ClevaLab
Explaining the Why of Biology

Cell Structure and Function - Cell Biology Explained.

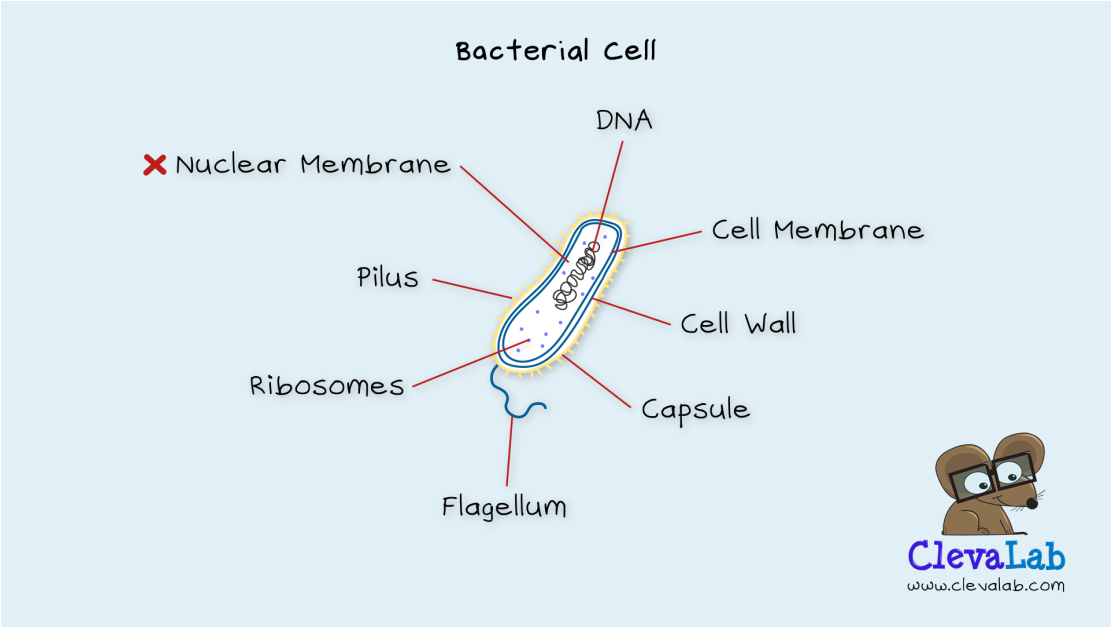
Increase your understanding of cell functions in the human body. There are trillions of cells in the human body. The exact same DNA sequence in every cell is able to create vastly different cell types. These cells also have very different functions. Watch the YouTube video or read on below.

There are 3 main cell types:

1. bacteria
2. plant
3. animal

What Does a Bacterial Cell Look Like?

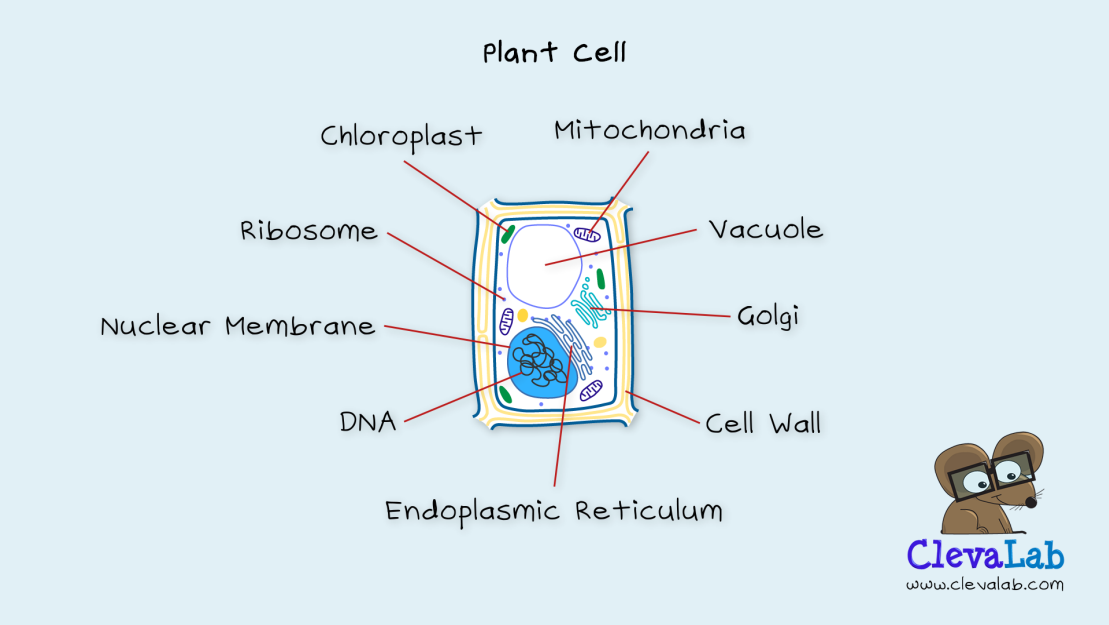
Bacteria are single celled organisms. They are prokaryotes, which means before the nut, so they have no nuclear membrane to hold their DNA. Given they're a single cell exposed to the elements, they do have some extra layers to protect them. A cell wall, as well as capsule. To help them move around some bacteria have a flagellum. Which acts like a propeller. They also have many small pilus, which help with movement but also can interact with other cells. Everything it needs to survive is within this one cell.



What Do Plant Cells Look Like?

