Tour of the cell biology paper flashcard

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Learning about Cells. First thing I want to show you is two beautiful pictures of a Cell. Imagine all of this is in something so small we cannot see it with our naked eyes. About 10, 000 average-sized human cells can fit on the head of a pin. There are a few exceptions, but the average cell is very tiny. Here are a few beautiful examples of a cell structure to kind of give you an idea of its beauty, and how they fit together. Plasma Membrane (cell membrane) First we are going to learn about the Plasma membrane it is also called the cell membrane. No, it is not the same thing as the Plasma Tv.

Most of you are probably familiar with. As you can see with the above picture the Plasma membrane is on the outer side of the cell. Plasma membrane is what separates the interior of the cell from the outside environment. It is like the peel on an orange. The cell membrane is selectively permeable to ions and organic molecules and controls the movement of substances in and out of cells. It is basically the fence that protects the cell from outside forces. It does allow a few things through though. Carbon Dioxide, oxygen and water are mostly what it allows through.

The cell membrane also plays a role in anchoring the cytoskeleton to provide shape to the cell, and in attaching to the extracellular matrix and other cells to help group cells together to form tissues. Biological membranes can be considered as a two-dimensional liquid in which all lipid and protein molecules diffuse more or less easily. Although the lipid bilayers that form the basis of the membranes do form two-dimensional liquids by themselves, the plasma membrane also contains a large quantity of proteins, which provide more structure.

Here is an illustration of the Cell Membrane or Plasma membrane. The Nucleus Next I want to tell you about the core or center of the cell. The nucleus is the center of the cell. Yes, we skipped from the outermost to the innermost part of a cell. The Nucleus is extremely important, because it holds most of the cell's DNA. As we know our DNA is what makes us what we are. Not only our DNA, but how we use it. The Nucleus is the control center of the cell. In cell biology, the nucleus (is a membrane-enclosed organelle found in eukaryotic cells.

It is complex with a large variety of proteins, such as histones, to form chromosomes. The genes within these chromosomes are the cell's nuclear genome. The function of the nucleus is to maintain the integrity of these genes and to control the activities of the cell by regulating gene expression — the nucleus is the control center of the cell. The nucleus is the largest cellular organelle in animals. It occupies about 10% of the total cell volume. The viscous liquid within it is called nucleoplasm, and is similar in composition to the cytosol found outside the nucleus.

It appears as a dense, roughly spherical organelle. The outer envelope, otherwise known as nuclear membrane, consists of two cellular membranes, an inner and an outer membrane, arranged parallel to one another. The nuclear envelope completely encloses the nucleus and separates the cell's genetic material from the surrounding cytoplasm, serving as a barrier to prevent macromolecules from diffusing freely between the nucleoplasm and the cytoplasm. The outer nuclear membrane is continuous with the membrane of the rough endoplasmic reticulum (RER), and is similarly studded with ribosomes.

The space between the membranes is called the pronuclear space. In this picture HeLa cells stained for the cell nucleus DNA with the Blue Hoechst dye. The central and rightmost cell are in interphase, thus their entire nuclei are labeled. On the left, a cell is going through mitosis and its DNA has condensed ready for division. Chromosomes Now we have something that a lot of people have heard about chromosomes. Our chromosomes tell us how we will look, our innate personality, and how our bodies will grow. Chromosomes are an organized structure of DNA, and protein found in cells.

They are a single piece of coiled DNA containing many genes, regulatory elements, and other nucleoid sequences, Chromosomes also contain DNA bound proteins which package the DNA and control its function. Chromosomes vary widely between different organisms. The DNA molecule may be circular or linear, and can be composed of 100, 000 to 10, 000, 000, 000 nucleotides in a long chain. Typically, eukaryotic cells (cells with nuclei) have large linear chromosomes and prokaryotic cells (cells without defined nuclei) have smaller circular chromosomes, although there are many exceptions to this rule.

