TutorTube: Tour of the Cell

Spring 2020

Introduction

Hello and welcome to TutorTube, where The Learning Center's Lead Tutors help you understand challenging course concepts with easy to understand videos. My name is Ethan, Lead Tutor for biology and chemistry. In today's video, we will explore cells and their organelles. Let's get started!

Origin of Cells

Just as a preview, here are fully labeled plant and animal cells with all the organelles we'll cover in this video, plus some extra ones. This diagram will be referenced at the end of the video to go along with some labeling practice.

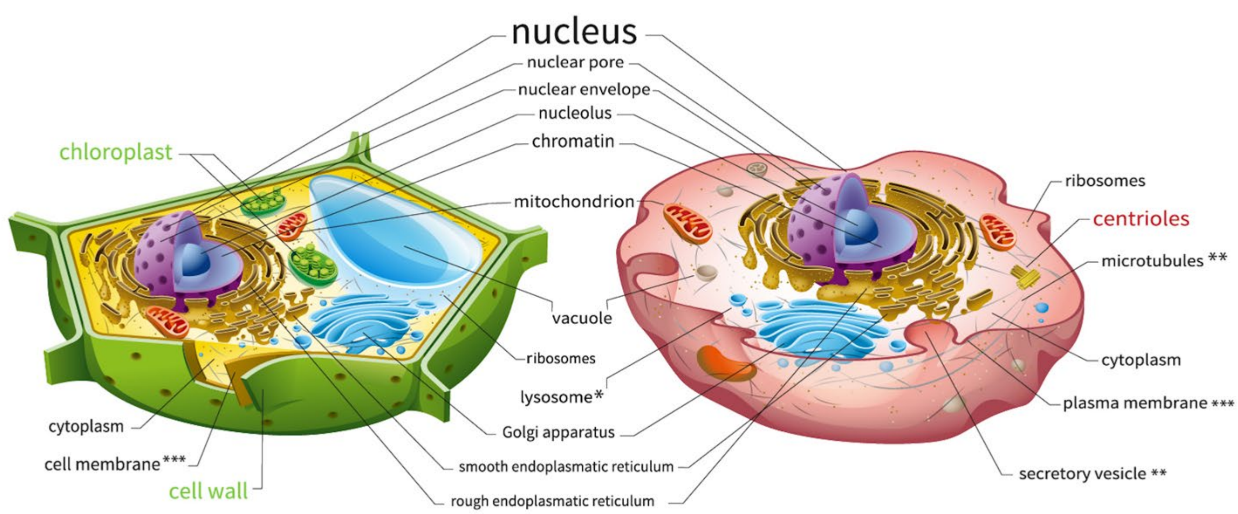

Image 1 (*Here's How Plant and Animal Cells Are Different)*

So, where do cells come from? On the right you can see a diagram of a fully functioning eukaryotic cell. But its predecessor is shown on the left. Cells stem from primitive structures called micelles and liposomes. On the left, you can see that a micelle is just a bunch of phospholipids self-arranging in water. A liposome, on the other hand, occurs where you have two layers of phospholipids, almost like one micelle wrapping around another micelle.