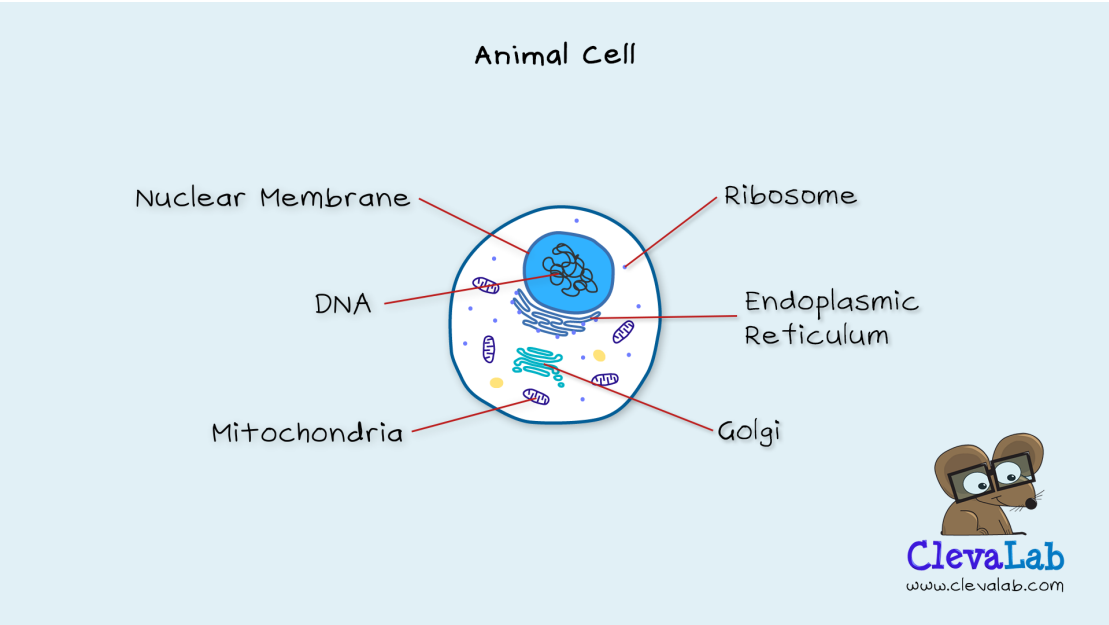
Compare the bacterial cell to a plant cell. These cells are eukaryotes, or good nut, because the DNA is now contained in a nuclear membrane. They're multicellular organisms. So there are trillions of cells that can make up a whole plant. Plants are able to store water in a vacuole inside the cell. Because of this they

also have a cell wall that protects the cell from bursting. Plants are also able to generate their own energy from light. Which they do in the chloroplasts. Here they use sunlight to make sugar, then the sugar gets converted to energy in the mitochondria. They also make proteins with ribosomes. But unlike a bacterial cell, a plant cell has endoplasmic reticulum and golgi to process and sort proteins.



What Does an Animal Cell Look Like?

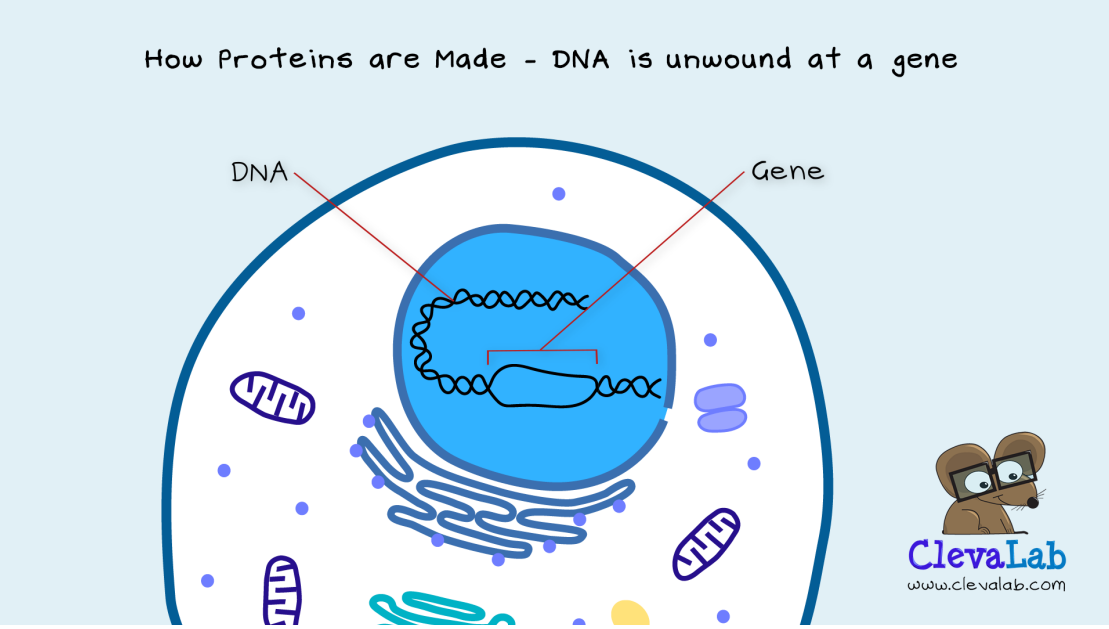
Finally, we have an animal cell. Animals are multicellular organisms, so there are trillions of these in our bodies. Animal cells are eukaryotes, so there's a nuclear membrane to hold the DNA. There's no vacuole and no cell wall. Animals don't make energy from light. Instead the mitochondria can make energy from fats, proteins, and sugars. Every cell in in your body has the same set of DNA instructions unique to you.

