

## Cellular and Molecular Biological Studies

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Cell and Molecular Biology studies the structure and function of the cell, which is the basic unit of life. Cell biology is concerned with the physiological properties, metabolic processes, signaling pathways, life cycle, chemical composition and interactions of the cell with their environment. This is done both on a microscopic and molecular level as it encompasses prokaryotic cells and eukaryotic cells. Knowing the components of cells and how cells work is fundamental to all biological sciences; it is also essential for research in bio-medical fields such as cancer, and other diseases. Research in cell biology is closely related to genetics, biochemistry, molecular biology, immunology and cytochemistry.

Cell biology (also cellular biology or cytology) is a branch of biology studying the structure and function of the cell, also known as the basic unit of life. Cell biology encompasses both prokaryotic and eukaryotic cells and can be divided into many sub-topics which may include the study of cell metabolism, cell communication, cell cycle, biochemistry, and cell composition. The study of cells is performed using several techniques such as cell culture, various types of microscopy, and cell fractionation. These have allowed for and are currently being used for discoveries and research pertaining to how cells function, ultimately giving insight into understanding larger organisms. Knowing the components of cells and how cells work is fundamental to all biological sciences while also being essential for research in biomedical fields such as cancer, and other diseases. Research in cell biology is interconnected to other fields such as genetics, molecular genetics, biochemistry, molecular biology, medical microbiology, immunology, and cytochemistry.

Cells were first seen in 17th century Europe with the invention of the compound microscope. In 1665, Robert Hooke termed the building block of all living organisms as "cells" after looking at a piece of cork and observing a cell-like structure, however, the cells were dead and gave no indication to the actual overall components of a cell. A few years later, in 1674, Anton Van Leeuwenhoek was the first to analyze live cells in his examination of algae. All of this preceded the cell theory which states that all living things are made up of cells and that cells are the functional and structural unit of organisms. This was ultimately concluded by plant scientist, Matthias Schleiden and animal scientist, Theodor Schwann in 1838, who viewed live cells in plant and animal tissue, respectively. 19 years later, Rudolf Virchow further contributed to the cell theory, adding that all cells come from the division of pre-existing cells. Although widely accepted, there have been many studies that question the validity of the cell theory. Viruses, for example, lack common characteristics of a living cell, such as membranes, cell organelles, and the ability to reproduce by themselves. Scientists have struggled to decide whether viruses are alive or not and whether they are in agreement with the cell theory.

Modern-day cell biology research looks at different ways to culture and manipulate cells outside of a living body to further

research in human anatomy and physiology, and to derive medications. The techniques by which cells are studied have evolved. Due to advancements in microscopy, techniques and technology have allowed for scientists to hold a better understanding of the structure and function of cells. Many techniques commonly used to study cell biology.

Cell communication is important for cell regulation and for cells to process information from the environment and respond accordingly. Communication can occur through direct cell contact or endocrine, paracrine, and autocrine signaling. Direct cell-cell contact is when a receptor on a cell binds a molecule that is attached to the membrane of another cell. Endocrine signaling occurs through molecules secreted into the bloodstream. Paracrine signaling uses molecules diffusing between two cells to communicate. Autocrine is a cell sending a signal to itself by secreting a molecule that binds to a receptor on its surface.

The growth process of the cell does not refer to the size of the cell, but the density of the number of cells present in the organism at a given time. Cell growth pertains to the increase in the number of cells present in an organism as it grows and develops; as the organism gets larger so does the number of cells present. Cells are the foundation of all organisms and are the fundamental unit of life. The growth and development of cells are essential for the maintenance of the host and survival of the organism. For this process, the cell goes through the steps of the cell cycle and development which involves cell growth, DNA replication, cell division, regeneration, and cell death. The cell cycle is divided into four distinct phases: G1, S, G2, and M. The G phase which is the cell growth phase makes up approximately 95% of the cycle. The proliferation of cells is instigated by progenitors. All cells start out in an identical form and can essentially become any type of cells. Cell signaling such as induction can influence nearby cells to differentiate determinate the type of cell it will become. Moreover, this allows cells of the same type to aggregate and form tissues, then organs, and ultimately systems. The G1, G2, and S phase (DNA replication, damage and repair) are considered to be the interphase portion of the cycle, while the M phase (mitosis) is the cell division portion of the cycle. Mitosis is composed of many stages which include prophase, metaphase, anaphase, telophase, and cytokinesis, respectively. The ultimate result of mitosis is the formation of two identical daughter cells.