Eukaryotic Cells: Plants and Animals

Since you've already looked at the structure of a prokaryotic cell, it seems like it makes sense to turn and explore a eukaryotic cell. Once again, you must be extremely small, but not nearly as tiny as before. Eukaryotic cells can be hundreds of times larger than prokaryotic cells. Out here, even from a distance, it is easy to see why Eukaryotic cells have their name. The one you're looking at is a part of a sheet of connected cells, and all of them have large, shadowy shapes inside of them, including a sort of central kernel. That central shape is the cell's nucleus, and all eukaryotes have one.

We should stop for a moment before we approach the cell, and mention that eukaryotes are special in many ways. Like prokaryotes, they can be unicellular, and also like prokaryotes, they can group together into colonies of cells that cooperate in some ways, but are still independent in others. Uniquely, eukaryotes can also be true multicellular creatures, with different cell types performing different tasks for the organism as a whole.

The cell we are approaching now is a part of a larger multicellular organism. It is a plant cell. In particular, it is a cell found on the upper surface of a leaf of an aquatic plant. As we get closer, we can see that it looks somewhat like a larger version of a bacterial cell: it also has a tough external cell wall, and it also appears to have a greenish color. Oh, the cell wall doesn't appear to be made of quite the same material, but it is still a strong resemblance. Once again, you find yourself undergoing endocytosis as the cell membrane embraces you, and you emerge on the inside of the cell. This time, though, it is like arriving at a busy metropolis. Tubes and rails seem to be everywhere, and the cytosol (also known as cytoplasm) is crowded with giant structures and busy proteins pulling themselves along, putting together other smaller molecules, or chewing up large ones to spit them out.

Altogether it seems to be a busy place. We might as well head for the giant central structure. This is, of course, the nucleus of the cell. Really, it seems to be a sort of cell within the cell. It has its own (nuclear) membrane, which have (nuclear) pores to let molecules in and out. There is a giant, folded thing attached, but we'll avoid that for now, and enter through one of the smaller pores.

Inside the nucleus, huge tangles of what looks somewhat like spaghetti are spread around. These are the chromosomes of DNA. They contain all the information on how to build proteins, which are the cellular machines that do the work of building and maintaining the rest of the cell. Swirling and moving through the DNA are other proteins, which seem to be copying the information in the DNA over into chains of a similar molecule, messenger RNA. The mRNA is then ferried out of a nuclear pore. When we follow it, it looks like we end up inside the twisted, folding structure that we saw attached to the nucleus from the outside. This is called the endoplasmic reticulum.

Inside the endoplasmic reticulum, the mRNA gets directed into a series of branching tunnels. Occasionally, one of the floating mRNA chains gets grabbed and redirected to a dark bulge in a tunnel wall. That huge boulder is really a tiny machine, also made of RNA. In this case, it is ribosomal RNA, and the boulder in the tunnel is a ribosome. The Ribosome feeds the mRNA in one side, and converts the information from RNA nucleotides to amino acids. Out the other side of the Ribosome, a protein starts emerging. When completed, it breaks free, and continues on down the tunnel. Periodically, other proteins will grab the newly completed one. Sometimes the two proteins will fit together, and the new one will get folded into a different shape, or have bits snipped off. Sometimes, they don't fit properly, and the newer protein gets released unchanged. By the time the ends of the tunnels inside the endoplasmic reticulum are reached, the information in the DNA has successfully been transcribed (or rewritten) into mRNA, and then translated by the Ribosomes in the Endoplasmic Reticulum (ER) into a protein. The protein that finally emerges from the ER has been folded and transformed into its final shape by enzymes (proteins that… do things).

Here, at the outer edge of the endoplasmic reticulum, we can see some of the newly completed proteins bouncing and wiggling their way out into the cytosol to begin their work. Others are being felt by some kind of protein that sorts through the emerging molecules. Occasionally, one will fit into its claw, and it will transfer it to another protein that is hanging from one of the tubes that runs throughout the cell. The hanging protein grabs the newer one, and slides along the tube like it was a track, delivering it to another folded structure in the distance.

The rail that the protein is moving on is a part of the cytoskeleton. It gives the cell some shape, and acts like a rail system for proteins to move along inside the cell. In this case, it is helping the protein move to what is called the Golgi Complex or a Golgi Body. (It has such a silly sounding name because it is named after the scientist who discovered it. He was an Italian, and if you ever travel to Pavia, you can witness some of the monuments built to honor him.) Inside the Golgi Complex, the protein is again modified as some extra chunks are added on. Some of these new bits are then used to grab the protein, package it up inside a small membrane, and ship it off to other places...some are in the cell, and some are outside of it.

Stepping to the edge of the Golgi Complex, you can see a few other large organelles. (They are called organelles because they are each tiny structures inside the cell that perform specialized tasks.) There are some green ovals that seem to be producing sugars. These are chloroplasts, and they are very much like the bacterium you visited before. In fact, it seems pretty likely that the chloroplasts that live inside modern plants and produce sugars from light, water and carbon dioxide are descended from photosynthetic bacteria that invaded eukaryote cells millions of years ago.

Scattered throughout the cell are also dark pill shaped structures, which look like they're filled with disks. These seem to be eating the sugar in the cytosol and mixing it with oxygen in order to spit out some sort of cellular fuel, and a few other products like carbon dioxide. The cellular fuel is what is being eaten up and spit out (in a slightly modified form) by all the enzymes in the cell. The dark pills are what release the energy locked into the sugars by the chloroplasts. They are called mitochondria, and the fuel they make is called Adenosine Triphosphate, or ATP.

It looks fuzzy from here through the thick and busy cytosol, but the giant structure way over there by the edge of the cell is called a vacuole. It stores things, mostly like water and sugars. Proteins on its surface act like pumps, moving substances in and out of the compartment, which has its own membrane, just like most of the organelles in here.

Floating nearby is another big container. This one is a lysosome. Proteins sent from the Golgi Complex are stored inside, where they break up old proteins and other substances delivered from around the cell. It is basically the recycling center of the cell.

That's it, really. The inside of a plant eukaryote is a lot like a bacterial prokaryote. It is just bigger, with different compartments separated by membranes inside. Instead of a few proteins performing a task, entire organelles are at work. If the bacteria is like someone building something in their garage, the plant eukaryote is like a factory: bigger, and more efficient.

But animals and fungi are a little different...but don't worry, they aren't different enough to need their own chapter! The main difference between cells that we consider to be animals and those that are plants is this: animal cells don't have a cell wall, and they don't have chloroplasts. Otherwise, they share the same organelles and other cell characteristics of plants.

Next up? How a cell makes babies!

Use this text to create a set of personal definitions for the terms listed below.

Eukaryote Terms

1. Animal Cell
2. ATP
3. Chloroplasts
4. Chromosome
5. Colony
6. Cytoskeleton
7. Cytosol
8. Endoplasmic Reticulum
9. Enzymes
10. Eukaryote
11. Golgi Body
12. Lysosome
13. Messenger RNA
14. Mitochondria
15. Multicellular
16. Nuclear Membrane
17. Nuclear Pore
18. Nucleus
19. Organelle
20. Plant Cell
21. Ribosomal RNA
22. Ribosome
23. Transcription
24. Translation
25. Vacuole