

LS1.A: Structure and Function

Grade/Course	Disciplinary Core Idea Statement with 2021 Performance Expectation Linked
1	<ul style="list-style-type: none"> All organisms have external parts. Different animals use their body parts in different ways to see, hear, grasp objects, protect themselves, move from place to place, and seek, find, and take in food, water, and air. Plants also have different parts (roots, stems, leaves, flowers, fruits) that help them survive and grow. (1-LS1-1)
4	<ul style="list-style-type: none"> Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction. (4-LS1-1)
6	<ul style="list-style-type: none"> All living things are made up of cells, which is the smallest unit that can be said to be alive. An organism may consist of one single cell (unicellular) or many different numbers and types of cells (multicellular). (6-LS1-1) Within cells, special structures are responsible for particular functions, and the cell membrane forms the boundary that controls what enters and leaves the cell. (6-LS1-2) In multicellular organisms, the body is a system of multiple interacting subsystems. These subsystems are groups of cells that work together to form tissues and organs that are specialized for particular body functions. (6-LS1-3)
Biology 1	<ul style="list-style-type: none"> Systems of specialized cells within organisms help them perform the essential functions of life. All cells contain genetic information, in the form of DNA. Genes are specific regions within the extremely large DNA molecules that form the chromosomes. Genes contain the instructions that code for the formation of molecules called proteins, which carry out most of the work of cells to perform the essential functions of life. Proteins provide structural components, serve as signaling devices, regulate cell activities, and determine the performance of cells through their enzymatic actions. (B-LS1-1)
Biology 2	<ul style="list-style-type: none"> Systems of specialized cells within organisms help them perform the essential functions of life. All cells contain genetic information, in the form of DNA. Genes are specific regions within the extremely large DNA molecules that form the chromosomes. Genes contain the instructions that code for the formation of molecules called proteins, which carry out most of the work of cells to perform the essential functions of life. Proteins provide structural components, serve as signaling devices, regulate cell activities, and determine the performance of cells through their enzymatic actions. (B-LS1-1) (repeat) All cells contain genetic information in the form of DNA molecules. Genes are regions in the DNA that contain the instructions that code for the formation of proteins. (secondary) (B-LS3-1)

K-12 Conceptual Vertical Articulation of LS1 – From Molecules to Organisms: Structure and Processes

Grade/Course	Disciplinary Core Idea Statement with 2021 Performance Expectation Linked
Anatomy & Physiology	<ul style="list-style-type: none"><li data-bbox="422 228 1969 298">• Multicellular organisms have a hierarchical structural organization, in which any one system is made up of numerous parts and is itself a component of the next level. (B-LS1-2)<li data-bbox="422 347 1913 417">• Feedback mechanisms maintain a living system’s internal conditions within certain limits and mediate behaviors, allowing it to remain alive and functional even as external conditions change within some range. (B-LS1-3)

LS1.B: Growth and Development of Organisms

Grade/Course	Disciplinary Core Idea Statement with 2021 Performance Expectation Linked
1	<ul style="list-style-type: none"> Adult plants and animals can have young. In many kinds of animals, parents, and the offspring themselves engage in behaviors that help the offspring to survive. (1-LS1-2)
3	<ul style="list-style-type: none"> Reproduction is essential to the continued existence of every kind of organism. Plants and animals have unique and diverse life cycles. (3-LS1-1)
8	<ul style="list-style-type: none"> Animals engage in characteristic behaviors that increase the odds of reproduction. Plants reproduce in a variety of ways, sometimes depending on animal behavior and specialized features for reproduction. (8-LS1-4) Genetic factors as well as local conditions affect the growth of the adult plant. The growth of an animal is controlled by genetic factors, food intake, and interactions with other organisms, and each species has a typical adult size range. (8-LS1-5) Organisms reproduce, either sexually or asexually, and transfer their genetic information to their offspring. (secondary) (8-LS3-2)
Biology 1	<ul style="list-style-type: none"> In multicellular organisms individual cells grow and then divide via a process called mitosis, thereby allowing the organism to grow (and repair). The organism begins as a single cell (fertilized egg) that divides successively to produce many cells, with each parent cell passing identical genetic material (two variants of each chromosome pair) to both daughter cells. Cellular division and differentiation produce and maintain a complex organism, composed of systems of tissues and organs that work together to meet the needs of the whole organism. (B-LS1-4)

