



Science Standard 6
Life Processes
Grade Level Expectations

Science Standard 6 Life Processes

The natural world is defined by organisms and life processes which conform to principles regarding conservation and transformation of matter and energy. Living organisms use matter and energy to build their structures and conduct their life processes, have mechanisms and behaviors to regulate their internal environments and to respond to changes in their surroundings. Knowledge about life processes can be applied to improving human health and well being.

Strand	Grades K-3	Grades 4-5	Grades 6-8	Grades 9-12
<p><u>Structure/Function Relationship</u></p> <p>Enduring Understanding: Living systems, from the organismic to the cellular level, demonstrate the complementary nature of structure and function.</p> <p>Essential Question: How does structure relate to function in living systems from the cellular to the organismic level?</p>	<p>1. Plants and animals are similar to and different from each other in observable structures and behavior. These characteristics distinguish them from each other and from nonliving things.</p> <p>2. Each plant or animal has different structures that serve different functions in growth, survival and reproduction.</p> <p>3. In animals the skeletal-muscular system provides structure, support and enables movement.</p>	<p>1. Structures that function for similar purposes in living things may have different appearances.</p> <p>2. The digestive system has major structures that function to break down food for use in the body. The major parts of the digestive system include the mouth, esophagus, stomach, small intestine, and large intestine.</p> <p>3. Organisms can be grouped based on similarities and differences in their structures and functions. These may include characteristics such as appendages, roots and leaves of plants, or the presence or lack of a backbone.</p>	<p>1. Living organisms share common characteristics that distinguish them from non-living, dead, and dormant things. They grow, consume nutrients, exchange gases, respond to stimuli, reproduce, need water, eliminate waste, and are composed of cell(s).</p> <p>2. Living systems in all kingdoms demonstrate the complementary nature of structure and function. Important levels of organization for structure and function include cells, tissues, organs, organ systems, and organisms.</p> <p>3. Most organisms are single celled while others are multi-cellular. Multi-cellular organisms consist of individual cells that cannot survive independently, while single-celled organisms are composed of one cell that can survive independently.</p> <p>4. The cell is the fundamental unit of life. Cells have basic needs for survival. They use energy, consume materials, require water, eliminate waste, and reproduce.</p>	<p>1. In order to establish and maintain their complex organization and structure, organisms must obtain, transform, and transport matter and energy, eliminate waste products, and coordinate their internal activities.</p> <p>2. Cells take highly varied forms in different plants, animals, and microorganisms. Structural variations among cells determine the function each cell performs.</p> <p>3. Cells have distinct and separate structures (organelles), which perform and monitor processes essential for survival of the cell (e.g., energy use, waste disposal, synthesis of new molecules, and storage of genetic material). The highly specific function of each organelle is directly related to its structure.</p> <p>4. The cell membrane is dynamic and interacts with internal membranous structures as materials are transported into and out of the cell.</p>

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			<p>5. Most cells contain a set of observable structures called organelles which allow them to carry out life processes. Major organelles include vacuoles, cell membrane, nucleus, and mitochondria. Plant cells have a cell wall and chloroplasts.</p> <p>6. The human body has systems that perform functions necessary for life. Major systems of the human body include the digestive, respiratory, reproductive, and circulatory systems.</p>	<p>5. The transportation of materials across the membrane can be passive (does not require the expenditure of cellular energy), or active (requires the expenditure of cellular energy) depending upon membrane structure and concentration gradients.</p> <p>6. Cells store and use information to guide their functions. DNA molecules in each cell carry coded instructions for synthesizing protein molecules. The protein molecules have important structural and regulatory functions.</p> <p>7. Most multi-cellular animals have a nervous system composed of a brain and specialized cells that conduct signals rapidly through the long cell extensions that make up nerves. The nerve cells communicate with each other by secreting specific molecules (neurotransmitters).</p>

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				<p>8. In multi-cellular organisms, cells perform specialized functions as parts of sub-systems (e.g., tissues, organs, and organ systems), which work together to maintain optimum conditions for the benefit of the whole organism.</p> <p>9. The endocrine system consists of glands which secrete chemical messengers (hormones) that are transported via the circulatory system and act on other body structures.</p> <p>10. The immune system consists of cells, organs, and secretions that protect the organism from toxins, irritants, and pathogens.</p>

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Strand	Grades K-3	Grades 4-5	Grades 6-8	Grades 9-12
<p><u>Matter and Energy Transformations</u></p> <p>Enduring Understanding: All organisms transfer matter and convert energy from one form to another. Both matter and energy are necessary to build and maintain structures within the organism.</p> <p>Essential Question: How is matter transferred and energy transferred/transformed in living systems?</p>	<p>1. Plants and animals are living things. All living things have basic needs for survival including air, water, food (nutrients), space, shelter, and light.</p> <p>2. In addition to basic needs for survival, living things have needs specific to the organism such as temperature range and food requirements.</p>	<p>1. Plants need the Sun's energy to grow and survive.</p> <p>2. Animals need food to provide materials and energy for life which they derive directly or indirectly from plants.</p>	<p>1. All organisms require energy. A general distinction among organisms is that plants use solar energy to make their own food (sugar) and animals acquire energy directly or indirectly from plants.</p> <p>2. Plants use the energy from sunlight, carbon dioxide, and water to produce sugars (photosynthesis). Plants can use the food (sugar) immediately or store it for later use.</p> <p>3. Most living things use sugar (from food) and oxygen to release the energy needed to carry out life processes (cellular respiration). Other materials from food are used for building and repairing cell parts.</p>	<p>1. Cells carry out a variety of chemical transformations (i.e., cellular respiration, photosynthesis, and digestion) which allow conversion of energy from one form to another, the breakdown of molecules into smaller units, and the building of larger molecules from smaller ones. Most of these transformations are made possible by protein catalysts called enzymes.</p> <p>2. Plant cells contain chloroplasts, which convert light energy into chemical energy through the process of photosynthesis. This chemical energy is used by the plants to convert carbon dioxide and water into glucose molecules, that may be used for energy or to form plant structures. Photosynthesis adds oxygen to the atmosphere and removes carbon dioxide.</p>

