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Cell Structure and its Function

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THEORY

Cell and its structure – Resting and Action Potential – Nervous system and its fundamentals – Basiccomponents of a biomedical system- Cardiovascular systems- Respiratory systems -Kidney and bloodflow - Biomechanics of bone - Biomechanics of soft tissues - Basic mechanics of spinal column andlimbs -Physiological signals and transducers - Transducers – selection criteria – Piezo electric,ultrasonic transducers - Temperature measurements - Fibre optic temperature sensors.

Cell and its Structure

Cell theory:

All living things are composed of cells. Cells are the basic units of life and all tissues and organs are composed of cells. They are so small that they must be viewed with a microscope. There are different types of cells.

Cells can either be eukaryotic or prokaryotic.

Eukaryotic cells have a nucleus and membrane bound organelles. Plant and animal cells are eukaryotes. Plant cells are generally a square shape while animal cells are usually circular. Plant cells and animal cells have evolved different organelles to perform specific functions. Plant cells have chloroplasts, a cell wall and a central vacuole. Animal cells lack these three organelles. Plant cells have chloroplasts because they make their own food. Plant cells have a cell wall so that they do not burst when the central vacuole fills up with water. Prokaryotes do not have a nucleus, and lack membrane bound organelles. They are the oldest cells on earth. Bacteria are prokaryotes. Prokaryotes often move using special structures such as flagella or cilia.

Cells have many structures inside of them called organelles. These organelles are like the organs in a human and they help the cell stay alive. Each organelle has its own specific function to help the cell survive. The nucleus of a eukaryotic cell directs the cell's activities and stores DNA. Eukaryotes also have a Golgi apparatus that packages and distributes proteins. Mitochondria are the power house of the cell and provide the cell with energy. Both plant and animal cells have mitochondria. Lysosomes are like the stomach of the cell. They contain enzymes that digest the cell's used parts. All of the cell's organelles must work together to keep the cell healthy.

The cell membrane is the protective barrier that surrounds the cell and prevents unwanted material from getting into it. The cell membrane has many functions, but one main function that it has is to transport materials (salts, electrolytes, glucose and other necessary molecules) into the cell to support necessary life functions. Not only does the membrane let molecules into the cell, but it also lets wastes such as carbon dioxide out of the cell. The cell membrane is made up of a phosholipid bilayer. Each phopholipid contains a hydrophilic, or water loving head and a hydrophobic, or water fearing tail. These properties that the phospholipids have and the specific orientation they are arranged in provide the cell with a selectively permeable barrier

Credit for developing cell theory is usually given to two scientists: Theodor Schwann and Matthias Jakob Schleiden.[10] While Rudolf Virchow contributed to the theory, he is not as credited for his attributions toward it. In 1839, Schleiden suggested that every structural part of a plant was made up of cells or the result of cells. He also suggested that cells were made by a crystallization process either within other cells or from the outside.[11] However, this was not an original idea of Schleiden. He claimed this theory as his own, though BarthelemyDumortier had stated it years before him. This crystallization process is no longer accepted with modern cell theory. In 1839, Theodor Schwann states that along with plants, animals are composed of cells or the product of cells in their structures.[12] This was a major advancement in the field of biology since little was known about animal structure up to this point compared to plants. From these conclusions about plants and animals, two of the three tenets of cell theory were postulated.[7]

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1. All living organisms are composed of one or more cells
2. The cell is the most basic unit of life

Schleiden's theory of free cell formation through crystallization was refuted in the 1850s by Robert Remak, Rudolf Virchow, and Albert Kolliker.[6] In 1855, Rudolf Virchow added the third tenet to cell theory. In Latin, this tenet states *Omniscellula e cellula*.[7] This translated to:

3. All cells arise only from pre-existing cells

However, the idea that all cells come from pre-existing cells had in fact already been proposed by Robert Remak; it has been suggested that Virchow plagiarizedRemak and did not give him credit.[13] Remak published observations in 1852 on cell division, claiming Schleiden and Schawnn were incorrect about generation schemes. He instead said that binary fission, which was first introduced by Dumortier, was how reproduction of new animal cells were made. Once this tenet was added, the classical cell theory was complete.