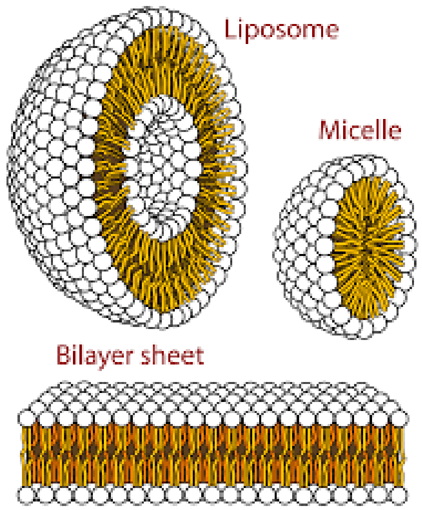

Image 2 (*Difference Between Liposome and Micelle)*

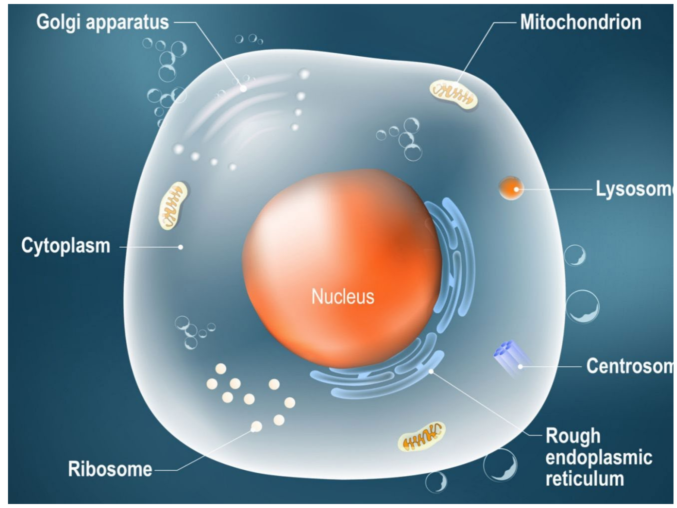

Image 3 (*Animal Cells Are Eukaryotic Cells With a Membrane-Bound Nucleus)*

Both of these structures form spontaneously in water due to the chemical properties of phospholipids.

These phospholipids have a polar head and nonpolar tails. If you can recall some chemistry, polar parts of molecules can also be called hydrophilic, which means “water-loving”, while nonpolar parts of molecules can be called hydrophobic, which means “water-fearing”. This means that polar regions will try to stay in contact with water (because water is polar) and nonpolar regions will try to avoid water.

Therefore, if you imagine water surrounding a collection of phospholipids, they arrange in a spherical micelle shape to maximize the contact between their polar heads and water while minimizing the contact between their nonpolar tails and water.

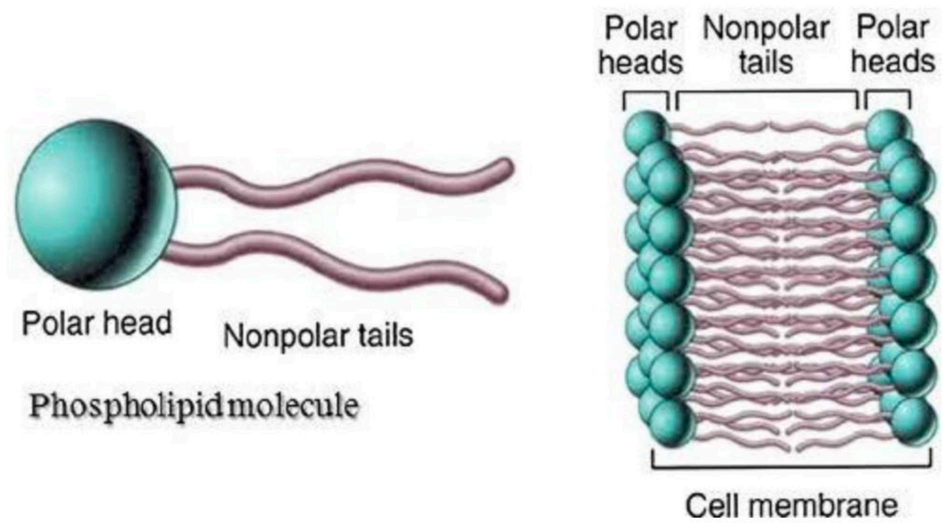

Image 4 (*How can the structure of a phospholipid molecule be described)*

Once you have a micelle, you have the potential for another micelle to form inside of the first one creating a bilayer of phospholipids. This is what we call the plasma membrane today. Beyond this, we don't know every other step that led to DNA inside the membrane, enzymes that read the DNA, and proteins that are produced.

But the important thing is to know how a membrane forms, which defines each and every cell as its own functioning unit. Also, it's important to understand that the polar head and nonpolar tails of phospholipids cause a membrane to form spontaneously in water.