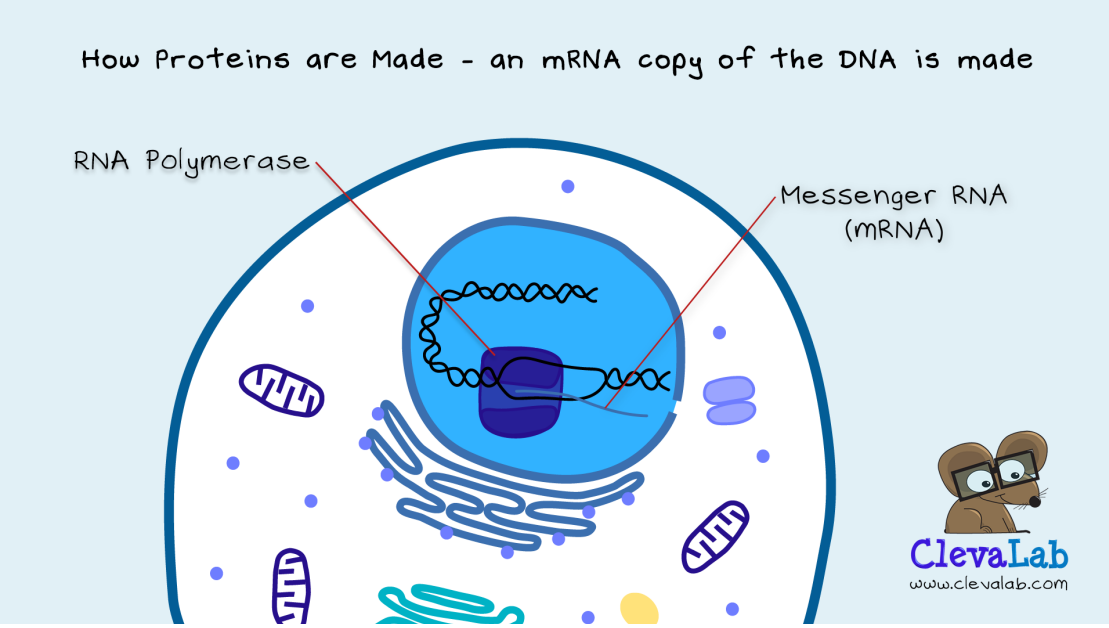


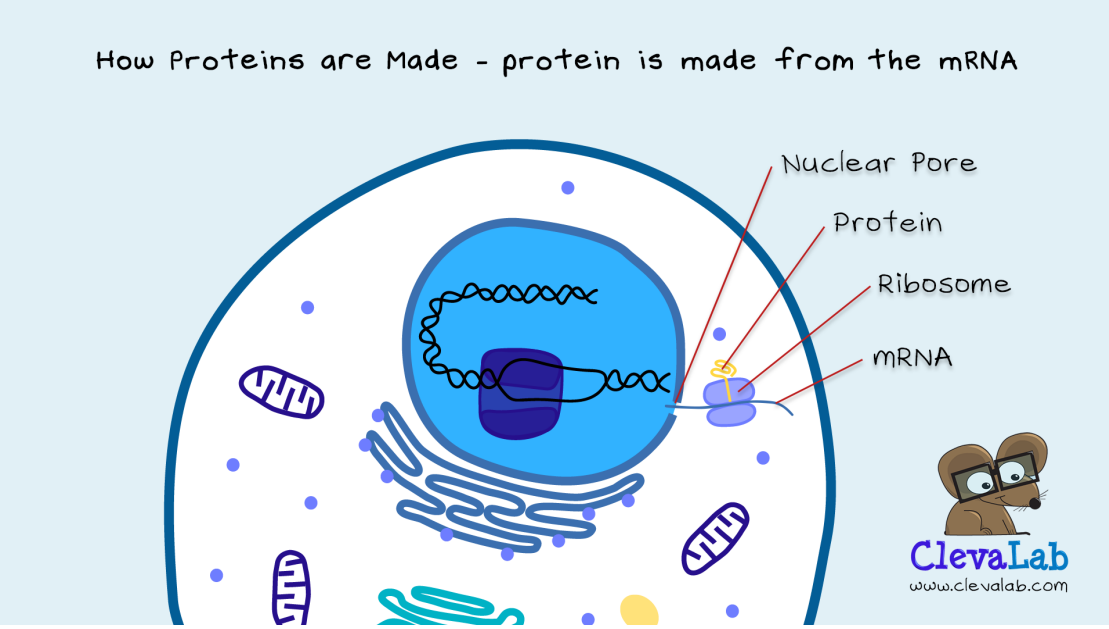
But even though it's identical in every cell. It can still make cells with all different kinds of functions. This is because different cells can make different sets of proteins.

How Do Proteins Get Made?

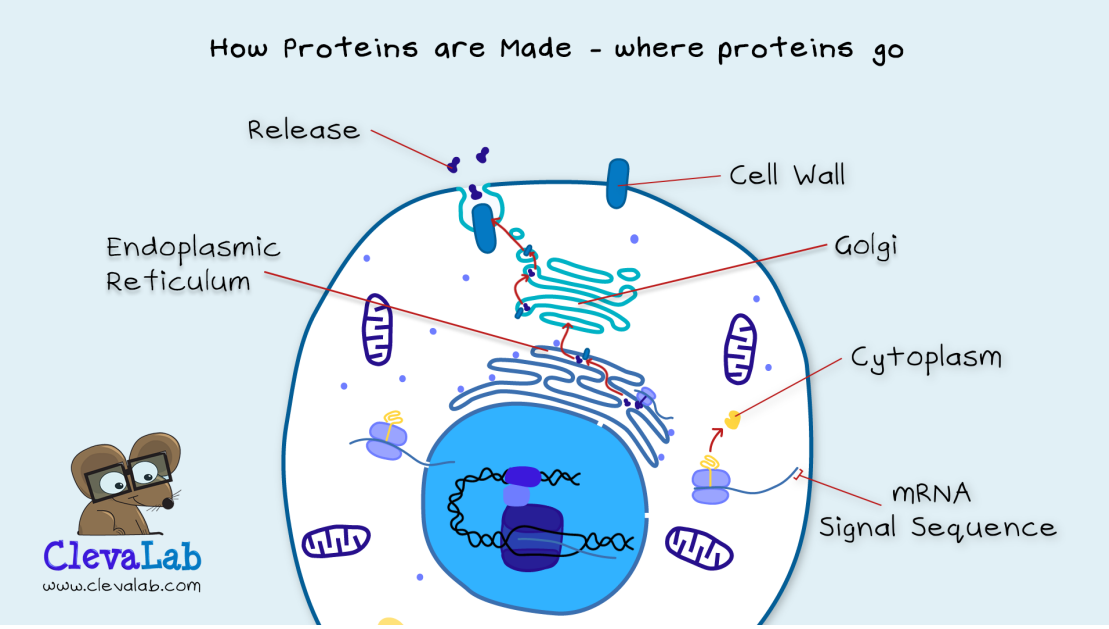
To make a protein, the DNA inside the nucleus is unwound. The protein instructions have a specific location on the DNA, so this is where they are unwound. The set of instructions that can make a protein is called a gene. The DNA is very large so it's not able to leave the nucleus, so a short messenger RNA, or mRNA, is made that can. The messenger RNA (mRNA) travels out of the nucleus via the nuclear pore. It can then be immediately made into protein by a ribosome that's ready and waiting in the cytoplasm.