LS1.C: Organization for Matter and Energy Flow in Organisms

Grade/Course	Disciplinary Core Idea Statement with 2021 Performance Expectation Linked
K	<ul style="list-style-type: none"> All animals need food in order to live and grow. They obtain their food from plants or from other animals. Plants need water and light to live and grow. (K-LS1-1)
5	<ul style="list-style-type: none"> Plants acquire their material for growth chiefly from air and water. (5-LS1-1) Food provides animals with the materials they need for body repair and growth and the energy they need to maintain body warmth and for motion. (secondary) (5-PS3-1)
7	<ul style="list-style-type: none"> Plants, algae (including phytoplankton), and many microorganisms use the energy from light to make sugars (food) from carbon dioxide from the atmosphere and water through the process of photosynthesis, which also releases oxygen. These sugars can be used immediately or stored for growth or later use. (7-LS1-6) Within individual organisms, food moves through a series of chemical reactions in which it is broken down and rearranged to form new molecules, to support growth, or to release energy. In most animals and plants, oxygen reacts with carbon- containing molecules (sugars) to provide energy and produce carbon dioxide; anaerobic bacteria achieve their energy needs in other chemical processes that do not require oxygen. (7-LS1-6) Within individual organisms, food moves through a series of chemical reactions in which it is broken down and rearranged to form new molecules, to support growth, or to release energy. (7-LS1-7)

K-12 Conceptual Vertical Articulation of LS1 – From Molecules to Organisms: Structure and Processes

Grade/Course	Disciplinary Core Idea Statement with 2021 Performance Expectation Linked
<p>Biology 1</p>	<ul style="list-style-type: none"> • The process of photosynthesis converts light energy to stored chemical energy by converting carbon dioxide plus water into sugars plus released oxygen. (B-LS1-5) • The sugar molecules thus formed contain carbon, hydrogen, and oxygen: the hydrocarbon backbones are used to make amino acids and other carbon-based molecules that can be assembled into larger molecules (such as proteins or DNA), used for essential life functions. (B-LS1-6) • As matter and energy flow through organizational levels of living systems, chemical elements are recombined to form different products. (B-LS1-6) • As matter and energy flow through different organizational levels of living systems, chemical elements are recombined in different ways to form different products. (B-LS1-7) • As a result of these chemical reactions, energy is transferred from one system of interacting molecules to another. Cellular respiration is a chemical process in which the bonds of food molecules and oxygen molecules are broken, and new compounds are formed that can transport energy to muscles. Cellular respiration also releases the energy needed to maintain body temperature despite ongoing energy transfer to the surrounding environment. Anaerobic cellular respiration follows a different and less efficient chemical pathway to provide energy in cells. (B-LS1-7)

LS1.D: Information Processing

Grade	Disciplinary Core Idea Statement with 2021 Performance Expectation Linked
1	<ul style="list-style-type: none">Animals have body parts that capture and convey different kinds of information needed for growth and survival. Animals respond to these inputs with behaviors that help them survive. Plants also respond to some external inputs. (1-LS1-1)
4	<ul style="list-style-type: none">Different sense receptors are specialized for particular kinds of information, which may be then processed by the animal’s brain. Animals are able to use their perceptions and memories to guide their actions. (4-LS1-2)
6	<ul style="list-style-type: none">Each sense receptor responds to different inputs (electromagnetic, mechanical, chemical), transmitting them as signals that travel along nerve cells to the brain. The signals are then processed in the brain, resulting in immediate behaviors or memories. Changes in the structure and functioning of many millions of interconnected nerve cells allow combined inputs to be stored as memories for long periods of time. (6-LS1-8)

Adapted from *The Framework for K-12 Science Education* and the *Next Generation Science Standards*.

References:

National Research Council. (2012). *A Framework for K-12 Science Education: Practices, Crosscutting Concepts, and Core Ideas*. Washington, DC: The National Academies Press.

NGSS Lead States. (2013). *Next Generation Science Standards: For States, By States (Appendix E: Disciplinary Core Idea Progression)*. Retrieved from <https://www.nextgenscience.org/>