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				<p>3. All organisms, including plants, use the process of cellular respiration to transform stored energy in food molecules into usable energy. The energy produced is stored in the form of ATP and is used by organisms to conduct their life processes. Cellular respiration may require oxygen and adds carbon dioxide to the atmosphere.</p> <p>4. Photosynthesis and cellular respiration are complementary processes resulting in the flow of energy and the cycling of matter in ecosystems.</p>
<p><u>Regulation and Behavior</u></p> <p>Enduring Understanding: Organisms respond to internal and external cues, which allow them to survive.</p> <p>Essential Question: How do responses to internal and external cues aid in an organism's survival?</p>	<p>1. Senses help humans and other organisms detect internal and external cues.</p> <p>2. The brain receives signals from parts of the body via the senses. In response, the brain sends signals to parts of the body to influence reactions.</p>	<p>1. An organism displays behaviors in response to internal cues, such as hunger, and external cues, such as light, temperature, or interaction with living things.</p> <p>2. There are similarities and differences in how organisms respond to internal and external cues. These behaviors may include strategies for acquiring food, building shelters, or evading predators.</p>	<p>1. Regulation of an organism's internal environment involves sensing external changes in the environment and responding physiologically to keep conditions within the range required for survival (e.g., increasing heart rate with exertion).</p>	<p>1. The endocrine, nervous, and immune systems coordinate and help maintain homeostasis in humans and other organisms.</p> <p>2. Multi-cellular animals have nervous systems that generate behavioral responses. These responses result from interactions between organisms of the same species, organisms of different species, and from environmental changes.</p>

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Strand	Grades K-3	Grades 4-5	Grades 6-8	Grades 9-12
<p><u>Life Processes and Technology Application</u></p> <p>Enduring Understanding: Grades K-8: The life processes of organisms are affected by their interactions with each other and their environment, and may be altered by human manipulation. Grades 9-12: The health of humans and other organisms is affected by their interactions with each other and their environment, and may be altered by human manipulation.</p> <p>Essential Question: What can we do to benefit the health of humans and other organisms?</p>	<ol style="list-style-type: none"> 1. Technology expands the range of human senses. 2. Humans use devices and specialized equipment to ensure safety and to improve their quality of life (e.g., goggles, glasses, hearing aids, and wheelchairs). 3. The ability of an organism to meet its needs for survival is dependent upon its environment. Manipulation of the environment can positively or negatively affect the well being of various organisms that live there. 	<ol style="list-style-type: none"> 1. The development of safety devices and protective equipment has helped in the prevention of injuries. 2. Short term and long term studies are used to determine the effects of environmental changes (natural and man-made) on the health of the organisms within that environment. 	<ol style="list-style-type: none"> 1. Technological advances in medicine and improvements in hygiene have helped in the prevention and treatment of illness. 2. The functioning and health of organisms are influenced by many factors (i.e., heredity, diet, lifestyle, bacteria, viruses, parasites, and the environment). Certain body structures and systems function to protect against disease and injury. 3. The environment may contain dangerous levels of substances in the water and soil that are harmful to organisms. Careful monitoring of these is important for healthy life processes. 	<ol style="list-style-type: none"> 1. Certain chemicals, pathogens, and high-energy radiation seriously impair normal cell functions and the health of the organism. 2. The scientific investigation of cellular chemistry enables the biotechnology industry to produce medicines, foods, and other products for the benefit of society. 3. Many drugs exert their effects by mimicking or increasing the production or destruction of neurotransmitters. 4. Biotechnology is a growing international field of research and industry. Many scientists, including those in Delaware, conduct cutting-edge research in biotechnology.