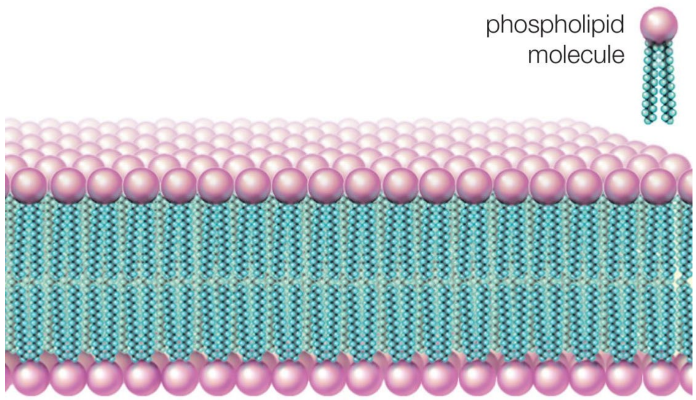

Image 5 (*How Phospholipids Help Hold a Cell Together)*

So, cells are the building blocks of life. Everything that we consider living has microscopic cells that can function on their own. Some organisms like bacteria consist of a single cell and are called prokaryotes, while organisms like us are multicellular and are considered eukaryotes.

The main differences you want to know between prokaryotes and eukaryotes is as follows:

Prokaryotes are usually unicellular, have NO nucleus, and NO membrane bound organelles.

However, eukaryotes are usually multicellular, they DO have a nucleus, and they DO have membrane bound organelles. As with anything, there are some exceptions. For example, there are some unicellular eukaryotes like algae or protozoa.

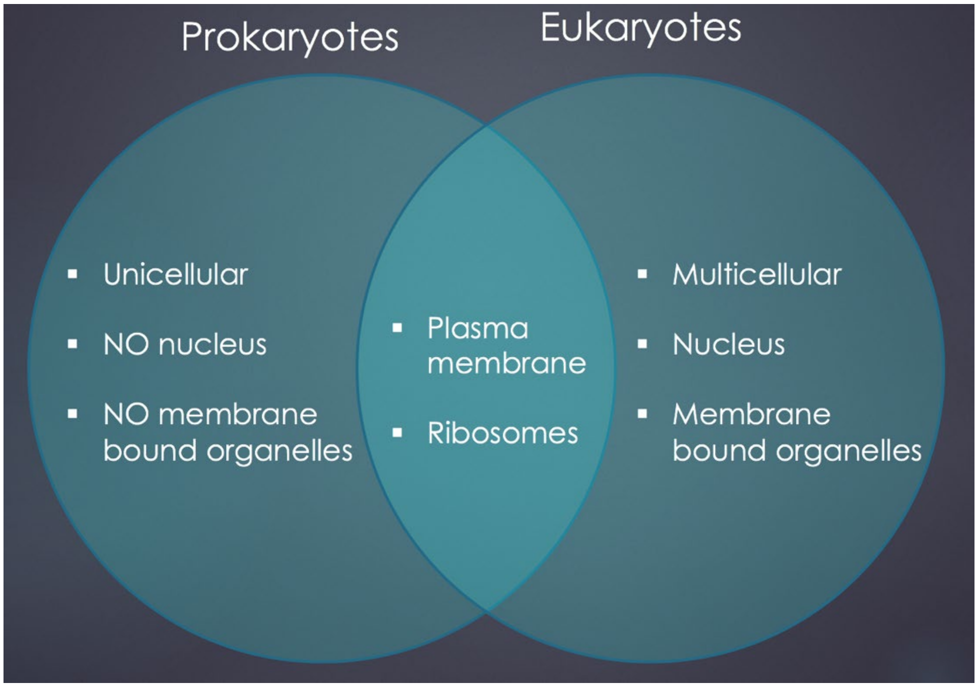

Image 6

Here are diagrams showing a prokaryotic cell on the left and a eukaryotic cell on the right. Notice that the prokaryotic cell has no membrane-bound organelles, while the eukaryote has a bunch of organelles scattered throughout.

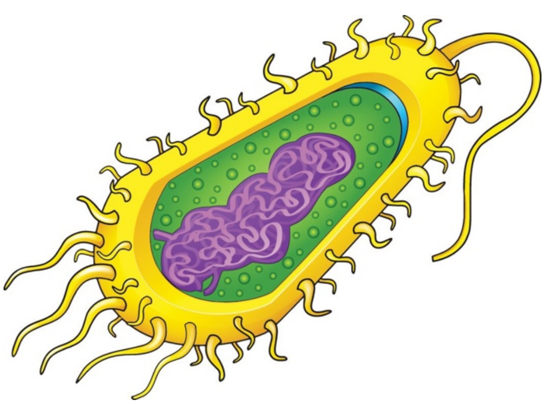

Image 7 (What is a prokaryotic cell)

Image 8 (*Eukaryotic Cells)*

Now that we know the difference between prokaryotes and eukaryotes, we can start going through the organelles found in eukaryotic cells. Here's a list of all the major organelles we'll learn about:

Plasma membrane, cell wall, cytoplasm, nucleus, ribosomes, endoplasmic reticulum, golgi apparatus, mitochondria, chloroplast, vacuoles, lysosomes

Organelles

Let's go through each of the organelles individually.

