UNIT-3

CELL-The cell theory, or cell doctrine, states that all organisms are composed of similar units of organization, called cells. The concept was formally articulated in 1839 by Schleiden & Schwann and has remained as the foundation of modern biology. The idea predates other great paradigms of biology including Darwin's theory of evolution (1859), Mendel's laws of inheritance (1865), and the establishment of comparative biochemistry (1940).

While the invention of the telescope made the Cosmos accessible to human observation, the microsope opened up smaller worlds, showing what living forms were composed of. The cell was first discovered and named by Robert Hooke in 1665. He remarked that it looked strangely similar to cellula or small rooms which monks inhabited, thus deriving the name. However what Hooke actually saw was the dead cell walls of plant cells (cork) as it appeared under the microscope. Hooke's description of these cells was published in Micrographia. The cell walls observed by Hooke gave no indication of the nucleus and other organelles found in most living cells. The first man to witness a live cell under a microscope was Anton van Leeuwenhoek, who in 1674 described the algae Spirogyra. Van Leeuwenhoek probably also saw bacteria.

Formulation of the Cell Theory

In 1838, Theodor Schwann and Matthias Schleiden were enjoying after-dinner coffee and talking about their studies on cells. It has been suggested that when Schwann heard Schleiden describe plant cells with nuclei, he was struck by the similarity of these plant cells to cells he had observed in animal tissues. The two scientists went immediately to Schwann's lab to look at his slides. Schwann published his book on animal and plant cells (Schwann 1839) the next year, a treatise devoid of acknowledgments of anyone else's contribution, including that of Schleiden (1838). He summarized his observations into three conclusions about cells:The cell is the unit of structure, physiology, and organization in living things.

The cell retains a dual existence as a distinct entity and a building block in the construction of organisms.

Cells form by free-cell formation, similar to the formation of crystals (spontaneous generation).

We know today that the first two tenets are correct, but the third is clearly wrong. The correct interpretation of cell formation by division was finally promoted by others and formally enunciated in Rudolph Virchow's powerful dictum, Omnis cellula e cellula,: "All cells only arise from pre-existing cells".

Modern Cell TheoryAll known living things are made up of cells.

The cell is structural & functional unit of all living things.

All cells come from pre-existing cells by division. (Spontaneous Generation does not occur).

Cells contains hereditary information which is passed from cell to cell during cell division.

All cells are basically the same in chemical composition.

All energy flow (metabolism & biochemistry) of life occurs within cells.

As with the rapid growth of molecular biology in the mid-20th century, cell biology research exploded in the 1950's. It became possible to maintain, grow, and manipulate cells outside of living organisms. The first continuous cell line to be so cultured was in 1951 by George Otto Gey and coworkers, derived from cervical cancer cells taken from Henrietta Lacks, who died from her cancer in 1951. The cell line, which was eventually referred to as HeLa cells, have been the watershed in studying cell biology in the way that the structure of DNA was the significant breakthrough of molecular biology.

In an avalanche of progress in the study of cells, the coming decade included the characterization of the minimal media requirements for cells and development of sterile cell culture techniques. It was also aided by the prior advances in electron microscopy, and later advances such as development of transfection methods, discovery of green fluorescent protein in jellyfish, and discovery of small interfering RNA (siRNA), among others.

Prokaryotic cell-Prokaryotic cells are cells that do not have a true nucleus or most other cell organelles. Organisms that have prokaryotic cells are unicellular and called prokaryotes. Bacteria and archaea are prokaryotes. Prokaryotic cells can be contrasted with eukaryotic cells, which are more complex.

Eukaryotic cells contain membrane-bound organelles, including a nucleus. Eukaryotes can be single-celled or multi-celled, such as you, me, plants, fungi, and insects. Bacteria are an example of prokaryotes. Prokaryotic cells do not contain a nucleus or any other membrane-bound organelle.

Examples of Prokaryotic cells are: Bacteria and blue-green algae; Eukaryotic cells include: Yeasts, Fungi, Animal cells including Protozoa and Plant cells including Algae. Prokaryotic cells are cells without a membrane bound nucleus.They also do not contain membrane bound cell organelles.