Standard 6: Life Processes, Grade Level Expectations Grades K-3

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<p>Enduring Understanding: Living systems demonstrate the complementary nature of structure and function.</p> <p>Enduring Understanding: All organisms transfer matter and convert energy from one form to another. Both matter and energy are necessary to build and maintain structures within the organism.</p> <p>Enduring Understanding: Organisms respond to internal and external cues, which allow them to survive.</p> <p>Enduring Understanding: The life processes of organisms are affected by their interactions with each other and their environment, and may be altered by human manipulation.</p>			
<p>All students in Kindergarten will be able to:</p>	<p>Building upon the Kindergarten expectations, all students in Grade 1 will be able to:</p>	<p>Building upon the K-1 expectations, all students in Grade 2 will be able to:</p>	<p>Building upon the K-2 expectations, all students in Grade 3 will be able to:</p>
<p>Enduring Understanding: Living systems demonstrate the complementary nature of structure and function.</p> <p>Observe and describe the properties of a variety of living and non-living things using the five senses.</p> <p>Identify the five sense structures and tell which sense is associated with which structure.</p> <p>Use the physical properties of living and non-living things to describe their similarities and differences.</p> <p>Sort, group, and regroup a variety of familiar living and non-living things based on their physical properties (e.g., shape, color, texture, taste, size, etc.).</p> <p>Use a hand lens (magnifier) to inspect a variety of living things and demonstrate through discussion and drawings how the lens extends the sense of sight to see structures in greater detail.</p> <p>Use non-standard units of measure to compare the size and mass of structures of living things (e.g., string around trees,</p>	<p>Enduring Understanding: Living systems demonstrate the complementary nature of structure and function.</p> <p>Select the hand lens as an appropriate instrument for observing the structure of aquatic and terrestrial organisms in greater detail.</p> <p>Observe individuals of the same plant or animal group. Describe physical differences (e.g., size, color, shape, markings).</p> <p>Identify and describe structures of plants and animals that help them survive in aquatic and terrestrial environments.</p> <p>Sort and group plants and animals based on the structures that enable them to function in their environment (e.g., animals that have fins for swimming versus animals that have legs for movement on land).</p> <p>Compare and contrast the observable structures of humans to those of other animals and plants. Record and communicate the similarities and differences in their structures.</p>	<p>Enduring Understanding: Living systems demonstrate the complementary nature of structure and function.</p> <p>Identify and describe the structures of insects and various other organisms that enable them to function in their environment.</p> <p>Compare and contrast the structures on different kinds of insects at different stages of development.</p> <p>Given several pictures of adult organisms, identify and explain which organisms are insects and which are not.</p> <p>Observe common structures of different insects (e.g., mouth parts or legs). Describe the similarities and differences among the structures. Recognize that the structure is related to the function it performs (e.g., a caterpillar mouth for chomping leaves differs from a butterfly proboscis for obtaining nectar).</p>	<p>Enduring Understanding: Living systems demonstrate the complementary nature of structure and function.</p> <p>Describe how bones, muscles, and joints function together in humans to enable movement, protection and support.</p> <p>Identify the structures of different types of joints (gliding, hinged, ball and socket) and describe the movement enabled by each. Recognize the importance of each type of joint to human movement.</p> <p>Compare and contrast the structure and function of the human skeleton to that of other vertebrate animals.</p>

Standard 6: Life Processes, Grade Level Expectations Grades K-3

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<p>Enduring Understanding: Living systems demonstrate the complementary nature of structure and function.</p> <p>Enduring Understanding: All organisms transfer matter and convert energy from one form to another. Both matter and energy are necessary to build and maintain structures within the organism.</p> <p>Enduring Understanding: Organisms respond to internal and external cues, which allow them to survive.</p> <p>Enduring Understanding: The life processes of organisms are affected by their interactions with each other and their environment, and may be altered by human manipulation.</p>			
<p>All students in Kindergarten will be able to:</p>	<p>Building upon the Kindergarten expectations, all students in Grade 1 will be able to:</p>	<p>Building upon the K-1 expectations, all students in Grade 2 will be able to:</p>	<p>Building upon the K-2 expectations, all students in Grade 3 will be able to:</p>
<p>paper clips to measure length of leaves).</p> <p>Identify structures on plants and animals and describe how the structure functions (e.g., trees have bark for protection and rabbits have fur to keep them warm).</p> <p>Enduring Understanding: All organisms transfer matter and convert energy from one form to another. Both matter and energy are necessary to build and maintain structures within the organism.</p> <p>Identify the basic needs that plants and animals need to survive including light, air, water, and nutrients.</p>	<p>Enduring Understanding: All organisms transfer matter and convert energy from one form to another. Both matter and energy are necessary to build and maintain structures within the organism.</p> <p>Observe a variety of plants and animals and identify basic needs that are common to plants or animals of the same group, such as food, water, air, shelter, space and light.</p>	<p>Enduring Understanding: All organisms transfer matter and convert energy from one form to another. Both matter and energy are necessary to build and maintain structures within the organism.</p> <p>Identify the basic needs of all insects for survival. These include food, water, air, space, light, and shelter. Recognize that insects also have specific needs according to their kind, (i.e., specific food such as nectar or mulberry leaves).</p> <p>Observe a variety of plants and animals. Compare specific needs that are common to plants or animals of the same group (i.e., all fish need water but some fish need cold water to live and some need warm water to live, all plants need water but some need a humid environment and some need a dry environment).</p>	<p>Enduring Understanding: All organisms transfer matter and convert energy from one form to another. Both matter and energy are necessary to build and maintain structures within the organism.</p> <p>Explain that humans have basic needs for survival as do other animals. Recognize that, like other animals, these basic needs may be specific, such as range of temperature and nutrients.</p>

