Lecture 3 (2020/2021)

If you recall from week one, I mentioned that one of the characteristics of all living things is that they are made up of cells. We are now ready to look at cells in a little more detail. We will also look at some things that are "sort of alive". By this, I mean they have some of the characteristics of living things but not all of the characteristics.

We will start with a basic **eukaryotic** animal cell. A eukaryotic cell is a cell that has DNA that is enclosed in a specialized region called a **nucleus**. Humans are made up of a bunch of eukaryotic cells. Dogs are made of eukaryotic cells. Plants are made up of eukaryotic cells (although they are a little bit different and we will discuss them more in a minute). In fact, almost everything that you know about that is alive, except for bacteria, is made up of eukaryotic cells.

Here is a picture of a Eukaryotic animal cell and some of its organelles. **Organelles** are parts of a cell that perform a particular function (Figure 3.1a):

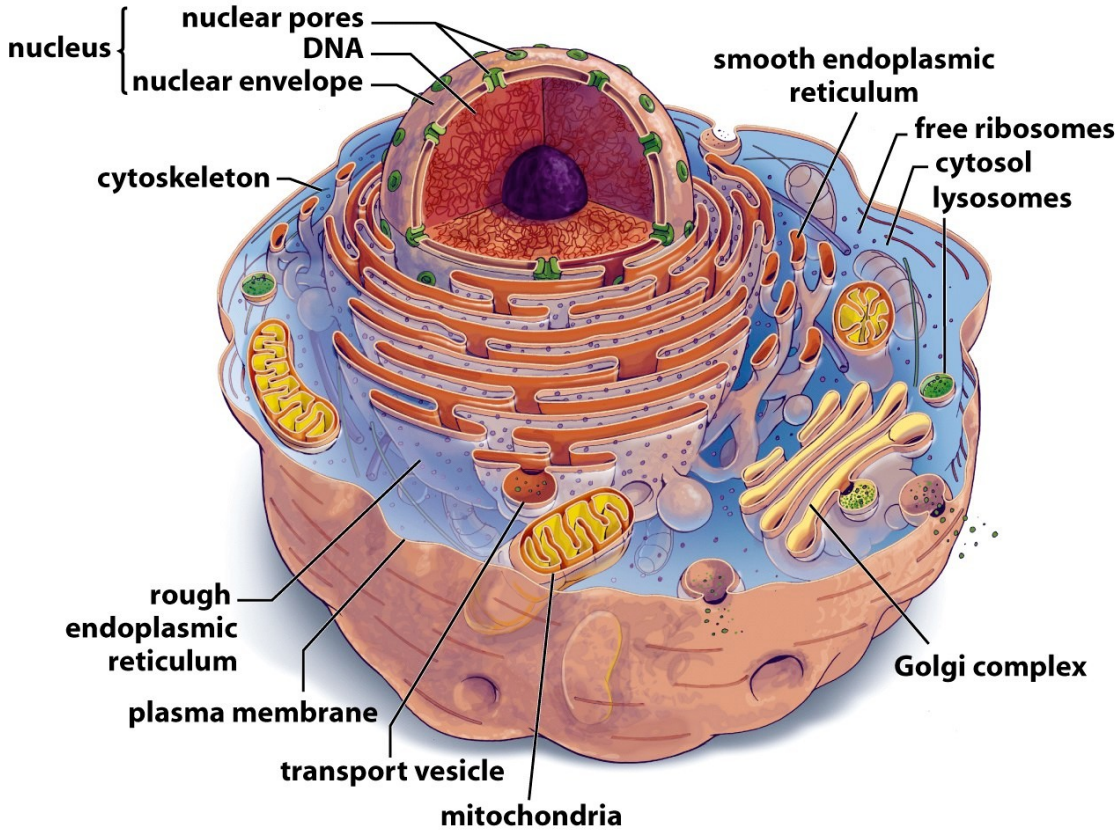

Figure 4-4 A Brief Guide to Biology, 1/e
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Figure 3.1a

Make sure you know the following organelles found in eukaryotic cells and what they do. Also, make sure you know which type of eukaryotic cell has them (plant, animal or both) (Table 3.1a).