Cells are the basic, fundamental unit of life. So, if we were to break apart an organism to the cellular level, the smallest independent component that we would find would be the cell.

Explore the cell notes to know what is a cell, cell definition, cell structure, types and functions of cells. These notes have an in-depth description of all the concepts related to cells.

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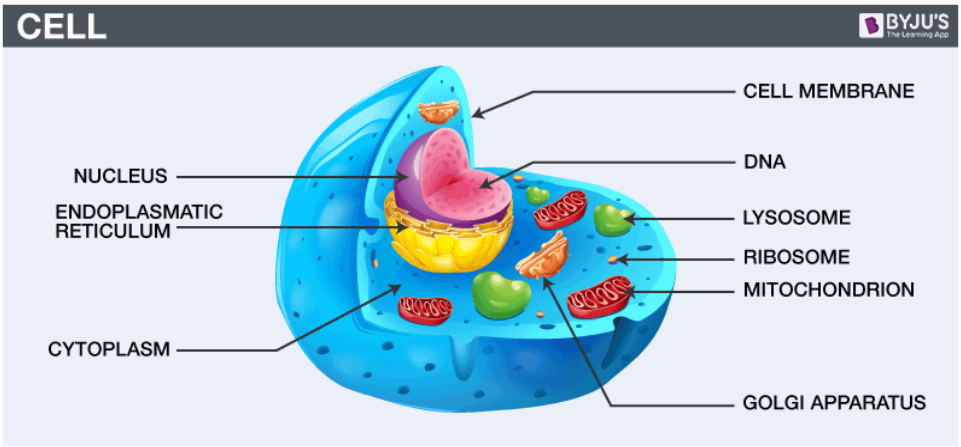

Cells are the fundamental unit of life. They range in size from 0.0001 mm to nearly 150 mm across.

Cell Definition

"A cell is defined as the smallest, basic unit of life that is responsible for all of life's processes."

Cells are the structural, functional, and biological units of all living beings. A cell can replicate itself independently. Hence, they are known as the building blocks of life.

Each cell contains a fluid called the cytoplasm, which is enclosed by a membrane. Also present in the cytoplasm are several biomolecules like proteins, nucleic acids and lipids. Moreover, cellular structures called cell organelles are suspended in the cytoplasm.

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What is a Cell?

A cell is the structural and fundamental unit of life. The study of cells from its basic structure to the functions of every cell organelle is called Cell Biology. Robert Hooke was the first Biologist who discovered cells.

All organisms are made up of cells. They may be made up of a single cell (unicellular), or many cells (multicellular). Mycoplasmas are the smallest known cells. Cells are the building blocks of all living beings. They provide structure to the body and convert the nutrients taken from the food into energy.

Cells are complex and their components perform various functions in an organism. They are of different shapes and sizes, pretty much like bricks of the buildings. Our body is made up of cells of different shapes and sizes.

Cells are the lowest level of organisation in every life form. From organism to organism, the count of cells may vary. Humans have more number of cells compared to that of bacteria.

Cells comprise several cell organelles that perform specialised functions to carry out life processes. Every organelle has a specific structure. The hereditary material of the organisms is also present in the cells.

Discovery of Cells

Discovery of cells is one of the remarkable advancements in the field of science. It helps us know that all the organisms are made up of cells, and these cells help in carrying out various life processes. The structure and functions of cells helped us to understand life in a better way.

Who discovered cells?

Robert Hooke discovered the cell in 1665. Robert Hooke observed a piece of bottle cork under a compound microscope and noticed minuscule structures that reminded him of small rooms. Consequently, he named these “rooms” as cells. However, his compound microscope had limited magnification, and hence, he could not see any details in the structure. Owing to this limitation, Hooke concluded that these were non-living entities.