Standard 6: Life Processes, Grade Level Expectations Grades K-3

<p>Essential Question: How does structure relate to function in living systems?</p> <p>Essential Question: How is matter transferred and energy transferred/transformed in living systems?</p> <p>Essential Question: How do responses to internal and external cues aid in an organism's survival?</p> <p>Essential Question: What can we do to benefit human health and the health of other organisms?</p>			
<p>Enduring Understanding: Living systems demonstrate the complementary nature of structure and function.</p> <p>Enduring Understanding: All organisms transfer matter and convert energy from one form to another. Both matter and energy are necessary to build and maintain structures within the organism.</p> <p>Enduring Understanding: Organisms respond to internal and external cues, which allow them to survive.</p> <p>Enduring Understanding: The life processes of organisms are affected by their interactions with each other and their environment, and may be altered by human manipulation.</p>			
<p>All students in Kindergarten will be able to:</p>	<p>Building upon the Kindergarten expectations, all students in Grade 1 will be able to:</p>	<p>Building upon the K-1 expectations, all students in Grade 2 will be able to:</p>	<p>Building upon the K-2 expectations, all students in Grade 3 will be able to:</p>
<p>Enduring Understanding: Organisms respond to and internal external cues, which allow them to survive.</p> <p>Describe how the five senses help humans react to their environment, (e.g., hear a whistle and line up, feel cold air and put on a jacket).</p> <p>Observe how the living things in an environment change with the seasons (e.g., trees lose their leaves in the winter).</p> <p>Enduring Understanding: The life processes of organisms are affected by their interactions with each other and their environment, and may be altered by human manipulation.</p> <p>Describe how the senses can be protected when conducting scientific investigations, e.g. goggles protect eyes, gloves protect hands.</p>	<p>Enduring Understanding: Organisms respond to internal and external cues, which allow them to survive.</p> <p>Using the senses to detect environmental conditions, respond by selecting the appropriate clothing for certain weather conditions based on temperature, wind speed, cloud cover and/or precipitation. Justify the selection of clothing and activity.</p> <p>Enduring Understanding: The life processes of organisms are affected by their interactions with each other and their environment, and may be altered by human manipulation.</p> <p>Design terrestrial and aquatic habitats that provide healthy environments for the plant and animal inhabitants.</p> <p>Propose changes to an aquatic or terrestrial habitat that increase the health of organisms (i.e., moisten the soil in a terrarium, add water to an aquarium).</p>	<p>Enduring Understanding: Organisms respond to external cues, which allow them to survive.</p> <p>Conduct simple investigations to determine and describe how insects and various other organisms respond to different kinds of stimuli, (e.g., light versus dark environment).</p> <p>Enduring Understanding: The life processes of organisms are affected by their interactions with each other and their environment, and may be altered by human manipulation.</p> <p>Investigate and evaluate how plant growth is affected by varying amounts of different soil components.</p> <p>Conduct simple investigations using artificial habitats to describe how the survival of insects is affected by the environment.</p>	<p>Enduring Understanding: Organisms respond to internal and external cues, which allow them to survive.</p> <p>Recognize that muscles move bones in response to signals from the brain.</p> <p>Conduct simple investigations to determine and describe how different body parts respond to of visual, auditory, and tactile stimuli.</p> <p>Enduring Understanding: The life processes of organisms are affected by their interactions with each other and their environment, and may be altered by human manipulation.</p> <p>Research and report on common diseases or problems of the muscular and skeletal systems. Explain how these systems can be affected by external factors (i.e., bones can be broken and healed, good nutrition leads to strong bones).</p>

Standard 6: Life Processes, Grade Level Expectations Grades 4-5

<p>Essential Question: How does structure relate to function in living systems?</p> <p>Essential Question: How is matter transferred and energy transferred/transformed in living systems?</p> <p>Essential Question: How do responses to internal and external cues aid in an organism's survival?</p> <p>Essential Question: What can we do to benefit the health of humans and other organisms?</p>	
<p>Enduring Understanding: Living systems demonstrate the complementary nature of structure and function.</p> <p>Enduring Understanding: All organisms transfer matter and convert energy from one form to another. Both matter and energy are necessary to build and maintain structures within the organism.</p> <p>Enduring Understanding: Organisms respond to internal and external cues, which allow them to survive.</p> <p>Enduring Understanding: The life processes of organisms are affected by their interactions with each other and their environment, and may be altered by human manipulation.</p>	
<p>Building upon the K-3 expectations, all students in Grade 4 will be able to:</p>	<p>Building upon the K-4 expectations, all students in Grade 5 will be able to:</p>
<p>Enduring Understanding: Living systems demonstrate the complementary nature of structure and function.</p> <p>Compare and contrast structures that have similar functions in various organisms (e.g., eyes, ears, mouths). Explain that the function of the structure is similar although the structures may have different physical appearances (e.g., compare eyes of an owl with the eyes of a crayfish).</p> <p>Observe and identify structures of plants and describe the function of each structure. Explain that most plants produce many seeds, most of which do not germinate and grow into new plants.</p> <p>Sort and group plants and animals according to similarities in structures or functions of structures. Explain why the plants and animals have been grouped in this manner.</p> <p>Enduring Understanding: All organisms transfer matter and convert energy from one form to another. Both matter and energy are necessary to build and maintain structures within the organism.</p> <p>Recognize that plants need light energy from the sun to make food, while animals need to eat plants and/or other animals as their food.</p>	<p>Enduring Understanding: Living systems demonstrate the complementary nature of structure and function.</p> <p>Recognize that the digestive system has many parts that work together to perform a function in humans and many other animals.</p> <p>Describe how to promote healthy digestion and recognize some symptoms that indicate disturbances associated with the normal functioning of the digestive system (i.e., stomach ache, flatulence).</p> <p>Identify, label the parts, and describe the basic functions of the human digestive tract including the mouth, esophagus, stomach, small intestine, large intestine (colon), rectum, and anus.</p> <p>Compare and contrast the human body digestive system with that of other animals e.g., earthworm, chicken, fish, crayfish, snail, cow.</p> <p>Enduring Understanding: All organisms transfer matter and convert energy from one form to another. Both matter and energy are necessary to build and maintain structures within the organism.</p> <p>Explain that all organisms require a form of energy to survive and that humans and other animals obtain energy and materials from food.</p>