The first one is the plasma membrane. As we talked about earlier, it is composed of a bilayer of phospholipids. It contains many proteins such as ion-transport channels, glycoproteins, and carrier proteins used for ion transport, cell recognition, and general transport, respectively.

Additionally, we describe the membrane as a "Fluid Mosaic Model" because all the components of the membrane can shift around throughout the membrane.

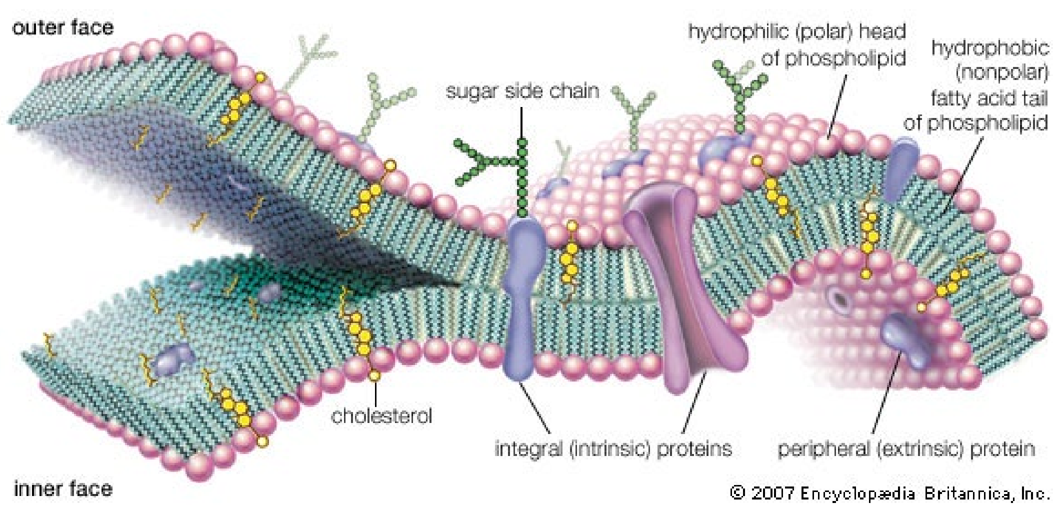

Image 9 (*Cell membrane)*

The cell wall is similar to the plasma membrane; however, it is more rigid and only found in plant cells and prokaryotes. Animal cells do not have cell walls. It provides structure, support, and protection. There are three main regions of the cell wall: the primary cell wall, which is the outermost layer, the secondary cell wall, which is the layer closest to the plasma membrane, and the middle lamella, which is the region in between individual plant cells.

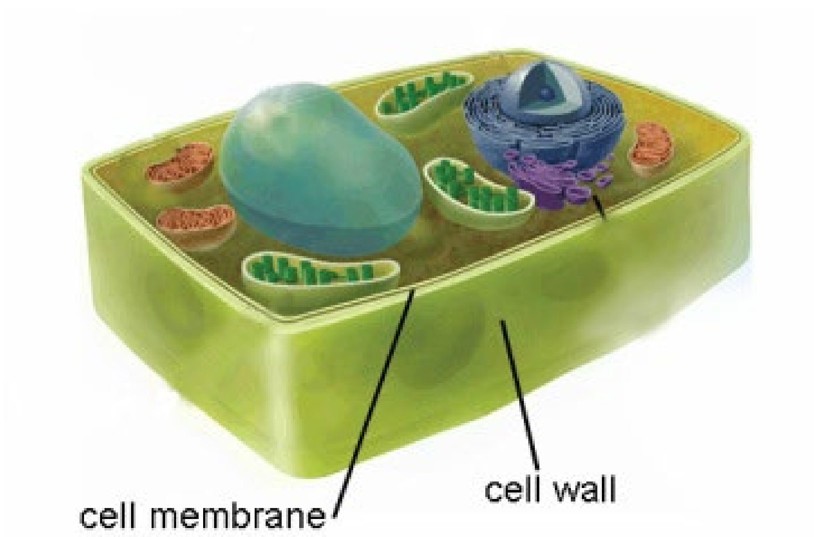

Image 10 (*Cell Wall)*

Here's a diagram clearly showing the different layers of a plant cell wall.