Later Anton Van Leeuwenhoek observed cells under another compound microscope with higher magnification. This time, he had noted that the cells exhibited some form of movement (motility). As a result, Leeuwenhoek concluded that these microscopic entities were “alive.” Eventually, after a host of other observations, these entities were named as animalcules.

In 1883, Robert Brown, a Scottish botanist, provided the very first insights into the cell structure. He was able to describe the nucleus present in the cells of orchids.

Characteristics of Cells

Following are the various essential characteristics of cells:

- Cells provide structure and support to the body of an organism.
- The cell interior is organised into different individual organelles surrounded by a separate membrane.
- The nucleus (major organelle) holds genetic information necessary for reproduction and cell growth.
- Every cell has one nucleus and membrane-bound organelles in the cytoplasm.
- Mitochondria, a double membrane-bound organelle is mainly responsible for the energy transactions vital for the survival of the cell.
- Lysosomes digest unwanted materials in the cell.
- Endoplasmic reticulum plays a significant role in the internal organisation of the cell by synthesising selective molecules and processing, directing and sorting them to their appropriate locations.

Also Read: Nucleus

Types of Cells

Cells are similar to factories with different labourers and departments that work towards a common objective. Various types of cells perform different functions. Based on cellular structure, there are two types of cells:

- Prokaryotes
- Eukaryotes

Explore: Difference Between Prokaryotic and Eukaryotic Cells

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Prokaryotic Cells

Main article: Prokaryotic Cells

1. Prokaryotic cells have no nucleus. Instead, some prokaryotes such as bacteria have a region within the cell where the genetic material is freely suspended. This region is called the nucleoid.
2. They all are single-celled microorganisms. Examples include archaea, bacteria, and cyanobacteria.
3. The cell size ranges from 0.1 to 0.5 µm in diameter.
4. The hereditary material can either be DNA or RNA.
5. Prokaryotes generally reproduce by binary fission, a form of asexual reproduction. They are also known to use conjugation – which is often seen as the prokaryotic equivalent to sexual reproduction (however, it is NOT sexual reproduction).

Eukaryotic Cells

Main article: Eukaryotic Cells

1. Eukaryotic cells are characterised by a true nucleus.
2. The size of the cells ranges between 10–100 µm in diameter.
3. This broad category involves plants, fungi, protozoans, and animals.
4. The plasma membrane is responsible for monitoring the transport of nutrients and electrolytes in and out of the cells. It is also responsible for cell to cell communication.
5. They reproduce sexually as well as asexually.
6. There are some contrasting features between plant and animal cells. For eg., the plant cell contains chloroplast, central vacuoles, and other plastids, whereas the animal cells do not.

Cell Structure

The cell structure comprises individual components with specific functions essential to carry out life's processes. These components include- cell wall, cell membrane, cytoplasm, nucleus, and cell organelles. Read on to explore more insights on cell structure and function.

Cell Membrane

- The cell membrane supports and protects the cell. It controls the movement of substances in and out of the cells. It separates the cell from the external environment. The cell membrane is present in all the cells.
- The cell membrane is the outer covering of a cell within which all other organelles, such as the cytoplasm and nucleus, are enclosed. It is also referred to as the plasma membrane.
- By structure, it is a porous membrane (with pores) which permits the movement of selective substances in and out of the cell. Besides this, the cell membrane also protects the cellular component from damage and leakage.
- It forms the wall-like structure between two cells as well as between the cell and its surroundings.
- Plants are immobile, so their cell structures are well-adapted to protect them from external factors. The cell wall helps to reinforce this function.

Cell Wall

- The cell wall is the most prominent part of the plant's cell structure. It is made up of cellulose, hemicellulose and pectin.
- The cell wall is present exclusively in plant cells. It protects the plasma membrane and other cellular components. The cell wall is also the outermost layer of plant cells.
- It is a rigid and stiff structure surrounding the cell membrane.
- It provides shape and support to the cells and protects them from mechanical shocks and injuries.

