Grade 7 Science, Unit 4

Structure and Function

Overview

Unit abstract

Students will plan and carry out investigations to develop evidence that living organisms are made of cells. Students will gather information to support explanations of the relationship between structure and function in cells. They will be able to communicate an understanding of cell theory and understand that all organisms are made of cells. Students will understand that special structures are responsible for particular functions in organisms. They will then be able to use their understanding of cell theory to develop and use physical and conceptual models of cells. The crosscutting concepts of scale, proportion, and quantity and structure and function are the organizing concepts for these core ideas about processes of living organisms.

Essential questions

- How do the structures of organisms contribute to life's functions?
- How can one explain the ways in which cells contribute to the function of living organisms?

Written Curriculum

Next Generation Science Standards

MS. Structure, Function, and Information Processing

Students who demonstrate understanding can:

MS-LS1-1. **Conduct an investigation to provide evidence that living things are made of cells; either one cell or many different numbers and types of cells.** [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.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
Planning and Carrying Out Investigations Planning and carrying out investigations in 6-8 builds on K-5 experiences and progresses to include investigations that use multiple variables and provide evidence to support explanations or solutions. ▪ Conduct an investigation to produce data to serve as the basis for evidence that meet the goals of an investigation. (MS-LS1-1)	**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). (MS-LS1-1)	**Scale, Proportion, and Quantity** ▪ Phenomena that can be observed at one scale may not be observable at another scale. (MS-LS1-1) --- *Connections to Engineering, Technology, and Applications of Science* **Interdependence of Science, Engineering, and Technology** ▪ Engineering advances have led to important discoveries in virtually every field of science, and scientific discoveries have led to the development of entire industries and engineered systems. (MS-LS1-1)

Connections to other DCIs in this grade-band: N/A
Articulation to DCIs across grade-bands: **HS.LS1.A** (MS-LS1-1)
Common Core State Standards Connections: *ELA/Literacy –* **WHST.6-8.7** Conduct short research projects to answer a question (including a self-generated question), drawing on several sources and generating additional related, focused questions that allow for multiple avenues of exploration. (MS-LS1-1) *Mathematics –* **6.EE.C.9** Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. Analyze the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation. *(MS-LS1-1)*

MS. Structure, Function, and Information Processing

Students who demonstrate understanding can:

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.** [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.]

The performance expectations above were developed using the following elements from the NRC document *A Framework for K-12 Science Education*:

Science and Engineering Practices	Disciplinary Core Ideas	Crosscutting Concepts
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. (MS-LS1-2)	**LS1.A: Structure and Function** ▪ Within cells, special structures are responsible for particular functions, and the cell membrane forms the boundary that controls what enters and leaves the cell. (MS-LS1-2)	**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. (MS-LS1-2)

Connections to other DCIs in this grade-band: **MS.LS3.A** (MS-LS1-2)
Articulation to DCIs across grade-bands: **4.LS1.A** (MS-LS1-2); **HS.LS1.A** (MS-LS1-2)
Common Core State Standards Connections: *ELA/Literacy –* **SL.8.5** Integrate multimedia and visual displays into presentations to clarify information, strengthen claims and evidence, and add interest. *(MS-LS1-2)* *Mathematics –* **6.EE.C.9** Use variables to represent two quantities in a real-world problem that change in relationship to one another; write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. Analyze the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation. *(MS-LS1-2)*

Clarifying the standards

Prior learning

The following disciplinary core ideas are prior learning for the concepts in this unit of study. By the end of Grade 5, students know that:

- Plants and animals have both internal and external structures that serve various functions in growth, survival, behavior, and reproduction.

Progression of current learning

Driving question 1

How can evidence developed from an investigation be used to support the understanding that living things are made of cells, either one cell or many different numbers and types of cells?

Concepts	Practices
• Distinguish between living and nonliving things. • Cells are the smallest unit of life that can be said to be alive. • All living things are made up of cells, either one cell or many different numbers and types of cells. • Organisms may consist of one single cell (unicellular). • Nonliving things can be composed of cells. • Organisms may consist of many different numbers and types of cells (multicellular). • Cells that can be observed at one scale may not be observable at another scale. • Engineering advances have led to important discoveries in the field of cell biology, and scientific discoveries have led to the development of entire industries and engineered systems.	• Conduct an investigation to produce data that provides evidence distinguishing between living and nonliving things. • Conduct an investigation to produce data supporting the concept that living things may be made of one cell or many and varied cells. • Distinguish between living and nonliving things. • Observe different types of cells that can be found in the makeup of living things.

Driving question 2

How do cells function as a whole and in what ways do parts of cells contribute to the function?