Standard 6: Life Processes, Grade Level Expectations Grades 4-5

<p>Essential Question: How does structure relate to function in living systems?</p> <p>Essential Question: How is matter transferred and energy transferred/transformed in living systems?</p> <p>Essential Question: How do responses to internal and external cues aid in an organism's survival?</p> <p>Essential Question: What can we do to benefit the health of humans and other organisms?</p>	
<p>Enduring Understanding: Living systems demonstrate the complementary nature of structure and function.</p> <p>Enduring Understanding: All organisms transfer matter and convert energy from one form to another. Both matter and energy are necessary to build and maintain structures within the organism.</p> <p>Enduring Understanding: Organisms respond to internal and external cues, which allow them to survive.</p> <p>Enduring Understanding: The life processes of organisms are affected by their interactions with each other and their environment, and may be altered by human manipulation.</p>	
<p>Building upon the K-3 expectations, all students in Grade 4 will be able to:</p>	<p>Building upon the K-4 expectations, all students in Grade 5 will be able to:</p>
<p>Enduring Understanding: Organisms respond to internal and external cues, which allow them to survive.</p> <p>Select a living organism and develop descriptions of how the organism responds to a variety of stimuli (i.e., light/dark, warm temperature/cold temperature) based on multiple observations and data collection (e.g., crayfish and Bess Beetles).</p> <p>Explain how individual organisms behave and use their structures to respond to internal and external cues such as hunger, drought, or temperature to improve their chances of survival.</p> <p>Enduring Understanding: The life processes of organisms are affected by their interactions with each other and their environment, and may be altered by human manipulation.</p> <p>Observe, record, and describe changes in the health or behavior of an organism as a result of changes in its environment.</p>	<p>Enduring Understanding: Organisms respond to internal and external cues, which allow them to survive.</p> <p>Identify external structures (i.e., legs) and behaviors (i.e., walking) of organisms that enable them to survive in their particular ecosystem and describe how these structures enable the organisms to respond to internal (i.e., hunger) and external (i.e., temperature, danger) cues.</p> <p>Research the ways that a variety of organisms respond to internal (i.e., need for food and shelter) and external (i.e., presence of predators) cues. Describe the similarities and differences among the organisms.</p> <p>Enduring Understanding: The life processes of organisms are affected by their interactions with each other and their environment, and may be altered by human manipulation.</p> <p>Identify safety equipment (e.g., goggles, gloves) and procedures (e.g., washing hands, wafting, not eating) used in classroom science investigations. Explain how these promote healthy living and prevent injuries.</p> <p>Identify and discuss how short-term and long-term alterations in the environment affect the health of organisms found in that ecosystem.</p>

Standard 6: Life Processes, Grade Level Expectations Grades 6-8

<p>Essential Question: How does structure relate to function in living systems from the organismic to the cellular level?</p> <p>Essential Question: How is matter transferred and energy transferred/transformed in living systems?</p> <p>Essential Question: How do responses to internal and external cues aid in an organism's survival?</p> <p>Essential Question: What can we do to benefit the health of humans and other organisms?</p>		
<p>Enduring Understanding: Living systems, from the organismic to the cellular level, demonstrate the complementary nature of structure and function.</p> <p>Enduring Understanding: All organisms transfer matter and convert energy from one form to another. Both matter and energy are necessary to build and maintain structures within the organism.</p> <p>Enduring Understanding: Organisms respond to internal and external cues, which allow them to survive.</p> <p>Enduring Understanding: The life processes of organisms are affected by their interactions with each other and their environment, and may be altered by human manipulation.</p>		
<p>Building upon the K-5 expectations, all students in Grade 6 will be able to:</p>	<p>Building upon the K-6 expectations, all students in Grade 7 will be able to:</p>	<p>Building upon the K-7 expectations, all students in Grade 8 will be able to:</p>
<p>Enduring Understanding: Living systems, from the organismic to the cellular level, demonstrate the complementary nature of structure and function.</p> <p>Explain that human body systems are comprised of organs (e.g., the heart, the stomach, and the lungs) that perform specific functions within one or more systems.</p> <p>Label and describe the functions of the basic parts of the circulatory system including the heart, arteries, veins and capillaries.</p> <p>Label and describe the functions of the basic parts of the male and female reproductive systems.</p> <p>Label and describe the functions of the basic parts of the respiratory system including the trachea, bronchi and lungs.</p> <p>Label and describe the functions of the basic parts of the digestive tract including the mouth, esophagus, stomach, small intestine, liver, large intestine (colon), rectum and anus.</p> <p>Express how the human circulatory, respiratory, and digestive systems work together to carry out life processes.</p>	<p>Enduring Understanding: Living systems, from the organismic to the cellular level, demonstrate the complementary nature of structure and function.</p> <p>Identify and apply criteria for determining whether specimens or samples are living, dead, dormant or nonliving.</p> <p>Classify organisms based on shared characteristics into currently recognized kingdoms and justify their placement. Give examples of organisms from each kingdom.</p> <p>Explain that individual cells are able to carry out basic life functions that are similar in organisms; however, explain that in multi-cellular organisms, cells become specialized, interdependent upon one another, and unable to survive independently.</p> <p>Describe the hierarchical organization of multi-cellular organisms. Recognize that multi-celled organisms are organized as specialized cells within tissues that make up organs within organ systems, which work together to carry out life processes for the entire organism.</p> <p>Observe and sketch cells using microscopes and other appropriate tools. Compare and contrast plant, animal, protist, and bacterial cells by noting the presence or absence of major organelles (i.e., cell membrane, cell wall, nucleus, chloroplasts, mitochondria and vacuoles) using the sketches and other resources.</p>	<p>Enduring Understanding: Living systems, from the organismic to the cellular level, demonstrate the complementary nature of structure and function.</p> <p><i>There are no specific grade level expectations for this understanding. They are incorporated into Standards 7 and 8, where prior knowledge of structure/function is critical.</i></p>