Many kinds of prokaryotes and eukaryotes contain a structure outside the cell membrane called the cell wall. With only a few exceptions, all prokaryotes have thick, rigid cell walls that give them their shape. Among the eukaryotes, some protists, and all fungi and plants, have cell walls.

Unicellular organism-A unicellular organism, also known as a single-celled organism, is an organism that consists of only one cell, unlike a multicellular organism that consists of more than one cell. Unicellular organisms fall into two general categories: prokaryotic organisms and eukaryotic organisms.

Examples of Unicellular Organisms. All prokaryotes, most protists, and some fungi are unicellular. Some of these organisms do live in large colonies, but each individual cell is a simple living organism.

Multicellular organism-Multicellular is a complex organism, made up of many cells. Humans are multicellular. While single-celled organisms can't usually be seen without a microscope, you can see most multicelluar organisms with the naked eye.

Examples: Amoeba and Paramecium, both unicellular. Algae, or plant-like protists, have characteristics of plant cells. Examples: Chlamydomonas (unicellular), Volvox and kelp (both multicellular).

Cell Wall-A cell wall is a structural layer surrounding some types of cells, just outside the cell membrane. It can be tough, flexible, and sometimes rigid. It provides the cell with both structural support and protection, and also acts as a filtering mechanism.

The cell wall is the protective, semi-permeable outer layer of a plant cell. A major function of the cell wall is to give the cell strength and structure, and to filter molecules that pass in and out of the cell.

The cell wall is an outer protective membrane in many cells including plants, fungi, algae, and bacteria. ... The main functions of the cell wall are to provide structure, support, and protection for the cell. The cell wall in plants is composed mainly of cellulose and contains three layers in many plants.

The cell membrane (also known as the plasma membrane (PM) or cytoplasmic membrane, and historically referred to as the plasmalemma) is a biological membrane that separates the interior of all cells from the outside environment (the extracellular space) which protects the cell from its environment consisting of a lipid bilayer with embedded proteins. The cell membrane controls the movement of substances in and out of cells and organelles. In this way, it is selectively permeable to ions and organic molecules.

The primary function of the plasma membrane is to protect the cell from its surroundings. Composed of a phospholipid bilayer with embedded proteins, the plasma membrane is selectively permeable to ions and organic molecules and regulates the movement of substances in and out of cells.

Transmembrane protein channels and transporters: Transmembrane proteins extend through the lipid bilayer of the membranes; they function on both sides of the membrane to transport molecules across it. Nutrients, such as sugars or amino acids, must enter the cell, and certain products of metabolism must leave the cell.

Fluid mosaic fluid-Fluid mosaic model explains various observations regarding the structure of functional cell membranes. According to this model, there is a lipid bilayer in which the protein molecules are embedded. The lipid bilayer gives fluidity and elasticity to the membrane. ... Its main function is to give shape to the cell.

The fluid mosaic model explains various observations regarding the structure of functional cell membranes. ... The model, which was devised by SJ Singer and GL Nicolson in 1972, describes the cell membrane as a two-dimensional liquid that restricts the lateral diffusion of membrane components.

Exocytosis-Exocytosis is the cellular process in which intracellular vesicles in the cytoplasm fuse with the plasma membrane and release or "secrete" their contents into the extracellular space. Exocytosis can be constitutive (occurring all the time) or regulated.

Exocytosis is a process by which a cell transports secretory products through the cytoplasm to the plasma membrane. Secretory products are packaged into transport vesicles (membrane-bound spheres). Let's look at some examples of cellular secretory products: Secreted protein - enzymes, peptide hormones, and antibodies.

Endocytosis-Endocytosis is a cellular process in which substances are brought into the cell. The material to be internalized is surrounded by an area of plasma membrane, which then buds off inside the cell to form a vesicle containing the ingested material.

There are three types of endocytosis: phagocytosis, pinocytosis, and receptor-mediated endocytosis. In phagocytosis or “cellular eating,” the cell's plasma membrane surrounds a macromolecule or even an entire cell from the extracellular environment and buds off to form a food vacuole or phagosome.

