The fluid mosaic model of membrane structure

The fluid mosaic model of membrane structure is a cell membrane that behaves like a two- dimensional liquid of mixed composition. The cell membrane is described to be fluid because of its hydrophobic components that are integrated into the membrane structure such as lipids and membrane proteins that move sideways throughout the membrane. That means the membrane more like a fluid. The membrane is referred to as mosaic because like a mosaic that is made up of many different parts the cell membrane has a mixed composition of lipids and proteins. The cell membrane gets it fluidity because the phospholipids in a typical cell membrane are not bonded to one another. Each phospholipid molecule has a head that is attracted to water that is pointing toward the outside of the cell membrane, making it hydrophilic, and a tail that repels water forming the inside of the bilayer, making it non-polar hydrophobic, but this is, on an individual basis, relatively weak. Proteins and substances such as cholesterol become embedded in the bilayer, but the plasma membrane has the consistency of vegetable oil at body temperature, so the proteins and other substances are able to move across it. The molecules that are embedded in the cell membrane also serve a purpose. For example, the cholesterol that gets stuck in there makes the membrane more stable and prevents it from solidifying when your body temperature is low. Carbohydrate chains attach to the outer surface of the cell membrane and form glycoproteins and glycolipids. These carbohydrates are specific to every person, and they supply characteristics such as your blood type.

Functions of Following:

Ribosomes:

Ribosomes are found in prokaryotes and eukaryotes. Ribosomes in prokaryotes and eukaryotes are both protein synthesizers and contain ribonucleic acid but they differ in their composition. This is why some antibiotics can take advantage of this difference to kill prokaryotes (bacteria) while not harming eukaryotes (ourselves).

Prokaryotes are single-celled and they have no nucleus. In prokaryotes the ribosomes are “ free floating” in cytoplasm because they have no nucleus. Cytoplasm is a gel-like substance that is inside the cell membrane. It holds all the organelles of a cell. These floating ribosomes are the protein synthesizers and contain ribonucleic acid (RNA).

Eukaryotes are organisms that consist of one or more cells and normally have a nucleus. The nucleus is the organelle in which chromosomes are stored and protected from the activities that occur in the cell’s cytoplasm. In eukaryotes the ribosomes are contained within the nucleus. Ribosomes are attached to the outer surface of the rough endoplasmic reticulum (ER) and free in the cytoplasm. Ribosomes make polypeptides that thread into the interior of the ER as they are assembled. The synthesis of RNA and protein is the main function of ribosomes. The RNA and proteins exit the nucleus by nuclear pores that are in the nuclear envelope. The nuclear envelope is made up of two membranes. These membranes have holes that are called the nuclear pores. This is how the proteins and RNA exit the nucleus and move on to the rest of the cell or are dispersed outside the cell.

Endoplasmic Reticulum:

The endoplasmic reticulum (ER) is part of the endomembrane system, which is an extension of the nuclear envelope. There are two parts that make up the ER, the smooth ER and the rough ER. These two parts of ER are continuous with each other.

The rough ER has thousands of ribosomes that are attached to it. This makes the ER appear bumpy under an electron microscope giving it its name. It is a network of flattened sacs and tubes or “ channels” in the cytoplasm formed by highly folded membranes. The rough ER is a continuation of the protein synthesis for those proteins that are to be transported from the cell. The newly synthesized proteins are transported to the lumen, inside of the ER, where they can begin to be modified into their complex shape. The proteins are then transported through the lumen of the rough ER to the smooth ER where further processing of the protein may occur.

The smooth ER has no ribosomes to give it the bumpy appearance so it is referred to as smooth. Since there are no ribosomes, it does not make protein. Although, some of the polypeptides made in the rough ER end up as enzymes in the smooth ER. It is more tubular than rough ER and has a separate network of functions. Its main function is to make lipids, enzymes, and other proteins destined for secretion, or for insertion into cell membranes. It also plays a large part in detoxifying and recycling wastes, as well as other specialized functions.

Golgi Apparatus:

The Golgi apparatus consists of a series of flattened sacs with vesicles pinching off from the edges This organelle has a folded membrane that typically looks like a stack of pancakes. It receives many of the vesicles produced by the smooth ER. Vesicles are small organelles formed by a pocket of membrane pinching off from the ER to the Golgi apparatus and from the other end of Golgi apparatus. The Golgi apparatus processes proteins made by the ER before sending them out to the cell. Proteins enter the Golgi on the side by the ER and exit on the opposite side that faces the plasma membrane of the cell. Proteins are further processed along the way and become modified and packaged for transport to various locations within the cell. Some proteins will be packaged in vesicles for secretion from the cell while other proteins will be packaged to produce other organelles such as lysosomes that are used for cellular digestion. The finished products are transported by the vesicles that carry them to lysosomes or to the plasma membrane.

Lysosomes:

Lysosomes are membranous sacs of enzymes that bud from the Golgi. Lysosomes have various roles. Lysosomes serve as vessels for waste disposal. They contain powerful enzymes that break down carbohydrates, proteins, nucleic acids, and lipids in cellular digestion. They also serve as vessels for recycling the cell’s organic material. Enzymes inside them break large molecules into smaller subunits that the cell can use as building material or eliminate.

In humans, a variety of inherited conditions can affect lysosomes. These defects are called storage diseases and include Pompe’s disease and Tay-Sachs disease. People with these disorders are missing one or more of the lysosomal hydrolytic enzymes. Abnormal storage causes inefficient functioning and damage of the body’s cells, which can lead to serious health problems, including death.

Using the Data Analysis Exercise at the top of page 75 in the textbook, answer the following questions:

Abnormal Motor Proteins Cause Kartagener Syndrome

An abnormal form of the motor protein dynein causes Kartagener syndrome, a genetic disorder characterized by chronic sinus and lung infections. Biofilms form in the thick mucus that collects in the airways, and the resulting bacterial activities and inflammation damage tissues. Affected men can produce sperm but are infertile Some have become fathers after a doctor injects their sperm cells directly into eggs. Review Figure 4. 25, then explain how abnormal dynein could cause the observed effects.

Observe how the abnormal protein dynein alters flagella. Why would this abnormal protein cause a build up of mucus in one’s airways?

Kartagener syndrome is a genetic disorder caused by a mutated form of a protein dynein. People that are affected by this disease have chronically irritated sinuses, and mucus build up in the airways to their lungs. Bacteria also forms in the thick mucus. The disease typically progresses to overt bronchiectasis during late childhood or early adulthood and can ultimately

causes chronic respiratory failure. This disease is affected by the cilia and flagella which are appendages extending from the body of most eukaryotic cells. Motile cilia line the upper and lower airways of the lung. Motile cilia are rod-like organelles that extend from the airway cell surface and move the mucus by synchronized beating. There are about 200 motile cilia in the respiratory tract of a healthy individual. They are responsible for movement of the cell itself or the generation of fluid flow, such as mucus. Beating coordinately, these cilia function to remove mucus and debris from the airway in a process called mucocilliary clearance. When the cilia malfunction, there is buildup of mucus and debris in the tract, which leads to respiratory difficulties. Immotile or respiratory cilia cause defective Mucociliary Clearance, because of the lack of uniform ciliary movement to transport particles, or mucus in or out of the organs or cells.

Why would this cause infertility unless the sperm were artificially injected into egg cells?

Males that are affected by Kartegener syndrome can produce sperm, but they are infertile. Sperm count is typically normal, but sperm are immotile due to the absence of dynein flagella or motility is severely limited due to a shortening of the flagella. Some can still become fathers with the help of a procedure that injects sperm cells directly into eggs.