# Unit 03: Cellular Structure and Function

Content Area: **Science**
Course(s):
Time Period: **Marking Period 2**
Length: **7-8 Weeks**
Status: **Published**

## Summary


**Introduction:**

The focus of this unit is the cell as the basic unit of life. Students will learn the history of the scientists who contributed to cell theory and how the microscope has aided in the discovery of cellular structure and function. The similarities and differences between prokaryotic and eukaryotic cells will be discussed. Students will then work with microscopes to identify the cellular structures unique to plant and animal cells. Students will make connections between cellular structures and the functions of each structure and the function of the cell as a whole. The structure and function of the plasma membrane will be examined, as well as the various processes that transport materials into and out of the, the plasma membrane. Students will examine how altering environmental factors affects the structure and function of enzymes.

Revised June 2022


## Standards

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| PFL.9.1.12.CFR | Civic Financial Responsibility |
| SCI.HS-PS1-1 | Use the periodic table as a model to predict the relative properties of elements based on the patterns of electrons in the outermost energy level of atoms. |
| LA.RL.9-10.1 | Cite strong and thorough textual evidence and make relevant connections to support analysis of what the text says explicitly as well as inferentially, including determining where the text leaves matters uncertain. |
| | Constructing explanations and designing solutions in 9–12 builds on K–8 builds on K–8 experiences and progresses to explanations and designs that are supported by multiple and independent student-generated sources of evidence consistent with scientific ideas, principles, and theories. |
| MA.A-REI.A | Understand solving equations as a process of reasoning and explain the reasoning |
| MA.A-REI.B | Solve equations and inequalities in one variable |
| LA.W.9-10.2.E | Establish and maintain a style and tone appropriate to the audience and purpose (e.g., |

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| | formal and objective for academic writing) while attending to the norms and conventions of the discipline in which they are writing. |
| LA.W.9-10.2.F | Provide a concluding paragraph or section that supports the information or explanation presented (e.g., articulating implications or the significance of the topic). |
| MA.A-REI.D | Represent and solve equations and inequalities graphically |
| SCI.HS.PS1.B | Chemical Reactions |
| | Obtaining, Evaluating, and Communicating Information |
| SCI.HS.LS1.A | Structure and Function |
| | Planning and Carrying Out Investigations |
| | Modeling in 9–12 builds on K–8 experiences and progresses to using, synthesizing, and developing models to predict and show relationships among variables between systems and their components in the natural and designed worlds. |
| SCI.HS.LS1.A | Structure and Function |
| WRK.9.2.12.CAP.3 | Investigate how continuing education contributes to one's career and personal growth. |
| TECH.9.4.2.CI.1 | Demonstrate openness to new ideas and perspectives (e.g., 1.1.2.CR1a, 2.1.2.EH.1, 6.1.2.CivicsCM.2). |
| TECH.9.4.2.CI.2 | Demonstrate originality and inventiveness in work (e.g., 1.3A.2CR1a). |
| TECH.9.4.2.CT | Critical Thinking and Problem-solving |
| TECH.9.4.2.CT.2 | Identify possible approaches and resources to execute a plan (e.g., 1.2.2.CR1b, 8.2.2.ED.3). |
| TECH.9.4.2.CT.3 | Use a variety of types of thinking to solve problems (e.g., inductive, deductive). |
| TECH.9.4.2.IML | Information and Media Literacy |
| | Information is shared or conveyed in a variety of formats and sources. |
| | Individuals from different cultures may have different points of view and experiences. |
| | Individuals should practice safe behaviors when using the Internet. |
| | Career planning requires purposeful planning based on research, self-knowledge, and informed choices. |
| | Collaboration can simplify the work an individual has to do and sometimes produce a better product. |
| | Critical thinkers must first identify a problem then develop a plan to address it to effectively solve the problem. |
| | Brainstorming can create new, innovative ideas. |

## Essential Questions/ Enduring Understanding

**Essential Questions:**

How did the invention of the microscope and the experiments of various scientists lead to the cell theory?

What structures and functions are similar and different in prokaryotic cells and eukaryotic cells?

How does the structure of a cellular component result in its function and how would this change if the structure was changed?

How does the structure of the plasma membrane relate to its function and how does the structure change for cellular transport change to meet the metabolic needs of the cell?

How does altering the temperature, concentration, and pH of a solution impact enzymatic activity?

**Enduring Understandings:**

Prokaryotic and eukaryotic cells have similarities and differences which can be observed using microscopy.

The plasma membrane prevents certain substances from entering and leaving the cell.

Cells can transport substances into and out of the cell, either with or without energy.

Enzymes are proteins that increase the rates of chemical reactions.

## Objectives

Students will know Key Vocabulary: surface area, volume, ratio, cell, cell theory, microscope, organelles, prokaryotic cell, eukaryotic cell, selective permeability, phospholipid bilayer, diffusion, osmosis, active transport, passive transport, endocytosis, exocytosis, phagocytosis, receptor-mediated endocytosis, pinocytosis.

Students will know the importance of cell size in relation to the efficiency of cellular function.

Students will know how the research of various scientists contributed to the development of cell theory.

Students will know how improvement in microscopy aided in the development of cell theory.