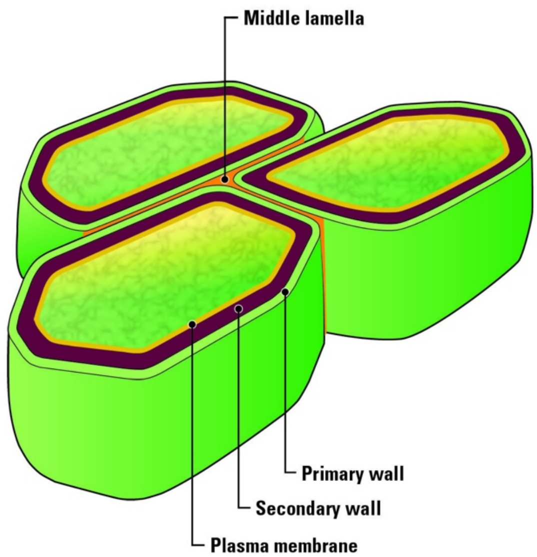

Image 11 (*Overview of Plant Cell Walls)*

The cytoplasm is all the interior part of a cell, and it’s a gel-like fluid that helps hold organelles in place. This is where all the chemical reactions within a cell occur if they aren’t occurring inside another organelle.

Image 12 (*What is Cytoplasm)*

The nucleus is where genetic information is stored, which is DNA for eukaryotes. It contains the instruction manual for each and every cell. The nuclear envelope is a double membrane that defines the nucleus, and it contains nuclear pores to exchange molecules with the rest of the cell.

Deeper in the nucleus is a region called the nucleolus, which helps produce ribosomes. Also, the nucleus is the location where transcription occurs to turn DNA into mRNA before proteins are made.

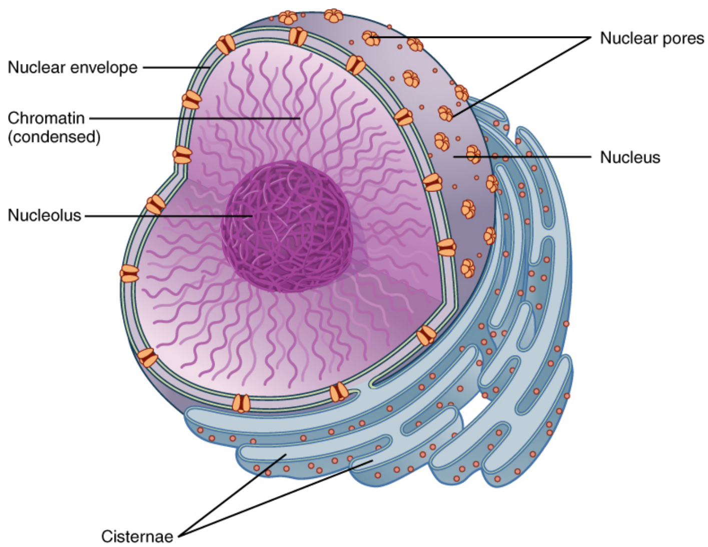

Image 13 (Nucleus Function Euchromatin vs Heterochromatin)

Ribosomes are technically not membrane-bound organelles, but they are a vital part of the cell. They are a bundle of RNA and proteins that synthesize proteins from mRNA. They are located all throughout the cell in the cytoplasm and on the endoplasmic reticulum.