Table 3.1a

Name of Organelle	Function	Plant/Animal/Both
Nucleus	Acts as the brain of the cell	Both
Nucleolus	The very dark center within the nucleus and the site where ribosomes are born!	Both
Ribosomes	Help to make proteins (small brown dots)	Both
Rough ER	Has Ribosomes that make proteins and labels molecules that will be placed in the cell membrane	Both
Smooth ER	Makes lipids and detoxifies harmful chemicals	Both
Mitochondria	Important for energy utilization	Both
Cell Membrane	Regulates what enters and exits the cell	Both
Golgi apparatus	Chemically labels molecules and determines where they will go to next	Both
Chloroplasts	Convert sunlight energy into chemical energy	Plants only
Cell Wall	Protects the cell	Plants only
Lysosomes	"Bags" of enzymes that digest cellular debris	Animals Only (but plants and others have other organelles that do a similar job.
Large Central Vacuole	A larger storage center for excess water and minerals	Plant cells only (although animals have much smaller versions of vacuoles
Cytoskeleton	Three types of very long proteins (Microtubules (the largest), intermediate filaments, and microfilaments) that act as scaffolding for cell support.	Both

Now here is a picture of a plant cell (Figure 3.2a). Notice that it has many of the same parts as an animal cell. Plants lack **centrioles** (important for cell division in animal cells), but they have **chloroplasts**, a **cell wall**, and a **large central vacuole** which are lacking in animal cells.

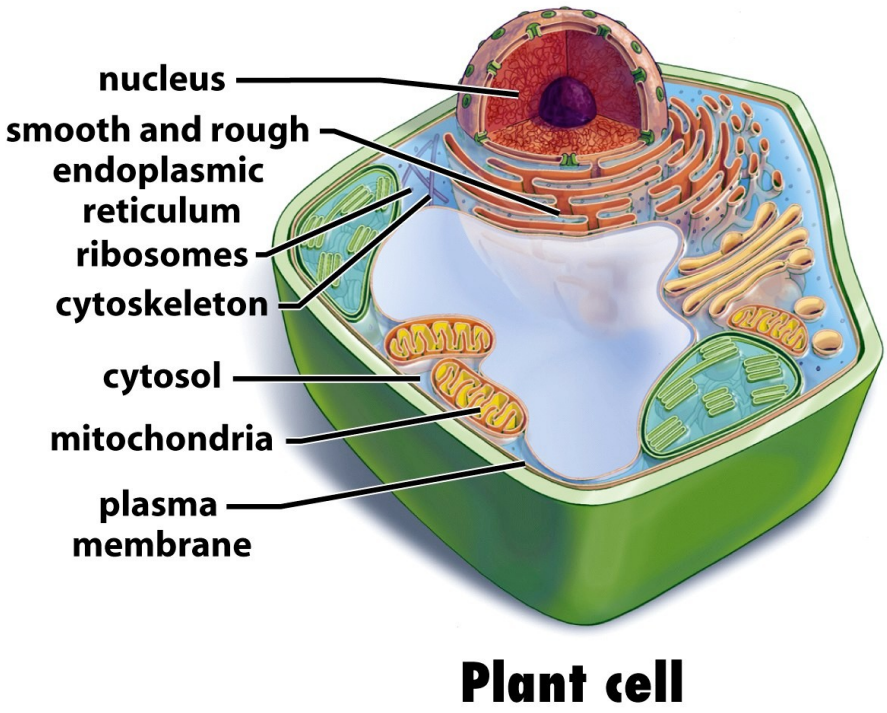

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Figure 3.2a

The cell wall is outside the cell membrane. The cell wall is important for maintaining the structure of a plant cell. It is made up in part of a **polysaccharide** called **cellulose.** In fact, cellulose is the reason that eating plants are a popular food choice for people trying to lose weight. Cellulose is not very easy for humans to digest. Therefore, you do not get many calories from eating things like lettuce (however, the salad dressing that you put on a salad can have LOTS of calories!). Animal cells do not have a cell wall. The large central vacuole is used to store excess liquid.

As I mentioned earlier, most of the living things you know about are composed of eukaryotic cells. Plants and animals are made up of eukaryotic cells and so are **Fungi** (such as mushrooms). There is also a group of organisms called **"protozoans"** that are single celled eukaryotic organisms. Some of these include things such as *Plasmodium vivax*, a single celled little creature that you can be infected with that causes **Malaria** (primarily in places like Africa). There are also several protozoans we will look at in lab such as **Paramecium** and Amoeba.