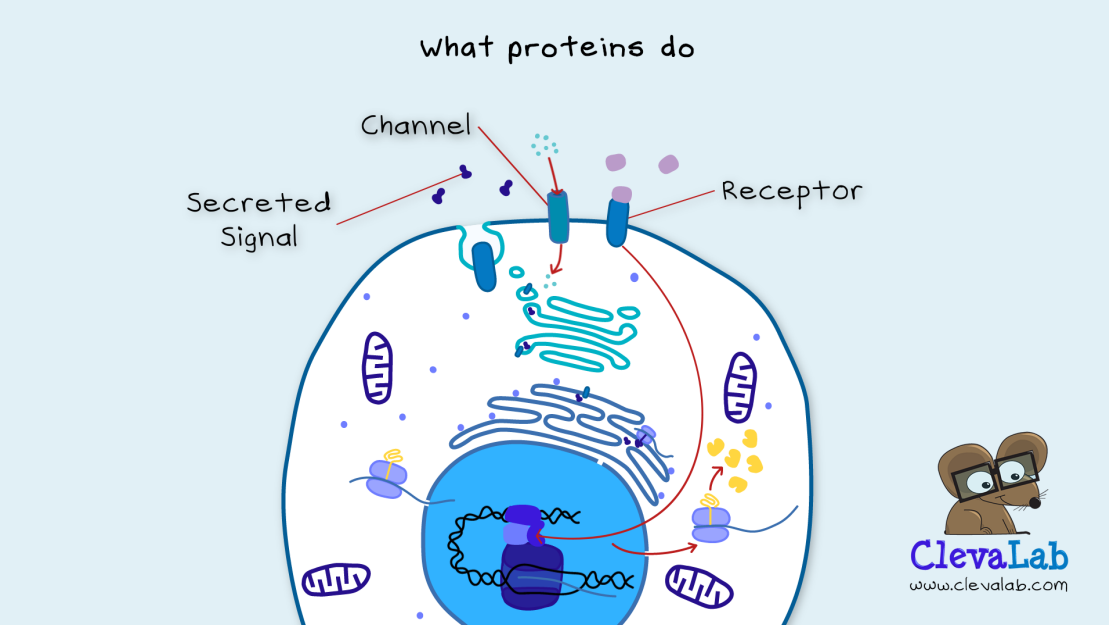


Where the protein ends up depends on a short sequence of instructions at the start of the mRNA. This directs it to either the cytoplasm, the cell wall, or for release from the cell. If it's destined for the cell wall or release. It must travel through the endoplasmic reticulum and golgi.

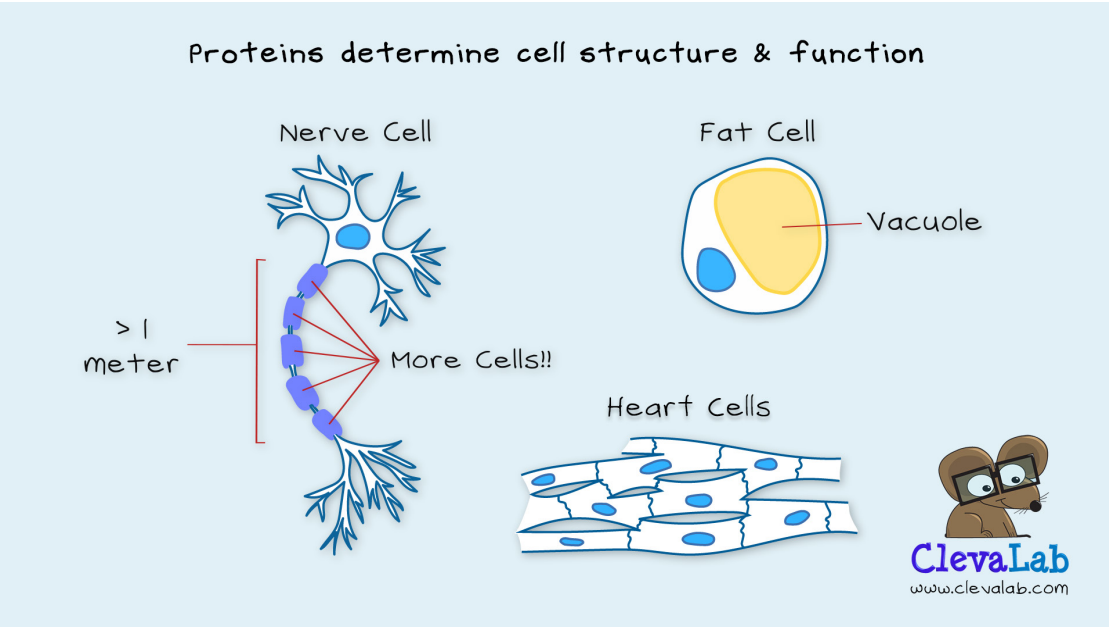


What Do Proteins Do in the Body?

Proteins can have many different functions. They can act channels that pump salts, fats, sugars or other molecules in and out of the cell. They can be receptors, which are proteins that pick up signals from outside the cell. The message passes through the membrane and to the nucleus. This will increase or decrease how much of a set of proteins are being made. Finally, they can be released from the cell to message and interact with other cells.