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Cytoplasm

- The cytoplasm is a thick, clear, jelly-like substance present inside the cell membrane.
- Most of the chemical reactions within a cell take place in this cytoplasm.
- The cell organelles such as endoplasmic reticulum, vacuoles, mitochondria, ribosomes, are suspended in this cytoplasm.
- Nucleus
- The nucleus contains the hereditary material of the cell, the DNA.
- It sends signals to the cells to grow, mature, divide and die.
- The nucleus is surrounded by the nuclear envelope that separates the DNA from the rest of the cell.
- The nucleus protects the DNA and is an integral component of a plant's cell structure.

Cell Organelles

Cells are composed of various cell organelles that perform certain specific functions to carry out life's processes. The different cell organelles, along with its principal functions, are as follows:

Cell Organelles and their Functions
Nucleolus
The nucleolus is the site of ribosome synthesis. Also, it is involved in controlling cellular activities and cellular reproduction.
Nuclear membrane
The nuclear membrane protects the nucleus by forming a boundary between the nucleus and other cell organelles.
Chromosomes
Chromosomes play a crucial role in determining the sex of an individual. Each human cells contain 23 pairs of chromosomes.
Endoplasmic reticulum
The endoplasmic reticulum is involved in the transportation of substances throughout the cell. It plays a primary role in the metabolism of carbohydrates, synthesis of lipids, steroids and proteins.
Golgi Bodies
Golgi bodies are called the cell's post office as it is involved in the transportation of materials within the cell.

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Ribosome
Ribosomes are the protein synthesisers of the cell.
Mitochondria
The mitochondrion is called “the powerhouse of the cell.” It is called so because it produces ATP – the cell’s energy currency.
Lysosomes
Lysosomes protect the cell by engulfing the foreign bodies entering the cell and help in cell renewal. Therefore, they are known as the cell’s suicide bags.
Chloroplast
Chloroplasts are the primary organelles for photosynthesis. It contains the pigment called chlorophyll.
Vacuoles
Vacuoles store food, water, and other waste materials in the cell.

Cell Theory

Cell Theory was proposed by the German scientists, Theodor Schwann, Matthias Schleiden, and Rudolf Virchow. The cell theory states that:

- All living species on Earth are composed of cells.
- A cell is the basic unit of life.
- All cells arise from pre-existing cells.

A modern version of the cell theory was eventually formulated, and it contains the following postulates:

- Energy flows within the cells.
- Genetic information is passed on from one cell to the other.
- The chemical composition of all the cells is the same.

Functions of Cell

A cell performs major functions essential for the growth and development of an organism. Important functions of cell are as follows:

Provides Support and Structure

All the organisms are made up of cells. They form the structural basis of all the organisms. The cell wall and the cell membrane are the main components that function to provide support and structure to the organism. For eg., the skin is made up of a large number of cells. Xylem present in the vascular plants is made of cells that provide structural support to the plants.

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Facilitate Growth Mitosis

In the process of mitosis, the parent cell divides into the daughter cells. Thus, the cells multiply and facilitate the growth in an organism.

Allows Transport of Substances

Various nutrients are imported by the cells to carry out various chemical processes going on inside the cells. The waste produced by the chemical processes is eliminated from the cells by active and passive transport. Small molecules such as oxygen, carbon dioxide, and ethanol diffuse across the cell membrane along the concentration gradient. This is known as passive transport. The larger molecules diffuse across the cell membrane through active transport where the cells require a lot of energy to transport the substances.

Energy Production

Cells require energy to carry out various chemical processes. This energy is produced by the cells through a process called photosynthesis in plants and respiration in animals.

Aids in Reproduction

A cell aids in reproduction through the processes called mitosis and meiosis. Mitosis is termed as the asexual reproduction where the parent cell divides to form daughter cells. Meiosis causes the daughter cells to be genetically different from the parent cells.