The other type of cell is called a **prokaryotic** cell. Here is a picture of a prokaryotic cell (this picture has more detail than you are required to learn; you need to know the DNA (chromosome), ribosomes, cell membrane (plasma membrane) and cell wall) (Figure 3.3a):

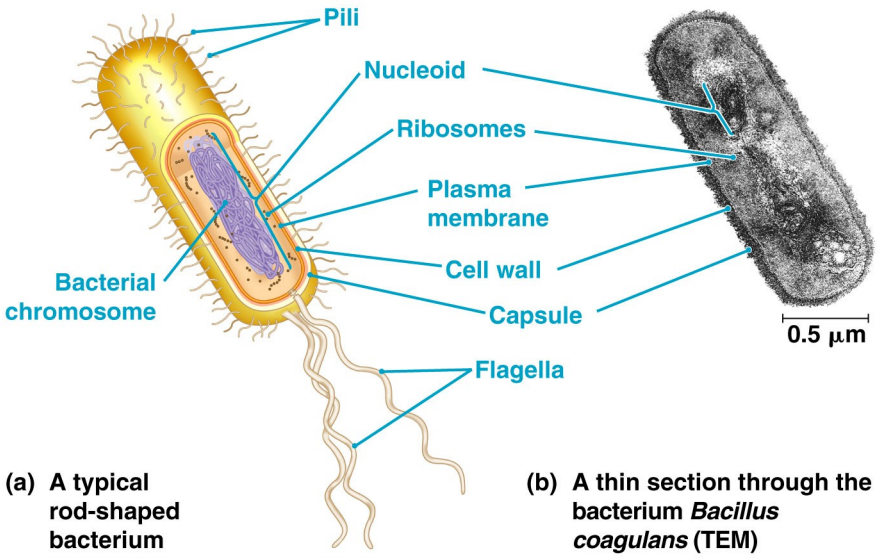

Figure 3.3a

Bacteria (and things like them) are made up of prokaryotic cells. You should notice that prokaryotic cells are much smaller and much simpler in design. Notice that the DNA of a prokaryotic cell is NOT contained in a nucleus. Instead, it is just floating around loose. You will also notice that there are lots of ribosomes floating around loose but there are NO OTHER organelles (no Mitochondria, no chloroplasts, etc.). You might also notice that bacteria have cell walls. The cell walls of bacteria, however, are made of a different material than plant cell walls, however.

There are only two basic types of cells: Prokaryotic and Eukaryotic. So, anything that is alive, must be made up of these types of cells.

In addition to cells, however, there are a couple of things that are sort of on the edge of life vs. non-life. By this I mean that they have some of the characteristics of living things but not all of the components. Some biologist argue back and forth about whether these should be classified as living things or as complex molecules. Either way, here they are.

We will start with **viruses.** Here are a few a pictures of viruses (Figure 3.4a):

