MIDDLE SCHOOL LIFE SCIENCE: CELLS, STRUCTURES, & PROCESSES

Standards Bundle

Standards are listed within the bundle. Bundles are created with potential instructional use in mind, based upon potential for related phenomena that can be used throughout a unit.

MS-LS1-1 Plan and carry out an investigation to provide evidence that living things are made of cells; either one cell or many different types and numbers of cells. (SEP: 3; DCI: LS1.A; CCC: Scale/Prop., Technology) [Clarification Statement: Emphasis is on developing evidence that living things are made of cells, distinguishing between living and non-living things, and understanding that living things may be made of one cell or many and varied cells.]

MS-LS1-2 Develop and use a model to describe the function of a cell as a whole and ways parts of cells contribute to the function. (SEP: 2; DCI: LS1.A; CCC: Structure/Function) [Clarification Statement: Emphasis is on the cell functioning as a whole system and the primary role of identified parts of the cell, specifically the nucleus, chloroplasts, mitochondria, cell membrane, and cell wall.] [*Assessment Boundary: Assessment of organelle structure/function relationships is limited to the cell wall and cell membrane. Assessment of the function of the other organelles is limited to their relationship to the whole cell. Assessment does not include the biochemical function of cells or cell parts.*]

MS-LS1-3 Construct an argument supported by evidence for how the body is a system of interacting subsystems composed of groups of cells. (SEP: 7 ; DCI: LS1.A; CCC: Systems) [Clarification Statement: Emphasis is on the conceptual understanding that cells form tissues and tissues form organs specialized for particular body functions. Examples could include the interaction of subsystems within a system and the normal functioning of those systems.] [*Assessment Boundary: Assessment does not include the mechanism of one body system independent of others. Assessment is limited to the circulatory, excretory, digestive, respiratory, muscular, and nervous systems.*]

MS-LS1-7 Develop a model to describe how food is rearranged through chemical reactions forming new molecules that support growth and/or release energy as this matter moves through an organism. (SEP: 2; DCI: LS1.C, PS3.D; CCC: Energy/Matter) [Clarification Statement: Emphasis is on describing that molecules are broken apart and put back together and that in this process, energy is released.]

Content Overview

This section provides a generic overview of the content or disciplinary core ideas as an entry point to the standards.

Cells are the smallest unit of life as every cell carries out all characteristics of life. All living things are made of one (unicellular) or more cells (multicellular). Some cells contain structures which carry out specific functions within the cell. In multicellular organisms, groups of cells work together to perform tasks and are called tissues. Groups of tissues may work together to form organs that perform a particular function in the body.

Some organisms create their own food through photosynthesis. Utilizing light, water, and carbon dioxide, any organism that has chloroplasts (which contain chlorophyll), can create sugars. Almost all organisms utilize these sugars by breaking them back down during aerobic cellular respiration into carbon dioxide and water. The bonds that held the sugar together provide the actual usable energy.

Phenomena

Phenomena can be used at varying levels of instruction. One could be used to anchor an entire unit, while another might be more supplemental for anchoring just a unit. Please remember that phenomena should allow students to engage in the SEP and use the CCC/DCI to understand and explain the phenomenon.

- An entire person grows from one fertilized egg.
- We found living microorganisms in our mini habitat, but we didn't put them there.
- Most plants are green, but animals are not.
- Even though water enters through a human's mouth, it gets to every single cell in the human body.
- Food going into the body looks much different than food exiting the body.
- Cork looks like a solid, but under the microscope it is actually made up of many small boxes.
- We swallow pills for aches and pains all over our body not just for pains in our mouth.

Storyline

This section aims to decode not only the DCI connections, but also the SEP and CCC in a detailed account of how they possibly fit together in a progression for student learning, including both rationale and context for the bundle.

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Planning and Carrying Out Investigations ● Conduct an investigation to produce data to serve as the basis for evidence that meet the goals of an investigation. **Developing and Using Models** ● Modeling in 6–8 builds on K–5 experiences and progresses to developing, using, and revising models to describe, test, and predict more abstract phenomena and design systems. Develop and use a model to describe phenomena. **Engaging in Argument from Evidence** ● Use an oral and written argument	**LS1.A: Structure and Function** ● 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). **LS1.C: Organization for Matter and Energy Flow in Organisms** ● 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	**Scale, Proportion, and Quantity** ● Phenomena that can be observed at one scale may not be observable at another scale. **Structure and Function** ● Complex and microscopic structures and systems can be visualized, modeled, and used to describe how their function depends on the relationships among its parts, therefore complex natural structures/systems can be analyzed to determine how they function. **Systems and System Models**

supported by evidence to support or refute an explanation or a model for a phenomenon.	for growth or later use.	• Systems may interact with other systems; they may have sub-systems and be a part of larger complex systems. **Energy and Matter** • Matter is conserved because atoms are conserved in physical and chemical processes.