Students will know how to differentiate between prokaryotic and eukaryotic cells.

Students will know the similarities and differences between plant and animal cell structure and function.

Students will know why eukaryotic cells are compartmentalized.

Students will know how the structure of organelles contributes to the function of the organelle and of the cell.

Students will know how the structural components of the plasma membrane result in the function of the plasma membrane.

Students will know how active and passive transport move substances into and out of the base based on their concentrations.

Students will know how enzyme function is a result of enzyme function in lowering the energy needed to start a reaction.

Students will be skilled at explaining why cells are microscopic and relating their size to surface area and volume.

Students will be skilled at calculating surface area, volume, and surface area-to-volume ratio.

Students will be skilled at using a microscope to observe and identify cells.

Students will be skilled at differentiating between the different types of cells.

Students will be skilled at predicting how substances will cross a semipermeable membrane based on their concentration inside and outside the cell.

Students will be skilled at determining how manipulating environmental factors will affect the rate of an enzymatic reaction.

Students will be skilled at gathering and analyzing experimental results to support or reject a hypothesis.

## Learning Plan

Unit Notes: Students will record detailed notes in a notebook that covers the learning goals of the unit.

Surface Area to Volume Activity: Students will predict whether a large cell or a small cell is more efficient. To test this prediction students will measure boxes of different sizes to represent cells of different sizes. The surface area to volume ratio will be calculated for each box and analyzed to determine which size is most efficient. Conclusions will be supported by an understanding of the importance of the surface area to volume ratio to cellular metabolism.

Cell Theory Timeline: Students will conduct online research about the history of cell theory. Students will create a timeline that orders the experiments conducted by various scientists that support cell theory.

Microscope Drawings: Students will learn how to properly use a microscope and about the function of each part of the microscope. Students will make wet mount slides and draw images of the specimens viewed under the microscope.

Prokaryotic and Eukaryotic Cell Venn Diagram: Students will read about either prokaryotic or eukaryotic cells and take notes on the structure and function of the cell type. Students will then pair with another student who researched the other cell type and work together to create a Venn Diagram that compares and contrasts prokaryotic and eukaryotic cells.

Plant and Animal Cell Lab: Students will hypothesize whether a provided, unknown cell is a plant or animal cell. Students will use a microscope to observe the specimen and draw the specimen. Students will identify cellular structures to use as evidence to support their claim. Students will write a formal lab report.

Plasma Membrane Comic Strip: Students will read about the structure and function of the plasma membrane. Students will then draw and color a diagram of the plasma membrane. Students will include captions that explain how each structural component of the plasma membrane contributes to the function of the plasma membrane.

Diffusion Lab: Students will complete a laboratory inquiry for which they will answer the question, “is the membrane permeable to starch or iodine?” Students will observe and record changes in the concentration of the substance on either side of the membrane using a chemical indicator. Students will compare the lab to the functions of the plasma membrane and justify their claim using evidence from data and reasoning from their understanding of diffusion.

Osmosis Lab:  Students will simulate osmosis across a selectively permeable membrane by placing eggs in solutions of various tonicities (hypotonic, isotonic, and hypertonic). Students will hypothesize how the size of each egg will change as a result of being placed in each solution. Students will measure and record the changes in the mass of the egg and record observations of the appearance of the egg over three days. Students will use their data and observations to explain how the tonicity of each solution resulted in moving into and out of the egg. Students will relate the experiment to the movement of water into and out of cells.

Enzyme Lab: Students will design an experiment that tests whether changing the temperature, pH, or concentration of a solution impacts the rate of enzymatic activity. Students will conduct the experiment to gather qualitative and quantitative data. Students will justify their claim with evidence from data and understanding of how enzymatic structure, and therefore function, can be altered by changing environmental factors.

## Assessment

Formative:

Do Now Questions about prior knowledge and upcoming course content

Exit Ticket Questions to summarize material learned

Whole Class Discussion Participation

Small Group Discussion Participation

Think-Pair-Share Participation (Prokaryotic and Eukaryotic Cell Venn Diagram)

Individual Student Questions/Responses

Independent Assignments (Cell Theory Timeline)

Labs (Plant and Animal Cell Lab, Diffusion Lab, Osmosis Lab, Enzyme Lab)

Summative:

Formal Lab Report (Plant and Animal Cell Lab, Osmosis Lab)

Unit Test

Quizzes (Cell Structure, Plasma Membrane, Cellular Transport)

Benchmark:

Honors Biology Midterm Exam

Alternative Assessments:

Unit Study Guide/Guided Test

Microbiology Project

Organelle Task List Choice Practice

## Materials

Textbook: Biology Concepts and Connections  (Pearson Education) by Campell, Reece, Taylor, Simon,

Dickey (2009)

Unit Learning Outline

Technology: computers for student and teacher, SmartBoard projector

Teacher Slide Presentations

Whiteboard + Accessories

Guided Notes/Worksheets

Lab Report Outline and Rubric

Personal Protective Equipment: safety glasses, gloves

Lab Equipment: beakers, water, microscopes, microscope slides, onion, eggs, sugar solution, iodine, starch

Graphing paper, rulers, colored pencils/markers