Concepts	Practices
• The cell functions as a whole system. • Identify parts of the cell, specifically the nucleus, chloroplasts, mitochondria, cell membrane, and cell wall. • Within cells, special structures are responsible for particular functions. • Within cells, the cell membrane forms the boundary that controls what enters and leaves the cell. • Complex and microscopic structures and systems in cells can be visualized, modeled, and used to describe how the function of the cell depends on the relationships among its parts. • Complex natural structures/systems can be analyzed to determine how they function. • A model can be used to describe the function of a cell as a whole. • A model can be used to describe how parts of cells contribute to the cell's function. • The structures of the cell wall and cell membrane are related to their function.	• Develop and use a model to describe the function of a cell as a whole. • Develop and use a model to describe how parts of cells contribute to the cell's function. • Develop and use models to describe the relationship between the structure and function of the cell wall and cell membrane.

Integration of content, practices, and crosscutting concepts

This unit of study begins with students distinguishing between living and nonliving things. Students will conduct investigations examining both living and nonliving things and using the data they collect as evidence for making this distinction. During this investigation, students will study living things that are made of cells, either one cell or many different numbers and types of cells.

Students will also study nonliving things, some of which are made up of cells. Students will understand that life is a quality that distinguishes living things—composed of living cells—from once-living things that have died or things that never lived. Emphasis is on students beginning to understand the cell theory by developing evidence that living things are made of cells, distinguishing between living and nonliving things, and understanding that living things may be made of one cell or many and varied cells.

Students will pose a question drawn from their investigations and draw on several sources to generate additional related, focused questions that allow for multiple avenues of exploration. They will conduct a short research project to collect evidence to develop and support their answers to the questions they generate. The report created from their research will integrate multimedia and visual displays of cells and specific cell parts into a presentation that will clarify the answers to their questions. Students will include in their reports variables representing two quantities, such as the number of cells that makes up an organism and units

representing the size or type of the organism, and their conclusion about the relationship between these two variables. They will write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. Students will analyze the relationship between the dependent and independent variables using graphs and tables and relate the graphs and tables to the equation.

As a continuation of their study of the cell, students will study the structure of the cell. This study begins with thinking of the cell as a system that is made up of parts, each of which has a function that contributes to the overall function of the cell. Students will learn that within cells, special structures—such as the nucleus, chloroplasts, mitochondria, cell membrane, and cell wall—are responsible for particular functions. It is important to remember that students are required only to study the functions of these organelles in terms of how they contribute to the overall function of the cell, not in terms of their biochemical functions.

As part of their learning about the structure of the cell, students use models as a way of visualizing and representing structures that are microscopic. Students will develop and use a model to describe the function of the cell as a whole and the ways parts of the cell contribute to the cell's function. Models can be made of a variety of materials, including student-generated drawings, digital representations, or 3-D structures.

Students will examine the structure and function relationship of the cell membrane and the cell wall. They will learn that the structure of the cell membrane makes it possible for it to form the boundary that controls what enters and leaves the cell. They will also learn that the structure of the cell wall makes it possible for it to serve its function. This study of the relationship between structure and function will be limited to the cell wall and cell membrane. Students will use variables to represent two quantities that describe some attribute of at least one structure of the cell—for example, how the surface area of a cell changes in relation to a change in the volume cell's volume. Students will write an equation to express the dependent variable in terms of the independent variable, and they will analyze the relationship between the dependent and independent variables using graphs and tables and relate these to the equation.

Throughout this unit, students will learn that some of the structures of the cell are visible when studied under certain magnification while others are and that engineering discoveries are making many new industries possible.

Integration of mathematics and/or English Language Arts/literacy

Mathematics

- Use variables to represent two quantities, such as the number of cells that makes up an organism and units representing the size or type of the organism, and determine the relationship between these two variables.
- Write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. Analyze the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation.
- Use variables to represent two quantities in a real-world problem that change in relationship to one another—for example, determining the ratio of a cell's surface area to its volume. Write an equation to express one quantity, thought of as the dependent variable, in terms of the other quantity, thought of as the independent variable. Analyze the relationship between the dependent and independent variables using graphs and tables, and relate these to the equation.

English language arts/literacy

- Conduct a short research project collecting evidence that living things are made of cells to answer a question (including a self-generated question). Draw on several sources and generate additional related, focused questions that allow for multiple avenues of exploration.
- Integrate multimedia and visual displays of cells and specific cell parts into presentations to clarify information, strengthen claims and evidence, and add interest.

Future learning

Life science

- Systems of specialized cells within organisms help cells perform the essential functions of life.
- 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, which carry out most of the work of cells.
- 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.
- Feedback mechanisms maintain a living system's internal conditions within certain limits and mediate behaviors, allowing the system to remain alive and functional even as external conditions change within some range. Feedback mechanisms can encourage (through positive feedback) or discourage (through negative feedback) what is going on inside the living system.

Number of Instructional Days

Recommended number of instructional days: 15 (1 day = approximately 50 minutes)

Note—The recommended number of days is an estimate based on the information available at this time. Teachers are strongly encouraged to review the entire unit of study carefully and collaboratively to determine whether adjustments to this estimate need to be made.