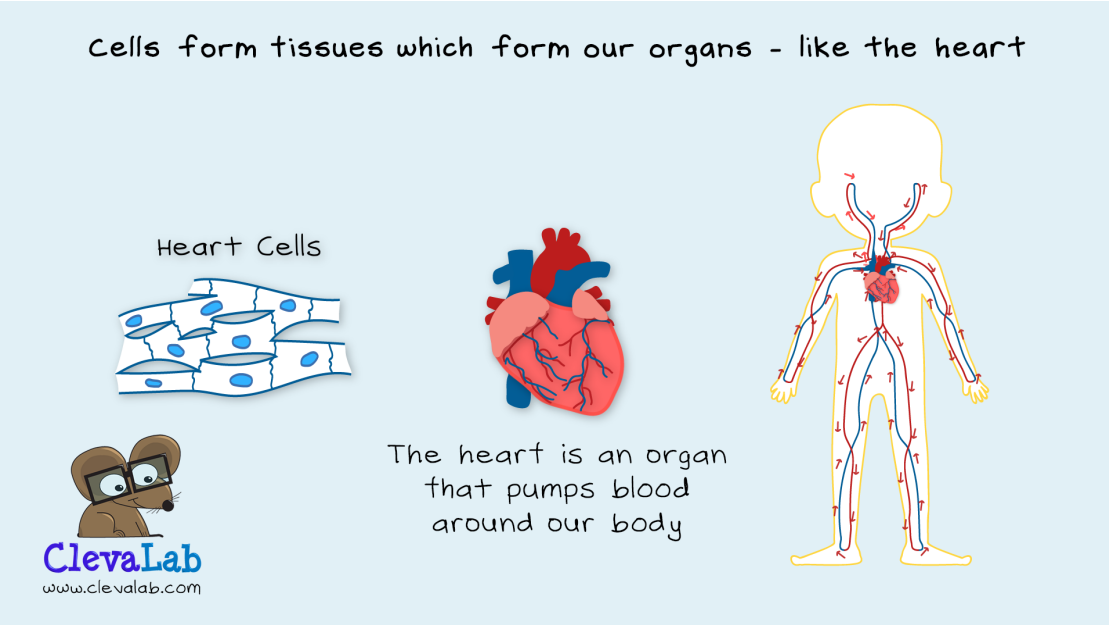


The type and amount of protein made by a cell will determine how it looks and what role it plays in the body. A cells structure is also related to it's function. A fat cell has a large vacuole taking up the majority of the cell to allow them to store fat. Nerve cells need to send fast signals from one cell to another, and from one end of the cell the other. To reach across the body some can have very long axons of over 1 meter. So they get insulated by other cell types to make sure the signal can travel all the way to the other end.

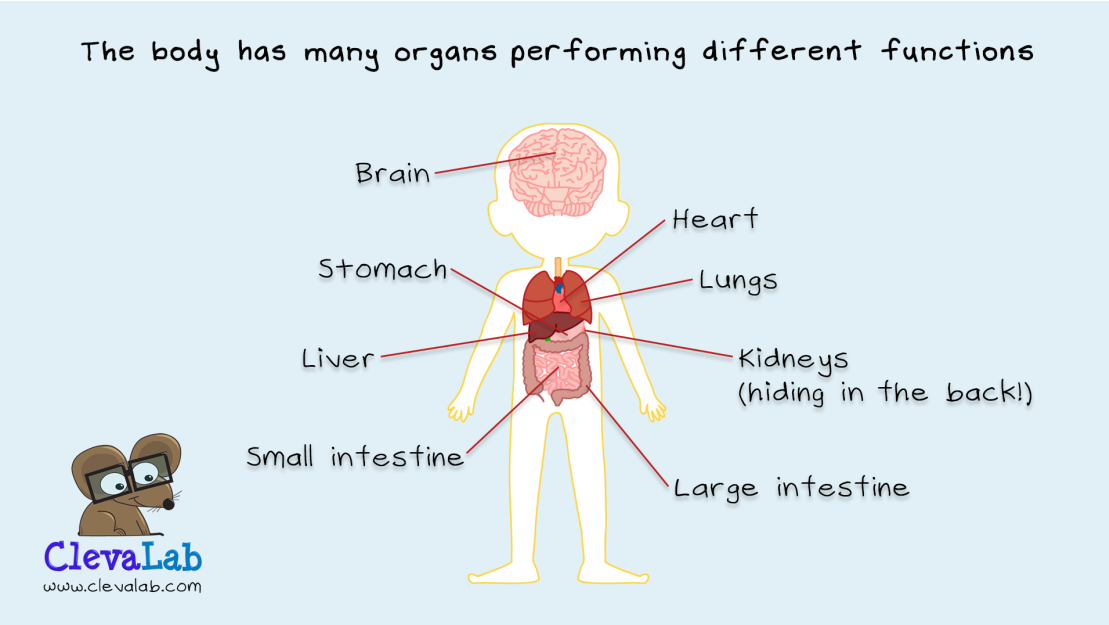


Heart cells join together and branch out to form many connections. This is so an electrical impulse can quickly spread through all the cells at once. The cells will all become shorter at the same time, which creates a heart contraction. In the heart tissue this shortening and lengthening of the cells forces blood in and out of the heart. This is how our heart beats. Tissues are cells working in a group to do a common job.

Tissues then form our organs, like the heart that pumps blood around our body.



There are also many other organs in the human body. The brain to think, control our bodies and store memories. The lungs to absorb oxygen from the air and let out carbon dioxide. The liver to help break down our food, as well as remove toxins from the blood. The stomach and intestines to absorb nutrients from our food for energy. And the kidneys to filter the blood and remove waste and excess water. Cells work together as organs to keep us alive. But keeping us going is hard work and there are still more roles a cell needs to play.



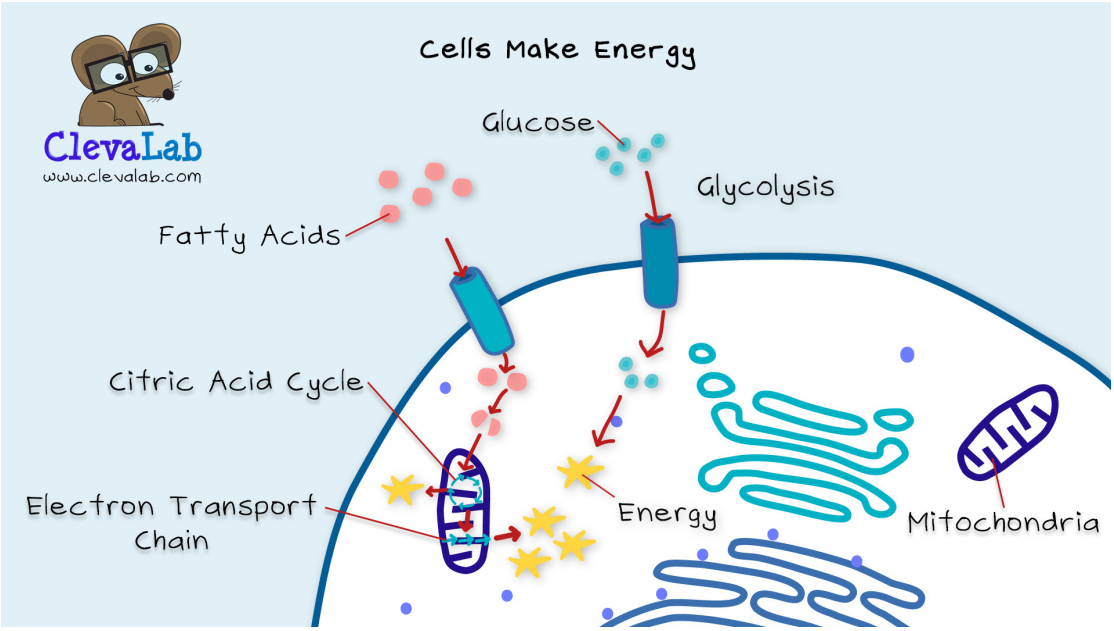
Main Functions of a Cell:

