental change. **[G/T]**

c. Explain that within any environment organisms with similar needs may compete with one another for resources.
- Discuss why producers are essential for the survival of an ecosystem.
- Use a food chain to model the transfer of energy from one organism to another in an ecosystem such as organisms that eat plants or animals break down what they have consumed (food) to produce the materials and energy they need to survive or stored for later use.
- Identify the relationship between a food chain and a food web.
- Compare characteristics of food webs from different land and water biomes.
- Develop a food web that illustrates the movement of matter through a given ecosystem.

d. Cite examples to illustrate that competition is reduced when organisms use different sets of resources, such as birds in a forest eat different kinds and sizes of seeds.
- Recognize and describe that competition is reduced when organisms use different sets of resources, such as birds in a forest eat different kinds and sizes of seeds.
- Classify examples of interactions between organisms as competition, predation (predator/prey), and symbiosis (commensalism, mutualism, parasitism-parasite/host).

- Design an ideal protected ecosystem incorporating unicellular and multicellular producers, consumers, and decomposers. **[G/T]**

Goal 2. Recognize and compare how different parts of the world have varying amounts and types of natural resources and how the use of those resources impacts environmental quality in terms of living organisms.

a. Identify and describe natural resources as:
   - Land
   - Forests
   - Water
   - Wildlife.

b. Identify and describe the distribution of natural resources around the Earth.

c. Identify and describe how the natural change processes may be affected by human activities.
   - Agriculture
   - Beach preservation
   - Development/construction
   - Stream/river alteration

d. Identify and describe problems associated with obtaining, using, and distributing natural resources.

e. Identify possible solutions to problems associated with obtaining, using, and distributing natural resources.

Goal 3. Recognize and explain the impact of a changing human population on the use of natural resources and on environmental quality.

a. Based on data, identify and describe the positive and negative impacts of an increasing human population on the use of natural resources.
   - Graphically represent the changes in a population over time.
   - Infer from a graph the effect of an environmental change on the population size of various organisms in the ecosystem.
   - Critically evaluate the impact of an increasing human population on an ecosystem such as evaluating the impact of natural resources use such as land use, forests, water, and wildlife (e. g., effects of land development on tiger beetle habitats).

Goal 4. Recognize and explain that human-caused changes have consequences for Maryland's environment as well as for other places and future times.

a. Identify and describe a range of local issues that have an impact on people in other places.
   - Determine factors such as pH, salinity, dissolved oxygen, and introduction of non-native species that affect the productivity and vulnerability of organisms in the Chesapeake Bay.
   - Identify the relationship between land use/development, fragmentation, and sedimentation and their effects on the Chesapeake Bay.
   - Examine the effect of sediment on aquatic life in the Chesapeake Bay, and discuss its strengths and limitations.
   - Describe the effect of nutrients on life in the Chesapeake Bay and the effect of water conservation on reducing nutrient pollution.
   - Analyze a specific ecological problem related to the Chesapeake Bay. **[G/T]**

b. Recognize and describe how environmental change in one part of the world can have consequences for other parts of the world.
c. Identify and describe that ecosystems can be impacted by human activities.
   - Protection of the Chesapeake Bay watershed
   - Resource acquisition and use
   - Land use decisions (agriculture, mining, and development)
   - Recycling
   - Use and disposal of toxic substances

Goal 5. Recognize and describe that environmental changes can have local, regional, and global consequences.

a. Identify and describe a local, regional, or global environmental issue.
b. Identify and describe that different individuals or groups are affected by an issue in different ways.
   - Investigate issues related to the Chesapeake Bay from different viewpoints (e.g., watermen, politicians, scientists, and land developers.

Goal 6. Recognize and explain how human activities can accelerate or magnify many naturally occurring changes in terms of living organisms.

a. Based on data from research identify and describe how natural processes change the environment.
   - Cyclic climate change
   - Sedimentation in watersheds
   - Population cycles
   - Extinction
b. Identify and describe how human activities produce changes in natural processes:
   - Climate change
   - Loss of habitat
   - Introduction of nonnative species
   - Cycling of matter.