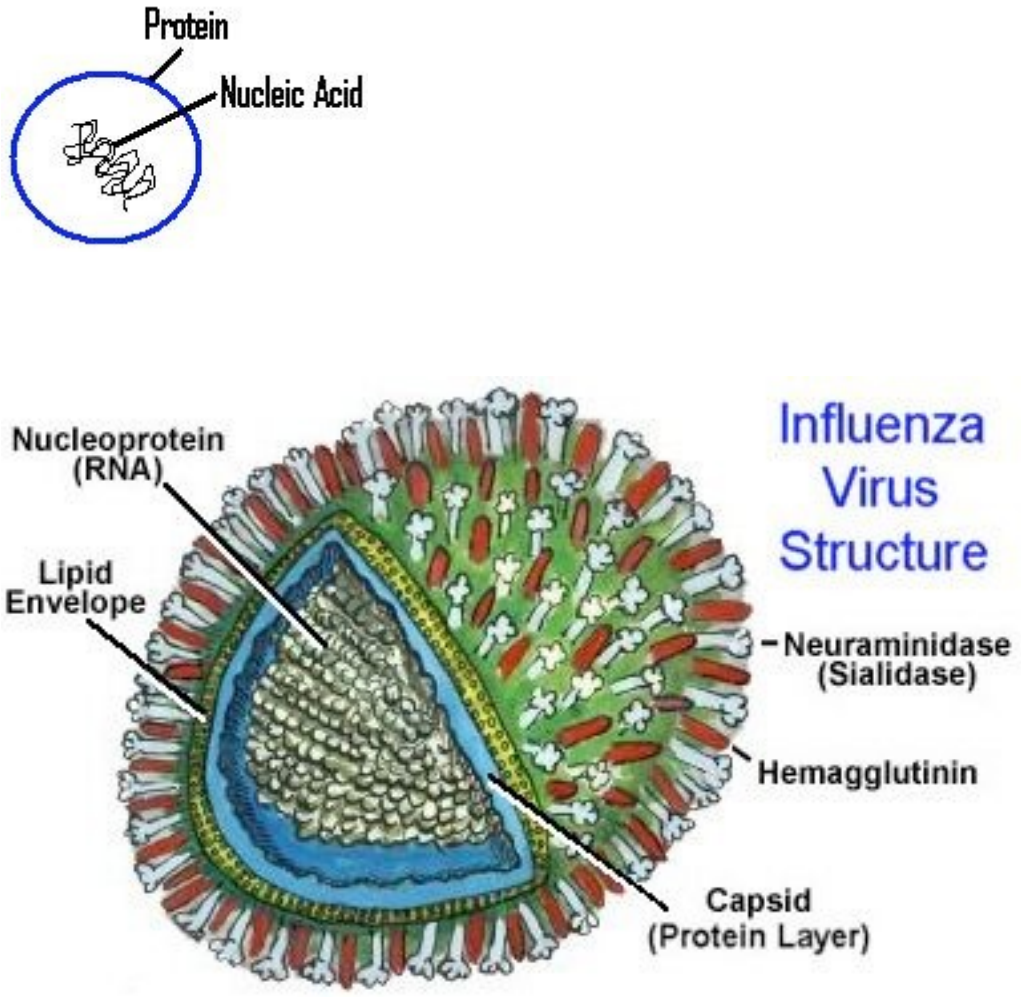

Figure 3.4a

Notice that it is pretty much made of a nucleic acid (DNA or RNA) and some type of protein cover. There is actually a great deal of variation among different types of viruses; but the basic nucleic acid wrapped in a protein coat theme is common to all of them. Some of them also have a structure called an envelope which surrounds them as well.

Basically, the way a virus works is that it takes over another cell (a prokaryotic or eukaryotic cell). It essentially infects the cell and inserts its DNA into say, one of your cells' DNA. It then takes over your cell and makes your cell do what the virus wants (not that the virus really has wants!). A virus takes over the machinery of the host cell and makes that cell make proteins and copy the viruses DNA and so forth.

Understanding the difference between viruses and bacteria is very important for your health. You can take an antibiotic for a bacterial infection, for example, because the antibiotic attacks something different about the bacteria. For example, many antibiotics interfere with how the ribosomes of a bacteria work. Although you have ribosomes in your cells, they are quite different in structure than those found in bacteria. A virus on the other hand, well, it is *within* your own cell a lot of the time. The only way to get that out is to kill your own cell. Sometimes you can get away with that because you are usually making new cells (depending on the kind of cell it is). Other times, you can just kill them. Either way, the way you treat a viral infection and a bacterial infection are very different.

Another group of things that have some of the properties of life are a group of molecules called **prions.** Prions are quite simply infectious protein particles. We don't really know that much about prions except that they seem to be able to alter other proteins into prion type proteins. Prion diseases generally cause neurological damage. As an example, you have probably heard about "**Mad Cow Disease**". This is a prion disease. Humans that eat cows infected with this prion can get a similar neurological problem that is called **Creutzfeldt-Jakob Disease** (although there are other ways to develop this disease as well).

Another prion disease called Kuru was discovered to be prevalent primarily in the women and children of the Fore tribe of Papau New Guinea. Upon further examination, researchers discovered that is was a culturally common practice to eat portions of deceased relatives. Women and children primarily ate the brains and other portions of the nervous system which tended to have the highest levels of the abnormal proteins.

In order to better understand eukaryotic and prokaryotic cells as well as viruses and prions, let's learn a few more specific disease caused by each and some of the characteristics associated with them. Some of these I have already mentioned while others are new. Make sure you learn this table (Table 3.2a)!