Standard 6: Life Processes, Grade Level Expectations Grades 6-8

<p>Essential Question: How does structure relate to function in living systems from the organismic to the cellular level?</p> <p>Essential Question: How is matter transferred and energy transferred/transformed in living systems?</p> <p>Essential Question: How do responses to internal and external cues aid in an organism's survival?</p> <p>Essential Question: What can we do to benefit the health of humans and other organisms?</p>		
<p>Enduring Understanding: Living systems, from the organismic to the cellular level, demonstrate the complementary nature of structure and function.</p> <p>Enduring Understanding: All organisms transfer matter and convert energy from one form to another. Both matter and energy are necessary to build and maintain structures within the organism.</p> <p>Enduring Understanding: Organisms respond to internal and external cues, which allow them to survive.</p> <p>Enduring Understanding: The life processes of organisms are affected by their interactions with each other and their environment, and may be altered by human manipulation.</p>		
<p>Building upon the K-5 expectations, all students in Grade 6 will be able to:</p>	<p>Building upon the K-6 expectations, all students in Grade 7 will be able to:</p>	<p>Building upon the K-7 expectations, all students in Grade 8 will be able to:</p>
<p>Enduring Understanding: All organisms transfer matter and convert energy from one form to another. Both matter and energy are necessary to build and maintain structures within the organism.</p> <p>Trace how the circulatory, respiratory, and digestive systems interact to transport the food and oxygen required to provide energy for life processes.</p>	<p>Research the sequence of events that led to the formation of the cell theory and correlate these events with technological advancements (e.g., hand lens, microscopes, and staining techniques).</p> <p>Enduring Understanding: All organisms transfer matter and convert energy from one form to another. Both matter and energy are necessary to build and maintain structures within the organism.</p> <p>Recognize that the process of photosynthesis occurs in the chloroplasts of producers. Summarize the basic process in which energy from sunlight is used to make sugars from carbon dioxide and water (photosynthesis). Indicate that this food can be used immediately, stored for later use, or used by other organisms.</p> <p>Recognize that the process of cellular respiration in the mitochondria of both plants and animals releases energy from food. Indicate that this food provides the energy and materials for repair and growth of cells. Explain the complementary nature between photosynthesis and cellular respiration.</p>	<p>Enduring Understanding: All organisms transfer matter and convert energy from one form to another. Both matter and energy are necessary to build and maintain structures within the organism.</p> <p><i>There are no specific grade level expectations for this understanding. They are incorporated into Standard 8, where a basic understanding of photosynthesis and respiration is critical.</i></p>