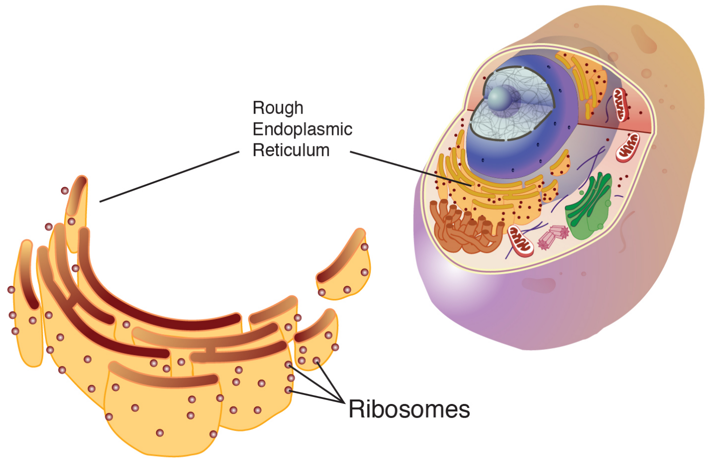

Image 14 (*Ribosome)*

The endoplasmic reticulum functions to take mRNA produced in the nucleus and turn it into proteins by using ribosomes. We call the part of the endoplasmic reticulum that has ribosomes "rough" and the part without "smooth."

The smooth endoplasmic reticulum has three main functions: lipid synthesis, detoxification, and calcium storage.

The golgi apparatus tags and transports proteins to the correct location in the cell. It receives proteins from the rough endoplasmic reticulum and puts chemical tags on those proteins. This is to ensure that they end up in the right location. It's analogous to the "post office" for a cell.

It has a cis face that faces the endoplasmic reticulum and nucleus, and it has a trans face that faces the plasma membrane.

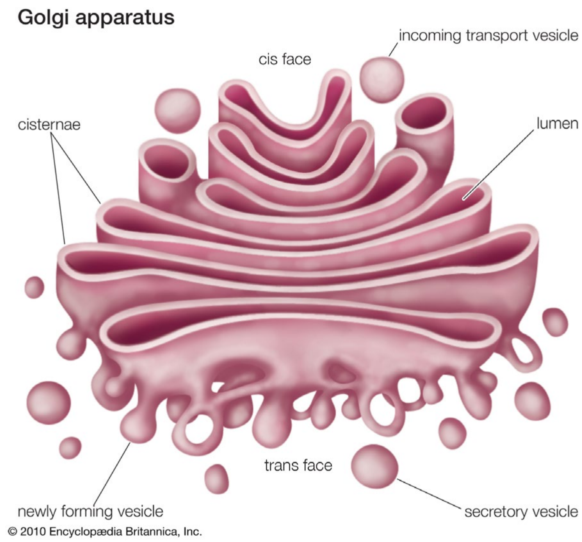

Image 15 (*Golgi apparatus)*

The mitochondria produces energy for the cell in the form of ATP, which stands for adenosine triphosphate. It does this through a process called cellular respiration. A couple interesting facts are that the mitochondria has its own DNA and a double membrane.

The inside of the first membrane is known as the intermembrane space, and the inside of the second membrane is known as the matrix.

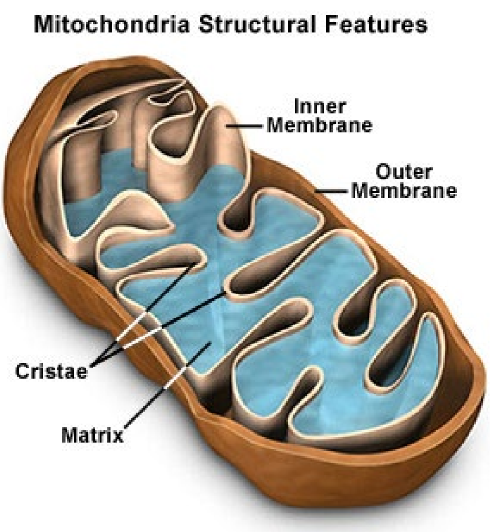

Image 16 (*Molecular Expressions Cell Biology: Mitochondria)*

The chloroplast has the job of performing photosynthesis, which turns sunlight into usable food called glucose, in plant cells. Chloroplasts contain three main features: thylakoid stacks, which are membranous sacs where photosynthesis actually occurs, the stroma, which is like the cytoplasm but for chloroplast, and a double membrane.

Similarly to mitochondria, chloroplasts have their own DNA.