1. make energy
2. communicate
3. move
4. divide
5. die

Cells Can Make Their Own Energy:

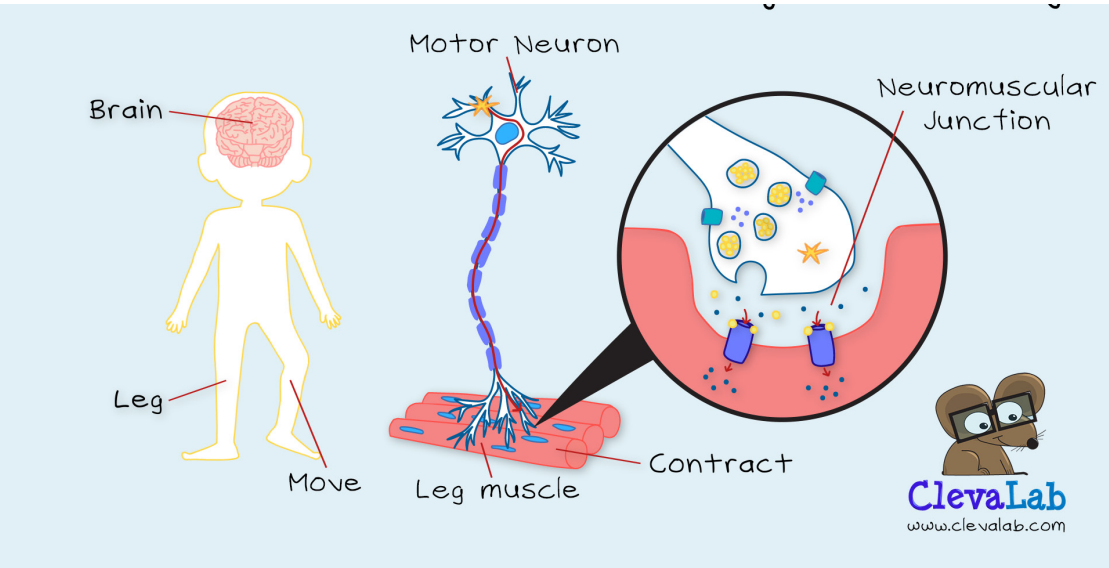
To make energy the food we eat is broken down in our stomach and intestines. The sugars, proteins, and fats from these get absorbed into our blood and delivered to our cells. A type of sugar called glucose is taken up by cells and turned into energy in the cytoplasm. This process is Glycolysis. Whereas, fatty acids taken up by cells are first broken down in the cytoplasm. Then transported to the mitochondria. Here a set of chemical reactions generate energy. They are the Citric Acid Cycle and the Electron Transport Chain. These processes use up oxygen, which we breathe in from the air. They then produce carbon dioxide, that we then breathe out. This energy is then used to fuel different processes in the cell.

Cells Can Communicate With Each Other:

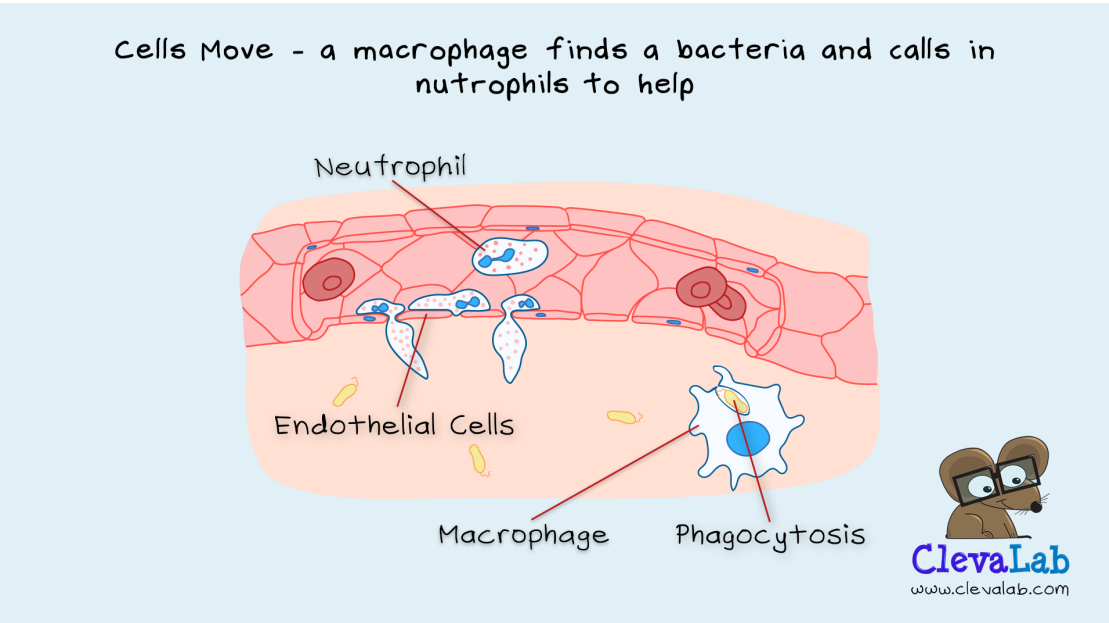


To work together cells must be able to talk to each other. If we want to move our leg, a nerve cell, or motor neuron, must send a signal from our brain to our leg to make it move. For this to happen a message in the form of an electrical impulse travels along the axon. When it reaches the very end it activates channels that let calcium into the cell. This triggers the release of a neurotransmitter. This neurotransmitter then travels across a small gap from the nerve to the muscle cell. It then binds to a receptor that lets sodium flow into the muscle. This gives the signal for the muscle cells to contract which allows us to move our leg.