Standard 6: Life Processes, Grade Level Expectations Grades 6-8

<p>Essential Question: How does structure relate to function in living systems from the organismic to the cellular level?</p> <p>Essential Question: How is matter transferred and energy transferred/transformed in living systems?</p> <p>Essential Question: How do responses to internal and external cues aid in an organism's survival?</p> <p>Essential Question: What can we do to benefit the health of humans and other organisms?</p>		
<p>Enduring Understanding: Living systems, from the organismic to the cellular level, demonstrate the complementary nature of structure and function.</p> <p>Enduring Understanding: All organisms transfer matter and convert energy from one form to another. Both matter and energy are necessary to build and maintain structures within the organism.</p> <p>Enduring Understanding: Organisms respond to internal and external cues, which allow them to survive.</p> <p>Enduring Understanding: The life processes of organisms are affected by their interactions with each other and their environment, and may be altered by human manipulation.</p>		
<p>Building upon the K-5 expectations, all students in Grade 6 will be able to:</p>	<p>Building upon the K-6 expectations, all students in Grade 7 will be able to:</p>	<p>Building upon the K-7 expectations, all students in Grade 8 will be able to:</p>
<p>Enduring Understanding: Organisms respond to internal and external cues, which allow them to survive.</p> <p>Conduct simple investigations (how the body reacts to exercise, changes in temperature, etc.) to determine how the systems in the human organism respond to various external stimuli to maintain stable internal conditions.</p> <p>Enduring Understanding: The life processes of organisms are affected by their interactions with each other and their environment, and may be altered by human manipulation.</p> <p>Use knowledge of human body systems to synthesize research data and make informed decisions regarding personal and public health.</p> <p>Research and report on how body systems are affected by lifestyle choices such as diet or exercise, for example lack of exercise leads to cardiovascular disease.</p>	<p>Enduring Understanding: Organisms respond to internal and external cues, which allow them to survive.</p> <p>Research external conditions needed by a variety of organisms for survival such as temperature, turbidity, pH, salinity, and amount of dissolved oxygen, phosphates, and nitrates. Predict how organisms may respond to changes in these external conditions based on research findings.</p> <p>Enduring Understanding: The life processes of organisms are affected by their interactions with each other and their environment, and may be altered by human manipulation.</p> <p>Use various indicators (pH, turbidity, nitrates, phosphates, salinity, and macro-invertebrate surveys) to establish the health and potential potability of local bodies of water.</p>	<p>Enduring Understanding: Organisms respond to internal and external cues, which allow them to survive.</p> <p>Understand and describe how the maintenance of a relatively stable internal environment is required for the continuation of life and explain how stability is challenged by changing physical, chemical, and environmental conditions.</p> <p>Explain that the regulatory and behavioral responses of an organism to external stimuli occur in order to maintain both short and long term equilibrium (e.g., migrating shorebirds behave differently along the migration path in order to support their life cycle).</p> <p>Enduring Understanding: The life processes of organisms are affected by their interactions with each other and their environment, and may be altered by human manipulation.</p> <p><i>There are no specific grade level expectations for this understanding. They are incorporated into Standard 8.</i></p>

Standard 6: Life Processes, Grade Level Expectations Grades 9-12

Essential Question: How does structure relate to function in living systems from the organismic to the cellular level?

Essential Question: How is matter transferred and energy transferred/transformed in living systems?

Essential Question: How do responses to internal and external cues aid in an organism's survival?

Essential Question: What can we do to benefit the health of humans and other organisms?

Enduring Understanding: Living systems, from the organismic to the cellular level, demonstrate the complementary nature of structure and function.

Enduring Understanding: All organisms transfer matter and convert energy from one form to another. Both matter and energy are necessary to build and maintain structures within the organism.

Enduring Understanding: Organisms respond to internal and external cues, which allow them to survive.

Enduring Understanding: The health of humans and other organisms is affected by their interactions with each other and their environment, and may be altered by human manipulation.

Building upon the K-9 expectations, all students in **Grade 10** will be able to:

Enduring Understanding: Living systems, from the organismic to the cellular level, demonstrate the complementary nature of structure and function.

Use microscopes to identify similarities and differences among a variety of cells (e.g., muscle, nerve, epithelial, blood, adipose), and explain how structural variations relate to the function that each of the cells performs.

Differentiate between prokaryotic cells and eukaryotic cells in terms of their general structures (cell membrane & genetic material) and degree of complexity. Give examples of prokaryotic organisms and organisms with eukaryotic cells.

Explain how organelles of single-celled organisms function as a system to perform the same basic life processes as are performed in multi-cellular organisms (e.g., acquisition of energy, elimination of waste, reproduction, gas exchange, growth, repair, and protein synthesis).

Use fluid mosaic models of the plasma membrane to explain how its structure regulates the movement of materials across the membrane.

Show how water moves in and out of cells down a concentration gradient. Recognize that this process, known as osmosis, requires no input of energy.

Explain the role of cell membranes as highly selective barriers (e.g., diffusion, osmosis, active transport).

Distinguish between active and passive transport. Recognize that active transport requires energy input to move molecules from an area of low concentration to an area of high concentration (against the concentration gradient).

Design a controlled experiment to investigate the capacity of the cell membrane to regulate how materials enter and leave the cell.

Construct cell models (e.g., phenolphthalein-agar cubes, potato-iodine cubes) to investigate the relationship among cell size, surface area to volume ratio and the rates of diffusion into and out of the cell. Explain why large organisms have developed from many cells rather than one large cell.

Recognize that as a result of the coordinated structures and functions of organ systems, the internal environment of the human body remains relatively stable despite changes in the outside environment.

Explain how the cells of a multi-cellular organisms work together for the benefit of the colonial or singular organism.

Standard 6: Life Processes, Grade Level Expectations Grades 9-12

Essential Question: How does structure relate to function in living systems from the organismic to the cellular level?

Essential Question: How is matter transferred and energy transferred/transformed in living systems?

Essential Question: How do responses to internal and external cues aid in an organism's survival?

Essential Question: What can we do to benefit the health of humans and other organisms?

Enduring Understanding: Living systems, from the organismic to the cellular level, demonstrate the complementary nature of structure and function.

Enduring Understanding: All organisms transfer matter and convert energy from one form to another. Both matter and energy are necessary to build and maintain structures within the organism.