Also, cells may contain more than one type of chromosome; for example, mitochondria in most eukaryotes and chloroplasts in plants have their own small chromosomes. In humans Chromosomes can be divided into two types —autosomes, and sex chromosomes. Certain genetic traits are linked to a person’s sex and are passed on through the sex chromosomes. The autosomes contain the rest of the genetic hereditary information. All act in the same way during cell division. There are a set number per species.

Humans have 23 pairs. Changes in these chromosomes are what cause many genetic abnormalities.

Such as Down syndrome. Ribosomes Now we are getting to the parts of the cell that are what I would call the helpers of the cells. The first one is called ribosomes, which number in the millions in a single human cell, have long been considered the “ black boxes” in molecular biology. They are what have the imprint of your entire DNA. Inside the ribosome, antibiotics and viruses are using chemistry to either fight or promote disease. Some viruses, like polio and hepatitis C, hijack human ribosomes, forcing them to pump out proteins that are beneficial for the viruses.

Which is why it is so important to understand them. We don’t have complete understanding of them yet, but there is allot of research going into it. A ribosome is a component of cells that synthesizes protein chains. It assembles the twenty specific amino acid molecules to form the particular protein molecule determined by the nucleotide sequence of an RNA molecule. They make up 25% of cells mass. Ribosomes consist of two subunits that fit together and work as one to translate the mRNA into a polypeptide chain during protein synthesis.

Bacterial sub-units consist of one or two and eukaryotic of one or three very large RNA molecules (known as ribosomal RNA or rRNA) and multiple smaller protein molecules. Crystallographic work has shown that there are no ribosomal proteins close to the reaction site for polypeptide synthesis. This suggests that the protein components of ribosomes act as a scaffold that may enhance the ability of rRNA to synthesize protein rather than directly

participating in catalysis. Endoplasmic reticulum This is the highway system of the cell.

The endoplasmic reticulum is an organelle of cells in eukaryotic organisms that forms an interconnected network of tubules, vesicles, and cisternae. Rough endoplasmic reticula are involved in the synthesis of proteins and is also a membrane factory for the cell, while smooth endoplasmic reticula is involved in the synthesis of lipids, including oils, phospholipids and steroids, metabolism of carbohydrates, regulation of calcium concentration and detoxification of drugs and poisons. Sarcoplasmic reticula solely regulate calcium levels.

The general structure of the endoplasmic reticulum is an extensive membrane network of cisternae (sac-like structures) held together by the cytoskeleton. The phospholipid membrane encloses a space, the cisternae space (or lumen), which is continuous with the perinuclear space but separate from the cytosol. The functions of the endoplasmic reticulum vary greatly depending on the exact type of endoplasmic reticulum and the type of cell in which it resides. The three varieties are called rough endoplasmic reticulum, smooth endoplasmic reticulum, and sarcoplasmic reticulum.

The quantity of RER and SER in a cell can quickly interchange from one type to the other, depending on changing metabolic needs: One type will undergo numerous changes including new proteins embedded in the membranes in order to transform. Also, massive changes in the protein content can occur without any noticeable structural changes, depending on the enzymatic needs of the cell. Golgi apparatus This part of the cell is the suitcase of the

cell. It is where the cell packages protein to get ready for travel. Its primary function is to store protein. Cells synthesize a large number of different macromolecules.

The Golgi apparatus is integral in modifying, sorting, and packaging these macromolecules for cell secretion or to use inside the cell. The vesicles that leave the rough endoplasmic reticulum are transported to the cis face of the Golgi apparatus, where they fuse with the Golgi membrane and empty their contents into the lumen. Once inside the lumen, the molecules are modified, then they are sorted for transport to their next destinations. The Golgi apparatus tends to be larger and more numerous in cells that synthesize and secrete large amounts of substances.

Lysosomes Next we come to what some refer to as the stomach of the Cell Lysosomes. Lysosomes are cellular organelles that contain acid hydrolase enzymes to break down waste materials and cellular debris. They are the cells digestive system. They are found in animal cells, though, in yeast and plants the same roles are performed by lytic vacuoles. Lysosomes digest excess or worn-out organelles, food particles, and devour viruses or bacteria. The membrane around a lysosome is what allows the digestive enzymes to work at the 4. 5 pH they require.