Cells Can Move and Die:

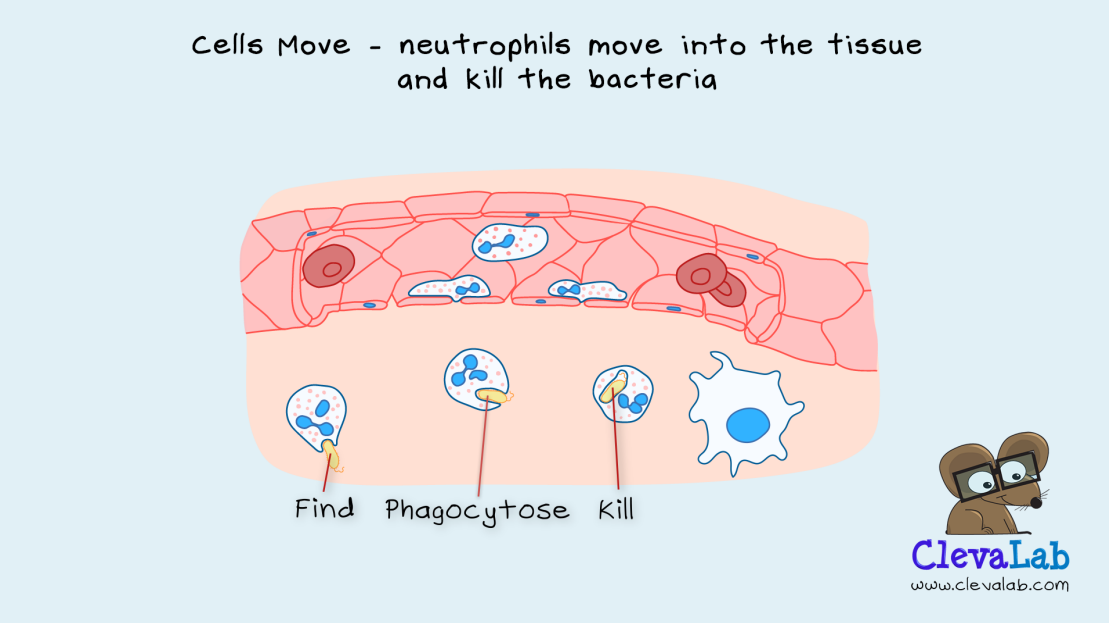


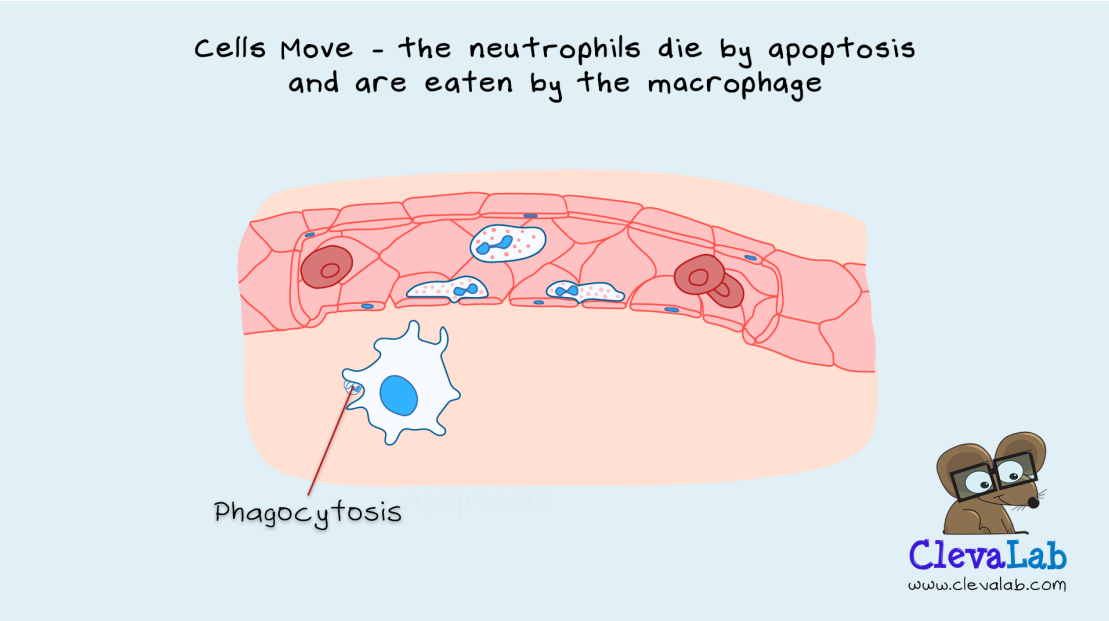
Cells are constantly sending signals, some of these are to tell cells to move. Macrophages, a type of immune cell, lie waiting in our tissue so they can find infections. When macrophages discover bacteria in the tissues, they eat the bacteria. A process called phagocytosis. The macrophage then releases proteins to signal to the endothelial cells. This signal is to allow neutrophils to travel out of the blood vessels into the tissue. Neutrophils are bacterial killing immune cells. They enter the tissues through small holes in the vessel wall. Where they find, phagocytose, and kill the bacterial cells. The neutrophils have now served their purpose and so die. This cell death is in a controlled way called apoptosis. Once dead the neutrophils get phagocytosed by macrophages, ending the tissue inflammation. Cell migration allows the body to get rid of infections. While cell death is necessary to get the tissues back to normal.



Cells Can Divide to Create More Cells:

The last cellular function to explore is cell division. We can't grow from a baby into an adult without making more cells. There are trillions more cells in an adult than in a baby. So cells need to makes copies of themselves for your body to grow.