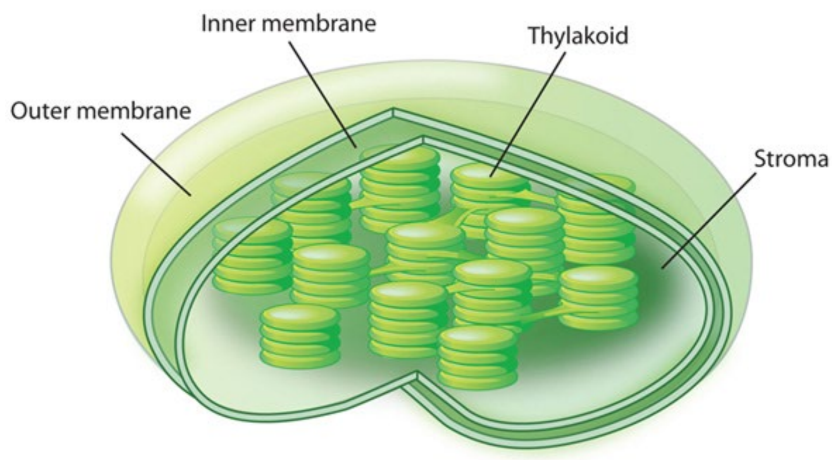

Image 17 (*Plant Cells, Chloroplasts, Cell Walls)*

Vacuoles have the purpose of storing various molecules the cell needs. They are very important in plant cells as they help to maintain what's called "turgor pressure", which gives structure to that plant. Whenever you see a plant wilting, it's due to a lack of water in their central vacuole, which leads to a lack of pressure and a lack of structural support.

Image 18 (*Plant Cell Diagram)*

The final organelle we will cover is the lysosome. Lysosomes are just a specialized vesicle that contains digestive enzymes to break down molecules inside the cell. Like other vesicles, the lysosome is a simple membrane made of phospholipids.

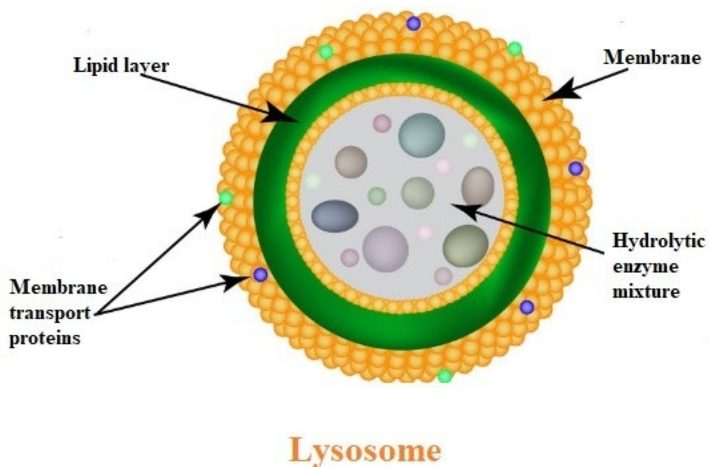

Image 19 (10 Importance of Lysosomes)

Conclusion

So, back to our original diagrams. Take some time to pause the video and try to fill in the blanks of the different organelles. The ones blocked in dark blue are used twice, and the ones blocked in green are only found in plant cells.