Table 3.2a

Disease	Caused by:	Info:
Influenza (Flu)	Virus	A respiratory disease that kills thousands every year. One particular strain, The Spanish Flu, killed 50-100 million people during 1918-1919 .
AIDS	Caused by HIV virus	A disease in which the immune system gets destroyed. So far, about 50 million deaths but very hard to get accurate numbers
Tuberculosis	Bacteria	Respiratory Disease that kills over 3 million people per year worldwide (mostly in developing countries)
Plague	Bacteria	Outbreaks are rare now but historically has had several outbreaks killing tens of millions of people. Can be transmitted from person to person or by the bite of an infected flea.
Malaria	Eukaryotic Protozoan	Infects Red Blood Cells. A disease which has killed millions of people. Once you have it, it is very difficult to treat. You get the disease by getting bitten by an infected mosquito.
Creutzfeldt-Jakob	Caused by Prion (an infectious protein particle)	A rare disease. Causes the destruction of the nervous system. 90% of the people that get it die within 1 year.
The Common Cold	Caused by many different types of viruses	Very, very common. As you get older, you develop an immunity to many of the cold strains.

Coming Up….(but you need to know at least this part for this coming quiz!)…

The cell membrane (or plasma membrane) is a very important organelle because it regulates what moves in and out of the cell. Because of this, we say that the cell membrane is **selectively permeable.**

The term **transport** refers to moving molecules across the cell membrane.

Transport that does not require any additional energy is called **passive transport.** This is when molecules move from high concentration to low concentration. Transport that does require energy is called **active transport.** Active transport moves molecules against the concentration gradient (from low concentration towards high concentration.).

To understand concentrations, you need to understand what a **solution** is. A solution is a mixture of **solute** (solid stuff) and s**olvent** (the liquid that does the dissolving). In biology, the solvent is usually water.

Concentration gradients are defined as being **hyperosmotic, hypoosmotic,** or **isoosomotic**. These terms are used when comparing one solution or one situation to another. For example, if the inside of a cell has 5% salt and the outside has 10% salt, we see that the inside of the cell is hypoosmotic to the outside (it has a lower concentration of solute (the salt)).

PLC#3 – Take a picture of something through your microscope. Make this picture a "background" of a picture of your (face only) and set this as your Canvas ID picture (like mine along with Dan Anderson).

Review Questions

1) Tuberculosis is caused by a:
a) virus
b) prion
c) bacteria
d) eukaryotic
e) none of the above

2) Tuberculosis is a disease that primarily affects which part of the body:

A) Lungs
B) Heart
C) Nervous System
D) Endocrine System
E) Digestive System

3) Creutzfeldt-Jakob is a disease caused by a:

a) virus
b) prion
c) bacteria
d) eukaryotic
e) none of the above

4) Which organelle is important for making lipids and detoxifying harmful chemicals?

a) mitochondria
b) rough ER
c) smooth ER
d) chloroplasts
e) ribosomes

5) What is the cytoskeleton?

6) Why are cells small?

7) What are the function of lysosomes?

8) What does the section in your book "The Stranger within:Endosymbiosis" mean?

9) What is the function of a central vacuole?

10) Who is Peter Duesberg? (Use the internet)….by the way, most of the world thinks he is totally wrong! I am definitely one of the people who thinks he is TOTALLY WRONG!!!

Words that you may be asked to define or use in fill-in-the blank types of questions:

Nucleus, ribosomes, rough ER, smooth ER, mitochondria, cell membrane, Golgi apparatus, chloroplasts, cell wall, prokaryotic cell, eukaryotic cell, protozoan, virus, prion, hyperosmotic, hypoosomotic, isosomotic, selectively permeable, plague, aids, Malaria, Creutzfeldt-Jakob Disease, Influenza, Tuberculosis, active transport, passive transport, solution, solvent, solute, Peter Duesberg

Why Peter Duesberg? I want to teach something very important here. Just because you find information on the internet does not mean it is correct! Even if someone is famous, even if you can find LOTS OF INFORMATION that takes a particular stance, it does not mean it is correct. How do you find correct information? You often do not know for sure! You need to be careful and research thoughts and ideas thoroughly. Other items you might find on the internet that are probably incorrect: Global Warming isn't real, smoking does not cause cancer, baby rattlesnakes are more dangerous than adult rattlesnakes to name just a few.