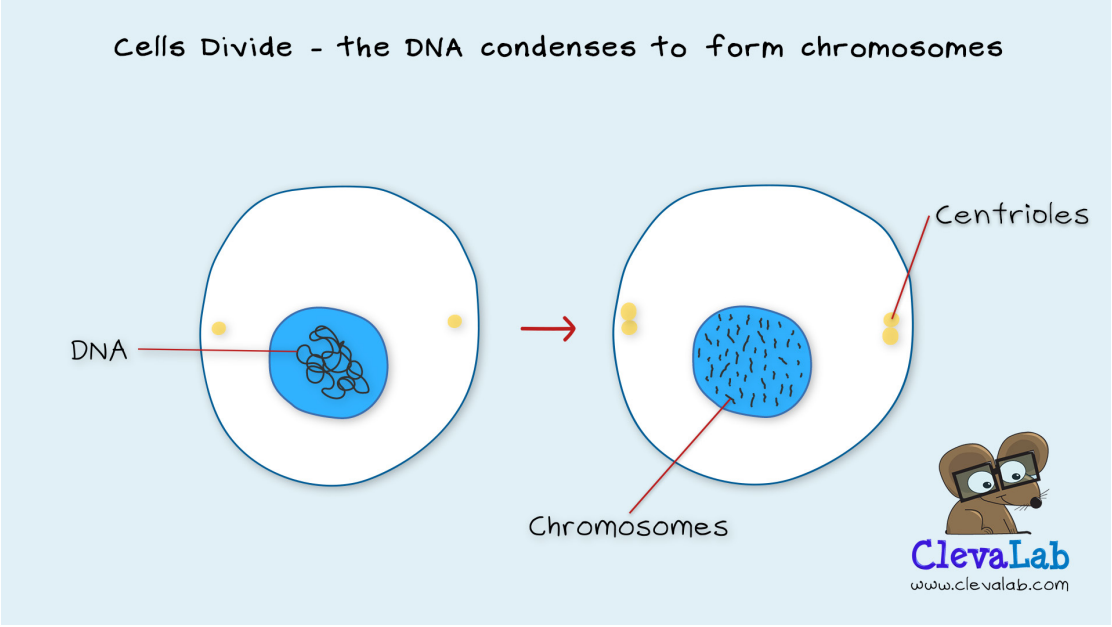


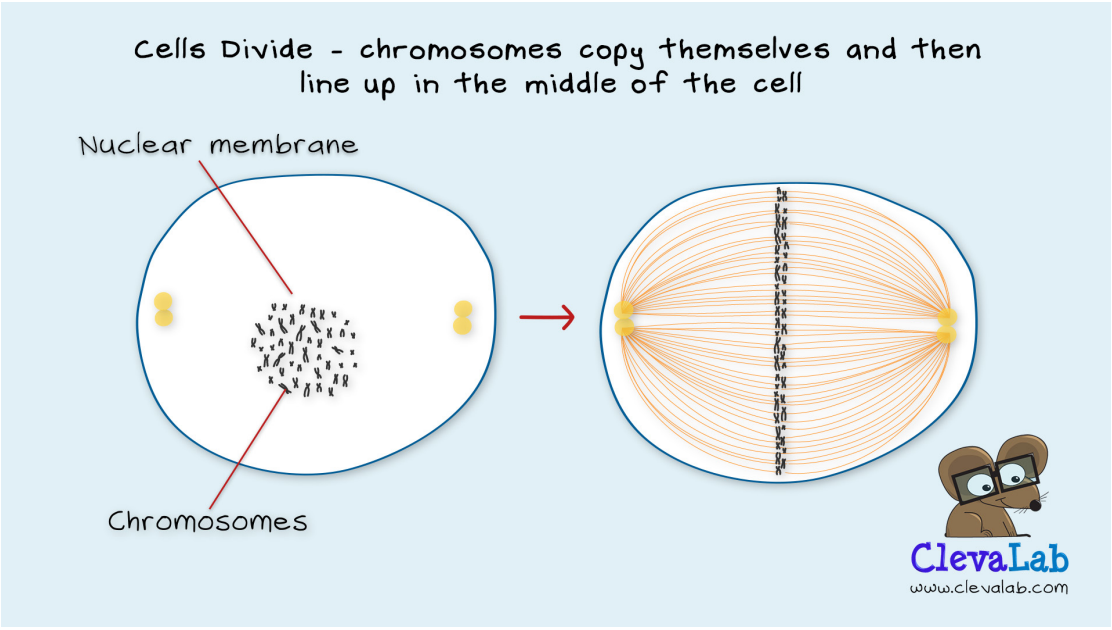


When cells divide they make an exact copies of themselves. First the DNA separates into separate chromosomes. The nuclear membrane disappears and a copy of each chromosome as well as the centromeres is made. The chromosomes then line up in the middle of the cell. A microtubule then pulls one copy of each chromosome to opposite sides of the cell. The cell itself also has become bigger and the cell

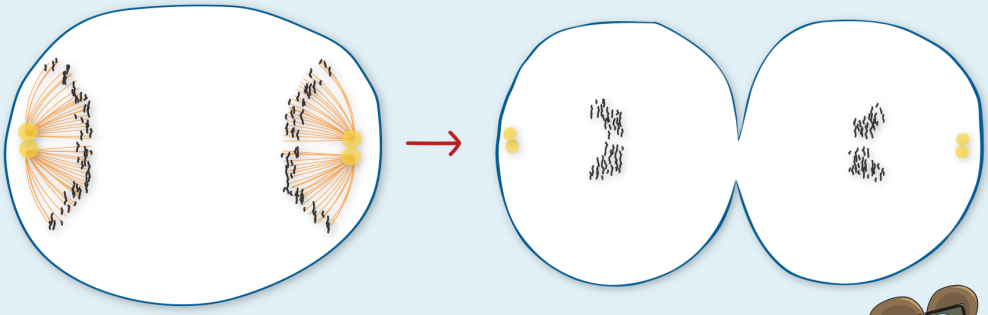
wall starts pinch in the middle. Until finally there are two identical separate cells. The nuclear membrane reforms and the DNA returns to its relaxed state. In this way one cell can divide into 2, 2 into 4, 4 into 8, 8 into 16, and so on, so that cells can quickly be made when needed.

Cells are the building blocks of life that form the tissues and organs of our bodies. Even through the DNA is the same in every cell of the human body, we have over 200 different cell types. These different cell types are possible because each have turned on a different set of genes. So they make a different set of proteins. All these different cell types work together so we can move, breath, fight infections and go on living.

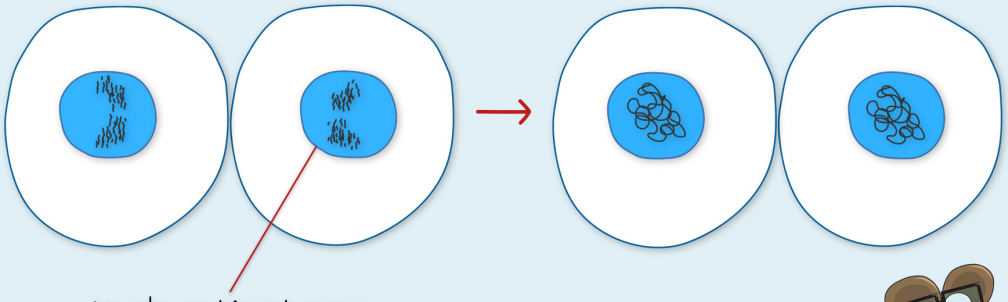




Cells Divide - one of each pair of chromosomes is pulled to each side of the cell and it pinches in the middle



Cells Divide - the nuclear membrane reforms and the DNA relaxes



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