Lysosomes fuse with vacuoles and dispense their enzymes into the vacuoles, digesting their contents. They are created by the addition of hydrolytic enzymes to early endosomes from the Golgi apparatus. The name lysosome derives from the Greek words lysis, to separate, and soma, body. They get their name due to having a process called Autolysis. Autolysis means to self-

digest, or self-destruction. The interior of the lysosomes is acidic compared to the slightly alkaline cytosol. The lysosome maintains this pH differential by pumping protons (H+ ions) from the cytosol across the membrane via proton pumps and chloride ion channels.

The lysosomal membrane protects the cytosol, and therefore the rest of the cell, from the enzymes that degrade biological molecules within the lysosome. The cell is additionally protected from any lysosomal acid hydrolases that drain into the cytosol, as these enzymes are pH-sensitive and do not function well or at all in the alkaline environment of the cytosol. This ensures that cytosolic molecules and organelles are not lysed in case there is leakage of the hydrolytic enzymes from the lysosome. Here is a picture of how it works. And now I will show you how a Lysosome looks.
Centrosome

The centrosome is an organelle that serves as the main microtubule organizing center of the animal cell as well as a regulator of cell-cycle progression. Role of the centrosome is cell cycle progression. Centrosomes are composed of two orthogonally arranged centrioles surrounded by an amorphous mass of protein termed the pericentriolar material (PCM). The PCM contains proteins responsible for microtubule nucleation and anchoring One reason the study of centrosomes are so important to us is that centrosomes are frequently altered in cancer cells. To understand cancer we would need to understand the centrosome.

Aberrant numbers of centrosomes in a cell have been associated with cancer. They are also involved in benign tumors. This usually happens when

the structure gets too big and causes structural aberrations. One particularly odd thing about the centrosome is that the centrosome is copied only once per cell cycle so that each daughter cell inherits one centrosome, containing two centrioles. In animal cells, centrosomes contain two structures called centrioles. Interestingly, centrioles are not required for the progression of mitosis, while centrosomes are needed.

Here is a diagram that shows how it works. Mitochondria Mitochondria are sometimes described as “ cellular power plants” because they generate most of the cell’s supply of adenosine triphosphate, used as a source of energy. It is the second largest organelle with an unique genetic structure. In addition to supplying cellular energy, mitochondria are involved in a range of other processes, such as signaling, cellular differentiation, cell death, as well as the control of the cell cycle and cell growth. Energy-producing chemical reactions take place on cristae.

It also Recycles and decomposes proteins, fats, and carbohydrates, and forms urea. A mitochondrion contains outer and inner membranes composed of phospholipid bilayers and proteins. The two membranes, however, have different properties. Because of this double-membrane organization, there are five distinct compartments within the mitochondrion. They are: the outer mitochondrial membrane, the inter-membrane space (the space between the outer and inner membranes), the inner mitochondrial membrane, the cristae space (formed by in-folding’s of the inner membrane), and the matrix (space within the inner- membrane).

The reason studying Mitochondria is so important is that they are involved in many human diseases including cardiac dysfunction (heart disease). Also it seems to be involved in the aging process. I read once that if they could flush Mitochondria clean. They believe that people would not age as fast, and the normal Deterioration of the human body would be much slowed. Cytoskeleton Next we are going to talk about the thing that makes the cell have the support and ability to do what it does. Without it the cells would be immobile, and would fall apart.

They cytoskeleton is more like a scaffolding for the cell. Although protection against wear and tear is one of its functions, it is certainly not limited to this function alone. It is in fact a dynamic structure that: maintains cell shape, often protects the cell, enables cellular motion, plays an important role in intracellular transport, is very important in cell division. It is made out of protein and is present in all cells. Cytoskeletal elements interact extensively and intimately with cellular membranes. The cytoskeleton not only gives support to the cell. Like our own bone skeleton does.