Students will discover all living things are made of cells. Microscopes (or internet images) allow students to observe cells directly. Structure of cells and the parts of the cell are always related to function. By making and observing models, students will get a better understanding of scale and proportion and how the structure of the organelles contributes to this function. Students will also understand how the cells form a network of systems which ultimately run entire organisms.

Through this bundle, students will understand that the smallest unit of life is the cell. Students will carry out investigations to discover that some organisms are only made of one cell (unicellular) while others are made of many cells (multicellular). Unicellular organisms, like multicellular organisms, need food, water, a way to dispose of waste, and an environment in which they can live. Cells have specialized structures which are responsible for these specialized functions within the cell to include: the cell membrane (the boundary that controls what enters and leaves the cell), nucleus (where genetic material is located within the cell, the control center of the cell), cell wall (provides support and protection in plant cells), chloroplasts (the location of photosynthesis in plant, algae or phytoplankton cells), and mitochondria (powerhouse of the cell - where energy-rich molecules for the cell (ATP) are created) . Organelles perform their individual functions, and then work together to perform the function of the cell as a whole.

While cells perform certain tasks independently, they can also work together as a subsystem. A group of similar cells working together to perform a task makes up tissues, a group of tissues working together forms organs, and several organs may work together to complete tasks for an entire organism; for example, a group of cardiac cells work together to form a valve in the heart; several kinds of tissue (including muscle tissue) make up the heart (an organ) which pumps blood to the lungs (another organ) and to the body to deliver oxygen to every cell and pick up wastes via arteries and veins. All of these subunits work together as the circulatory system, which is one of many body systems that work together to perform the functions of the entire body.

Formative Assessment

Formative assessment is crucial because all learners benefit from timely and focused feedback from others. It promotes self-reflection, self-explanation, and social learning. It can also make learning more relevant. Each of the questions below might be used throughout the formative assessment process. Specific prompts may focus on individual practices, core ideas, or crosscutting concepts, but, together, the components need to support inferences about students' three-dimensional science learning as described in a given bundle, standard or lesson-level performance expectation.

SEP Planning and Carrying Out Investigations

- Create & complete an investigation to prove plants have structures that move water throughout the entire plant and out the leaves.

SEP Developing and Using Models

- Develop, use, and describe a model of plant cells, animal cells, and single-celled organisms demonstrating the specialized organelles used in each to meet all characteristics of life.

SEP Engaging in Argument from Evidence

- Give supporting evidence for an explanation of how the trillions of cells in a human being meet their needs and complete the functions required for life.
- Identify evidence that supports cell theory, and articulate the scientific principle(s) that connect each piece of evidence to the claim.

CCC Scale, Proportion, and Quantity

- Draw a leaf viewed with just your eyes. Draw the same leaf as seen through the microscope at 40x and compare the views.

CCC Structure and Function

- Create a box and t-chart to compare the structure and functions of the vascular system of plants, the circulatory system of animals, and the circulatory system of an insect.

Performance Outcomes

These are statements of how students use knowledge and are similar to the standards in how they blend DCI, SEP, and CCC, but at a smaller grain-size. These are potential outcomes for instruction as it plays out in lessons and activities in the classroom. It is important to also think of these as smaller outcomes that build toward the larger goal of mastering the standards.

- **Engage in an argument from evidence** to differentiate between living cells and all other non-living matter.
- **Conduct an investigation** to produce data to demonstrate organisms are made up of cells.
- **Conduct an investigation** to produce data that organisms may be unicellular or multicellular.
- **Develop a model** to describe the primary role of the nucleus, chloroplast, and mitochondria.
- **Develop a model** to demonstrate the *structure and function* of the cell membrane.
- **Engage in argument from evidence** that plant cells contain *structures* that animal cells do not (ie. chloroplasts and cell wall).
- **Use a written argument supported by evidence** to explain that the body is a *system of multiple interacting subsystems*.
- **Develop a model** to demonstrate that the *body subsystems are groups of cells that work together* to form tissues and organs that *perform specialized functions* for the body.
- **Conduct an investigation** to prove *conservation of matter* in the processes of photosynthesis and aerobic cellular respiration in plants.