Enduring Understanding: Organisms respond to internal and external cues, which allow them to survive.

Enduring Understanding: The health of humans and other organisms is affected by their interactions with each other and their environment, and may be altered by human manipulation.

Building upon the K-9 expectations, all students in **Grade 10** will be able to:

Enduring Understanding: All organisms transfer matter and convert energy from one form to another. Both matter and energy are necessary to build and maintain structures within the organism.

Use molecular models to explain how carbon atoms uniquely bond to one another to form a large variety of molecules, including those necessary for life (e.g., polysaccharides, polypeptides).

Observe formulas and diagrams of compounds found in food (fats, proteins, carbohydrates). Identify elements that comprise these compounds.

Explain that physically breaking down food into smaller pieces by mechanical digestion helps facilitate breakdown (by increasing surface area) into chemical components and that digestive enzymes are necessary for the breakdown of food into those chemical components (e.g., starch to glucose, lipids and glycerol to fatty acids, proteins to amino acids).

Observe and recognize that unicellular organisms take in food from their environment and chemically digest it (if needed) within their cell body.

Recognize that both mechanical and chemical processes are necessary in digestion for multi-cellular organisms to get molecules that come from food to enter the cells. Trace the process whereby nutrients are transported to cells where they serve as building blocks for the synthesis of body structures and as reactants for cellular respiration.

Explain the processes used by autotrophs to transform light energy into chemical energy in the form of simple sugars. Give examples of how these compounds are used by living things as sources of matter and energy.

Describe the process by which water is removed from sugar molecules (dehydration synthesis) to form carbohydrates and is added to break them down (hydrolysis).

Describe photosynthesis as an energy storing process and explain how environmental factors such as temperature, light intensity, and the amount of water available can affect photosynthesis.

Identify the reactants and the products in equations that represent photosynthesis and cellular respiration. Explain how the equations demonstrate the Law of Conservation of Matter and Energy in terms of balanced equations.-

Investigate and describe the complementary relationship (cycling of matter and the flow of energy) between photosynthesis and cellular respiration.

Recognize that during photosynthesis, plants use energy from the sun and elements from the atmosphere and the soil to make specific compounds. Recognize that these compounds are used by living things as sources of matter and energy.

Compare the amount of chemical potential energy stored in chemical bonds of a variety of foods (calorimetry). Recognize that equal amounts of different types of food contain different amounts of energy.

Standard 6: Life Processes, Grade Level Expectations Grades 9-12

Essential Question: How does structure relate to function in living systems from the organismic to the cellular level?

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Enduring Understanding: Living systems, from the organismic to the cellular level, demonstrate the complementary nature of structure and function.

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Enduring Understanding: Organisms respond to internal and external cues, which allow them to survive.

Enduring Understanding: The health of humans and other organisms is affected by their interactions with each other and their environment, and may be altered by human manipulation.

Building upon the K-9 expectations, all students in **Grade 10** will be able to:

Enduring Understanding: All organisms transfer matter and convert energy from one form to another. Both matter and energy are necessary to build and maintain structures within the organism (cont'd).

Recognize that during cellular respiration, chemical bonds between food molecules are broken (hydrolysis), and energy is transferred to ADP to create ATP (the energy storage molecule that fuels cellular processes). Acknowledge that all organisms must break the high energy chemical bonds in food molecules during cellular respiration to obtain the energy needed for life processes.

Recognize that in general, synthesis reactions (i.e. photosynthesis) require energy while decomposition reactions (i.e. cellular respiration) usually release energy.

Investigate the role of enzymes (e.g., protease, amylase and lipase) in the rate of chemical breakdown of a variety of foods.

Explain how enzymes permit low temperature chemical reactions to occur in cells.

Investigate how various factors (temperature, pH, enzyme/substrate concentration) affect the rate of enzyme activity.

Enduring Understanding: Organisms respond to internal and external cues, which allow them to survive.

Illustrate how nerve cells communicate with each other to transmit information from the internal and external environment often resulting in physiological or behavioral responses.

Draw a schematic to illustrate a positive and negative feedback mechanism that regulates body systems in order to help maintain homeostasis.

Recognize that in order to help maintain the health of an organism, the immune system works in nonspecific ways (e.g., skin, mucous, membranes) and specific ways (e.g., antibody-antigen interactions.)

Standard 6: Life Processes, Grade Level Expectations Grades 9-12

Essential Question: How does structure relate to function in living systems from the organismic to the cellular level?

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Enduring Understanding: Organisms respond to internal and external cues, which allow them to survive.

Enduring Understanding: The health of humans and other organisms is affected by their interactions with each other and their environment, and may be altered by human manipulation.

Building upon the K-9 expectations, all students in **Grade 10** will be able to:

Enduring Understanding: The health of humans and other organisms is affected by their interactions with each other and their environment, and may be altered by human manipulation.

Investigate how scientists use biotechnology to produce more nutritious food, more effective medicine, and new ways to mitigate pollution.

Investigate how drugs can affect neurotransmission.

Explain how antibiotics (e.g., penicillin, tetracycline) kill bacterial cells without harming human cells due to differences between prokaryotic and eukaryotic cell structure.

Describe how environmental factors (e.g., UV light or the presence of carcinogens or pathogens) alter cellular functions.