Peer reviewed science writing

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**The Cell**

**Introduction**

There are roughly 40 trillion cells in our body. These cells are the ones that create tissues which become organs. Every cell in the body has a purpose like communicating or carrying reactions. The number of cells are not as impressive as the different functions cells can perform. For example, pumping blood, learning and memory, conduction of impulse through nervous system, and contraction of muscle. Therefore, to understand all these cells as a whole we will be looking at the different organelle and their functions in the succeeding paragraphs.

**Cell Theory**

Back in the day organisms were thought of as complete and inseparable beings. This was due to the inability of the microscope to see smaller structures. Around 1800’s the advancement in microscopes allowed scientists to observe a cell and differentiate its smaller structures. After much contemplation in the scientific community, three basic tenets were formed. First, all living things are composed of cells. Second, cell is the basic functional unit of life. Third, cells arise from pre-existing cells. Furthermore, due to the advancement in molecular biology, a fourth tenant was added- cells carry genetic information in form of DNA. This genetic material is passed down from parent to the daughter cell.

**Eukaryotic Cells**

The first major difference we can make between organisms is prokaryotic or eukaryotic cells. Eukaryotic cells can consist of unicellular or multicellular organisms, and they consist of a true nucleus. Whereas, prokaryotic cells do not consist of a true nucleus. Every cell has a cell membrane which is filled with a fluid called cytosol where the different organelles are suspended. The organelles found in eukaryotes are mostly membrane bound which allows for the compartmentalization of functions. This membrane is made of phospholipid bilayer which acts a barrier for the cell. The cytosol allows for the diffusion of different material that enters the cell. The nucleus consists genetic material in the form of DNA, which gets organized into chromosomes when replicating.

**Nucleus**

Nucleus is called the control center of the cell. It contains all the genetic information required from replication of the cell. Nucleus has a double membrane called the nuclear membrane which separates the genetic material from the rest of the cell. The membrane has small pores called the nuclear pores which allow for a selective two-way exchange between the cytoplasm or cytosol and the nucleus. DNA has coding regions called genes which dictate the expression, and this DNA is wound around organizing proteins called histones which further organize the DNA into linear strands called chromosomes. There is a subsection of nucleus called the nucleolus where ribosomal rRNA is synthesized which helps in the event of replication.

**Mitochondria**

Mitochondria is called the power house of the cell. It contains two layers, inner and outer membrane. The outer membrane is a barrier from the rest of the cell and the inner environment serves as the stabilizer for the inner environment of cell. The inner environment is folded in multiple layers called cristae which helps increase the surface area of mitochondria. Cristae contains the enzymes and molecules necessary for the electron transport chain. The space inside the inner membrane is called matrix, and the space between inner and outer membrane is called intermembrane space. Mitochondria are considered different from the rest of the cell because they are semi-autonomous, they have their own genes which allow them to replicate independently of the cell. Lastly, mitochondria are also capable of killing the cell by releasing enzymes through electron transport chain and initiating the process called apoptosis.

Lysozomes

Lysozomes contain hydrolytic enzymes that are capable of breaking down many different substrates, including material ingested during endocytosis and cellular waste product. It’s around the potentially harmful substance so that it can prevent damage to the cell. Afterwards, enzymes are released that breakdown the harmful material in a process called autolysis leaving to direct degradation of cellular components.

Endoplasmic Reticulum

Endoplasmic reticulum is a set of series of interconnected membranes attached to the nuclear envelope. The membrane of endoplasmic reticulum is folded into multiple invagination allowing for a greater surface area. There’re two different varieties of endoplasmic reticulum: rough and smooth. The rough ER has ribosomes attached to it, which allow the translation of proteins that get secreted into the lumen. On the other hand, smooth ER lacks the ribosomes and used mostly for lipid synthesis and detoxification of drugs and poisons. Lastly, smooth ER also transports proteins from the rough ER to the Golgi apparatus.

Golgi Apparatus

The Golgi apparatus consist of membrane-bound sacs that are stacked. First, Materials from the endoplasmic reticulum get transferred over to the Golgi apparatus. Next, the cellular products can be changed by the addition of various groups such as, phosphates, carbohydrates, and sulfates. Modification of similar products is also possible through Single sequences, which directs the delivery of product to a specific location. After sorting/ modification, the cellular products are repackaged in vesicles which get transferred to the correct location. If the products are meant to be secreted, the vesicle attaches to the cell membrane and releases its contents by a process called exocytosis.

Peroxisomes

Hydrogen peroxide is the composition of peroxisomes. The hydrogen peroxide allows for the breakdown of long chain fatty acids via Beta oxidation. Peroxisomes participate in the synthesis of phospholipids and also contain enzymes required in pentose phosphate pathway.

Cytoskeleton

The structure and shape of the cell is maintained by the cytoskeleton. In addition, the cytoskeleton provides for a conduit to transfer materials across the cell. There are three parts to the cytoskeleton: microfilament, microtubule, intermediate filament.

Microfilaments

 Microfilament are composed of polymerized rods of actin. The actin filament is organized into bundles and network which are resistant to both compression and fracture. The filament can also use ATP to generate force for movement by interacting with myosin, such as muscle contraction. Cytokinesis also uses microfilaments; the cleavage furrow is form from the microfilaments during mitosis. At the sight of division, microfilaments form a ring structure. This ring structure allows for the filament to contract, making that ring smaller and eventually pinching off the connection of the two cells.

 Microtubules

 Microtubules are hollow polymers of tubulin protein. Microtubules are spread all across the cell, providing the meet pathway for the motor proteins like dynein and kinesin to carry vesicles. Cilia and flagella are motile structures composed of microtubules. Cilia are small projections coming out of the cell that allow the movement of material across the surface of cell. They line the respiratory tract and also involved in movement of mucus. Next, Flagella are responsible for the movement of the cell. A great example is the sperm. If we look at the structure of cilia and flagella, a similarity is noticed. Both are composed of 9 pairs of microtubules which form a ring on the outside, with two microtubules in the center.

Intermediate Filaments

Keratin and desmin are the example of intermediate filaments. Many of the filaments are involved in cell to cell adhesion or maintenance of overall integrity of cytoskeleton. These filaments can bear tremendous amounts of tension, which makes the cell more rigid. In addition, intermediate filaments allow for anchoring of other organelles, including the nucleus.

Refrence used

Rogers, Kara. *Biochemistry, Cells, and Life*. Britannica Educational Pub. in Association with Rosen Educational Services, 2011.