It also acts as a transportation system to other cells. It is what gives the cells the ability to move. Cytoskeletons are very important in Cancer treatments. Some of the best cancer drugs interfere with the cytoskeleton function. Centrioles Here is another cell that is related to the Centrosome. Centrioles are also an organizing center, but it is not the main one. Centrioles are paired cylindrical organelles that are near the nucleus. They are composed of nine tubes, each with three tubules. They are involved in cellular division. They always lay at right angles to each other.

A centriole is a barrel-shaped cell structure found in most animal eukaryotic cells, though it is absent in higher plants and most fungi. In organisms with flagella and cilia, the position of these organelles is determined by the mother centriole, which becomes the basal body. An inability of cells to use centrioles to make functional cilia and flagella has been linked to a number of genetic and developmental diseases. In particular, the inability of centrioles to properly migrate prior to ciliary assembly has recently been linked to Meckel-Gruber syndrome. .

The next few things I am going to show you are only in plants, or mainly in plants I should say, so I want to show you a picture of a plant cell. Chloroplast The next part of the cell that we will be seeing is the Chloroplast. The Chloroplast is found in plant cells not animal. It is where Photosynthesis takes place. It contains green Chlorophyll. Over millions of years the end symbiotic cyanobacteria evolved structurally and functionally, retaining its own DNA and the ability to divide by binary fission (not mitotically) but giving up its autonomy by the transfer of some of its genes to the nuclear genome.

Within the inner membrane, in the region called the stoma, there is a system of interconnecting flattened membrane compartments, called the thylakoids. These are the sites of light absorption and ATP synthesis, and contain many proteins A little interesting note on this; this is what Casey Anthony’s mother said she was looking up when they brought up the internet searches on chlorophyll. If they could have proved the chlorophyll look up was to learn how to get ahold of it, or make it, it would have made her a premeditated murder.

Chloroplasts, like mitochondria, are very special organelles; these are formed from pre-existing organelles. Chloroplasts have a heterogeneous structure made up of small granules called “ Grana”, which are embedded within the stoma or Matrix. Here is a picture to give you a better idea of the structure of Chloroplasts. Vacuoles Our next step on the tour is the Vacuoles. Vacuoles are a membrane bound sac that is used for storage, digestion, and waste removal. It is mainly in plants, but is in a few animals. The main function is to store water, but it does many things.

Here is a list of things it does. Isolating materials that might be harmful or a threat to the cell: Containing waste products, Containing water in plant cells, Maintaining internal hydrostatic pressure or turgor within the cell, Maintaining an acidic internal pH, Containing small molecules, Exporting unwanted substances from the cell, Allows plants to support structures such as leaves and flowers due to the pressure of the central vacuole, In seeds, stored proteins needed for germination are kept in ‘ protein bodies’, which are modified vacuoles.

Most mature plant cells have one large central vacuole that typically occupies more than 30% of the cell’s volume, and that can occupy as much as 80% of the volume for certain cell types and conditions. Strands of cytoplasm often run through the vacuole. I wonder if humans had Vacuoles or something like them if we wouldn’t age as harshly like plants don’t, and if we would not get things like cancer. I am not really sure, but it is a thought I guess. Cell Wall Last we are going to talk about a Cell wall. It is most commonly found in plants, and acts somewhat similarly to the plasma membrane.

Its functions are to control truguty, to be a extracellular structure surrounding the plasma membrane. It is the plants primary cell wall. When the first cell wall is complete they form a secondary one around it. The cell wall is the tough, usually flexible but sometimes fairly rigid layer that surrounds some types of cells. It is located outside the cell membrane and provides these cells with structural support and protection, and also acts as a filtering mechanism. A major function of the cell wall is to act as a pressure vessel, preventing over-expansion when water enters the cell.

Think of the cell wall as a wicker basket in which a balloon has been inflated so that it exerts pressure from the inside. Such a basket is very rigid and resistant to mechanical damage. Thus does the prokaryote cell (and eukaryotic cell that possesses a cell wall) gain strength from a flexible plasma membrane pressing against a rigid cell wall. Here is a picture that will help you understand the structure of the Cell wall, and how it can be so strong yet flexible. Thank you for taking this tour of the cell with me. I hope you came through it with a better understanding of the cell, and how it relates to us.