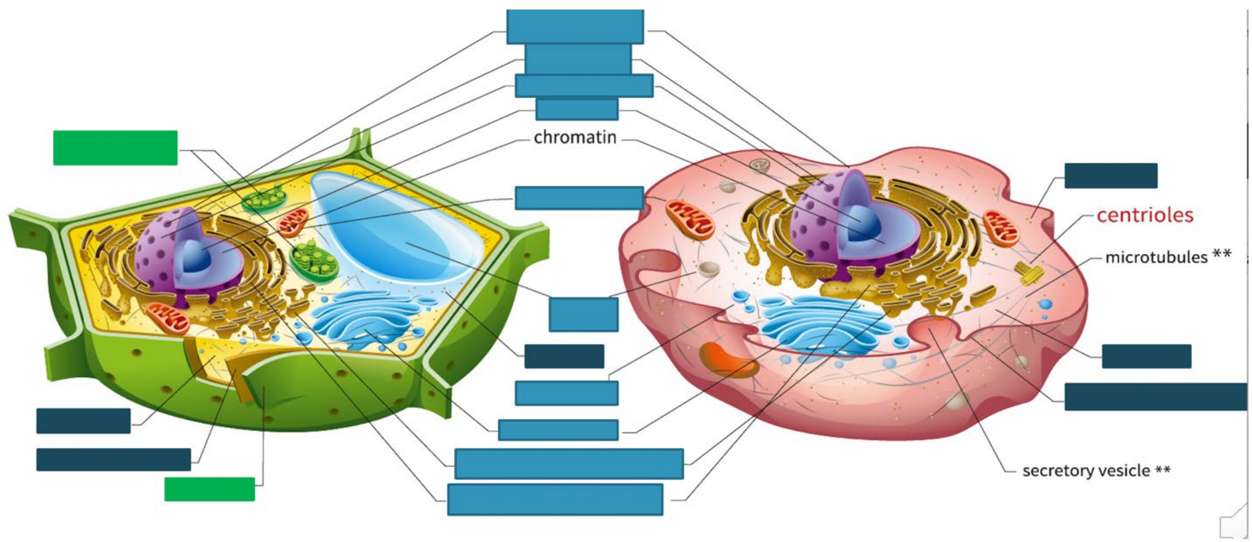

Image 1 (*Here's How Plant and Animal Cells Are Different)*

How did you do? Here is the key for the diagram. Feel free to pause the video to check your work.

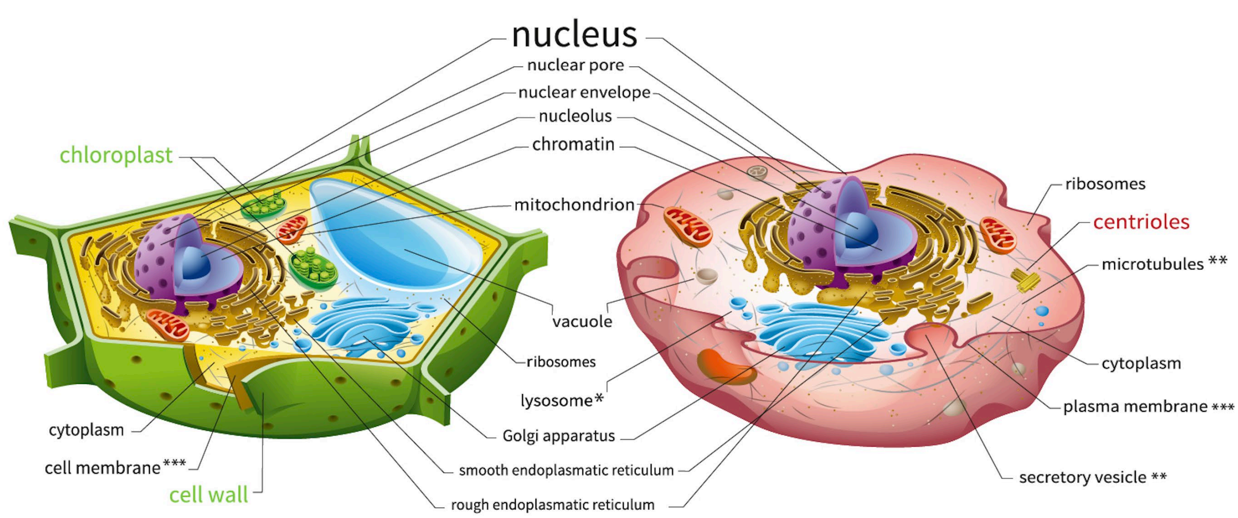

Image 1 (*Here's How Plant and Animal Cells Are Different)*

If you would like additional practice on specifically the functions of organelles, I recommend that you go through the practice quiz I've made in Kahoot. The link to the quiz is in the description below the video (also posted below).

https://create.kahoot.it/share/biol-1710-organelles-1/27ca7d44-93ef-4121-8e69-7498e1a891ae

I hope you now have a better understanding of cells and organelles. If you have any questions, you can visit learningcenter.unt.edu for various resources and services.

Outro

Thank you for watching TutorTube! I hope you enjoyed this video. Please subscribe to our channel for more exciting videos. Check out the links in the description below for more information about The Learning Center and follow us on social media. See you next time!

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