Cell Organelles-A small organ-like structure present inside the cell is called a cell organelle. It has a particular structural makeup and performs a specific function. Depending upon the presence or absence of membrane, cell organelles can be classified into three categories, namely:

Without membrane: Some cell organelles like ribosomes are not bounded by any membrane. They are present in prokaryotic as well as eukaryotic organisms.

Single membrane-bound: Some organelles are bounded by a single membrane. For example, vacuole, lysosome, Golgi Apparatus, Endoplasmic Reticulum etc. They are present only in a eukaryotic cell.

Double membrane-bound: Cell organelles like mitochondria and chloroplast are double membrane-bound organelles. They are present only in a eukaryotic cell.

Within the cytoplasm, the major organelles and cellular structures include:

Within the cytoplasm, the major organelles and cellular structures include:

(1) nucleolus

(2) nucleus

(3) ribosome

(4) vesicle

(5) rough endoplasmic reticulum

(6) Golgi apparatus

(7) cytoskeleton

(8) smooth endoplasmic reticulum

(9) mitochondria

(10) vacuole

(11) cytosol

(12) lysosome

(13) centriole.

Nucleus-Nucleus is a Latin word for the seed inside a fruit. It most often refers to: Atomic nucleus, the very dense central region of an atom. Cell nucleus, a central organelle of a eukaryotic cell, containing most of the cell's DNA.

Function of the Nucleus. The nucleus is an organelle found in eukaryotic cells. Inside its fully-enclosed nuclear membrane, it contains the majority of the cell's genetic material. This material is organized as DNA molecules, along with a variety of proteins, to form chromosomes.

Mitochondria-Mitochondria are the working organelles that keep the cell full of energy. Mitochondria are small organelles floating free throughout the cell. Some cells have several thousand mitochondria while others have none. Muscle cells need a lot of energy so they have loads of mitochondria.

Function. The most prominent roles of mitochondria are to produce the energy currency of the cell, ATP (i.e., phosphorylation of ADP), through respiration, and to regulate cellular metabolism. The central set of reactions involved in ATP production are collectively known as the citric acid cycle, or the Krebs cycle.

Mitochondria are found in all body cells, with the exception of a few. There are usually multiple mitochondria found in one cell, depending upon the function of that type of cell.

Cytoskelton-The cytoskeleton is the name given to the fibrous network formed by different types of long protein filaments… Three major types of filaments make up the cytoskeleton: actin filaments, microtubules, and intermediate filaments.

The Function Of a Cytoskeleton. ... Through a series of intercellular proteins, the cytoskeleton gives a cell its shape, offers support, and facilitates movement through three main components: microfilaments, intermediate filaments, and microtubules.

Cilia-Cilia and flagella move liquid past the surface of the cell. For single cells, such as sperm, this enables them to swim. For cells anchored in a tissue, like the epithelial cells lining our air passages, this moves liquid over the surface of the cell (e.g., driving particle-laden mucus toward the throat).

Tiny hairs called cilia (pronounced: SIL-ee-uh) protect the nasal passageways and other parts of the respiratory tract, filtering out dust and other particles that enter the nose with the breathed air.

Flagellum-A flagellum (plural: flagella) is a long, whip-like structure that helps some single celled organisms move. It is composed of microtubules. They help propel cells and organisms in a whip-like motion. The flagellum of eukaryotes usually moves with an “S” motion, and is surrounded by cell membrane.

A flagellum is a whip-like structure that allows a cell to move. They are found in all three domains of the living world: bacteria, archaea, and eukaryota, also known as protists, plants, animals, and fungi. While all three types of flagella are used for locomotion, they are structurally very different.

Ribosome- Ribosome begins to synthesize proteins that are needed in some organelles, the ribosome making this protein can become "membrane-bound". In eukaryotic cells this happens in a region of the endoplasmic reticulum (ER) called the "rough ER".

When it is time to make the protein, the two subunits come together and combine with the mRNA. The subunits lock onto the mRNA and start the protein synthesis. The process of making proteins is quite simple. ... With the mRNA offering instructions, the ribosome connects to a tRNA and pulls off one amino acid.