

Structure and function of eukaryotic cell organelles essay sample



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Nearly all animal cells have a nucleus, with the only exception being the red blood cell. The nucleus has two major functions, which are housing the DNA and controlling the cell's activities. In the centre of the nucleus is the nucleolus. This doesn't have a membrane, but holds itself together. In the nucleolus, ribosomes are created through the mixture of RNA and proteins. These proteins are originally found in the cytoplasm, outside the nucleus, but they travel through the pores in the nuclear envelope, through the chromatin and into the nucleolus. The structure of the nucleolus allows easy access for the proteins, as well as an easy exit for the ribosome subunits. The chromatin that surrounds the nucleolus contains both DNA and proteins. When the cell is dividing the chromatin, which is a mess of DNA strands, start to curl. After they have finished curling you can see clear, organised chromosomes. The cell divides when each of these chromosomes replicates itself through mitosis. On the outside of the nucleus is the nuclear envelope. This is a double layered membrane which holds together the contents of the nucleus, and is attached to the rough endoplasmic reticulum. Within the envelope are nuclear pores which allow proteins to enter the nucleus and the sub units of the ribosomes to leave.

Endoplasmic Reticulum.

Endoplasmic Reticulum (ER) is made from a network of membranous tubules and flattened sacs, known as cisternae. Within the ER membrane is the cisternal space. There are two morphologies of ER, smooth (SER) and rough (RER). RER has many ribosomes on the exterior giving a rough appearance, and consists of flattened sacs. RER is attached to the nuclear envelope, and is the site of first stage protein modification. The ribosomes attached to the

RER synthesise proteins, which then enter the cisternal space. Enzymes within the cisternal space then change these proteins into a 3D form. After modification the majority of proteins are transported via vesicles to other organelles such as the Golgi Body. The structure aids to the RER's function as it has a great surface area, meaning that the maximal number of proteins can be synthesised at any one time. By having a direct link to the nucleus it allows proteins to enter through here, quickening transportation. SER is made from tubules and this shape prevents ribosomes from attaching. SER's role is to synthesise carbohydrates and lipids and to store calcium. If ribosomes were present, these substances wouldn't be able to pass through the SER's membrane. Although having limited similarities RER and SER are interconnected, aiding with their functions as substances can pass between them through the cisternal space.

Ribosomes.

Ribosomes are tiny organelles. They are made within the nucleolus from 60% RNA and 40% protein, and consist of two subunits, one large and one small. When produced, the subunits stay separate to exit through the nuclear pores: it is only because of their miniscule size that they can fit through. Many ribosomes then bind themselves to the RER, although some stay free in the cytoplasm. Free and bound ribosomes both create polypeptide chains, which are used to make proteins. To create a polypeptide chain the large and small subunits must join together. Between the two, runs a strand of messenger RNA which holds the gene code for the ribosome to read. As the ribosome reads the mRNA, it collects amino acids from transfer RNA that match each codon. By having two separate units it keeps the mRNA secure

which allows for accurate reading. New amino acids are brought into site A, and then joined via a peptide bond to the growing polypeptide chain held in site P. After the amino acid has joined, the tRNA leaves via the exit site (E). Once the mRNA strand has been read, the subunits separate again. The chain that is created is then released either into the cytoplasm or directly into the cisternal space of the RER, depending on where the ribosome is.

Mitochondria.

Mitochondria are fairly large organelles that occur in great numbers throughout most cells. The structure of the mitochondria is extremely important to the functioning of the organelle. It has two membranes, a smooth outer membrane, and a convoluted inner membrane which allows cristae to be formed. Between the two membranes is a narrow intermembrane space and within the inner membrane is a larger internal matrix. Both contain a complex mix of specialised proteins. The outer membrane acts like a filter by having channels that prevent large particles from passing through. The inner membrane, like the outer one, allows particles to pass through, although it is much more selective. To guarantee that only the correct molecules get to the matrix, the inner membrane uses transport proteins. Mitochondria's role within the cell is to perform aerobic respiration (respiration in the presence of oxygen) to create ATP (adenosine 5'-triphosphate) which is then transported around the cell to be used as chemical energy. The enzyme used to make the ATP is housed within the inner membrane which is why the convoluted shape is necessary. This shape maximises the surface area, and therefore maximises the amount of ATP

that is generated. Within cells that are highly active such as muscle cells, the concentration of mitochondria is much greater as more energy is consumed.

Golgi Body.

The Golgi body, also known as the Golgi apparatus or the Golgi complex, is made up from flattened membranous cup-shaped sacs called cisternae.

Within the sacs are spaces called lumen that contain enzymes for modifying proteins, either by adding or removing carbohydrate subunits. The body has two faces, the cis face which fuses with incoming transport vesicles, and the trans face which excretes the secretory vesicles. The cis face fuses with vesicles coming from the ER effectively from many directions due to its convex shape, whereas the concave trans face can direct the secretory vesicles to their destination. When fusing with the cis face, the transport vesicles release their proteins to be absorbed for modification. Each cisternal layer of the Golgi body holds different enzymes which each modify the passing proteins in separate ways. Between the layers the proteins are moved through the gaps by small vesicles. When a protein has been modified correctly, it leaves the Golgi body via secretory vesicles which then carry the modified proteins to the cell membrane or another organelle. The proteins that are transported to the cell membrane are either excreted from the cell, or absorbed into the membrane to aid with its function. Some of the secretory vesicles which hold hydrolytic enzymes stay within the cytoplasm and function as lysosomes.

Lysosomes.

Lysosomes are specialized vesicles that are created by the Golgi body. Their role is to digest any worn out, excess or unwanted bodies within the cell.

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This could include bacteria or viruses as well as mitochondria which are no longer effective. To do this they contain an acidic (pH 4.5-5) hydrolytic enzyme mixture that is housed in a single membrane. This membrane has a glycoprotein coat on its inner surface which prevents the enzymes from digesting the lysosome itself. For the digestion of mitochondria the lysosome fuses with the mitochondria's membrane and then releases the digestive enzymes as can be seen in the diagram on the right. For bacteria or viruses the lysosome engulfs them within its own membrane trapping them within a vacuole. The lysosome then releases the hydrolytic enzymes into the vacuole, which in turn digest the bacteria or viruses. This process seen on the right is called Phagocytosis. Once an organelle or bacteria or virus has been digested the lysosome then releases the nutrients that have been collected into the cytoplasm to use in the synthesis of new cellular components. This can happen due to the transport proteins that are on the outside of the lysosome's membrane. Another function of the lysosome is to act as a membrane patch if the cell membrane should get damaged.

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