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Block B

Membranes, Membranes, and More Membranes

Membranes are a critical for cells to function because they separate the cytoplasm and inside of the cell from the external environment. The membrane is able to do this function by creating a selectively permeable barrier. The only molecules able to diffuse through the membrane are small and non-polar (O2, CO2, Cholesterol, Testosterone, and Estrogen). For other molecules to move across the membrane, transport proteins are needed. Not even water can move through the membrane without the assisted transport across the membrane from Aquaporin. Some transport proteins move solute against its concentration gradient, the opposite path necessary to reach an equilibrium across the membrane. This action can sometimes create an electrical potential as in the Sodium-Potassium pump. The membrane will maintain this electrical potential. The plasma membrane is made of a lipid bilayer. Lipids (in the plasma membrane of mammal cells) are phosphate groups attached to two (normally saturated) tails. The head, phosphate group, of the lipid is hydrophilic, associates well with water, because of its polar bonds, however the tails are hydrophobic, does not associate well with water, because they are non polar. This structure of lipids in the plasma membrane causes a lipid bilayer to form with all the lipid heads facing outward toward the water/cytoplasm and the tails tightly packed together in-between the layers of lipid heads.

The Rough ER (Endoplasmic Reticulum) is a organelle where membrane bound proteins are created by the bound ribosomes and injected directly into the membrane. Proteins created in the Rough ER are either membrane bound (peripheral or integral proteins) or will be secreted by the cell. The Rough ER has a single membrane that the ribosomes are bound to and where the proteins are injected. Sections of this membrane can bud off in vesicles, small sacks that are contained by a mini lipid bilayer, containing membrane bound proteins and other proteins to be secreted. These vesicles will be sent next to the Golgi Apparatus.

In the Golgi Apparatus, the single folded membrane could be thought of as an extension of the ER or as if both are part of the same protein factory. This organelle is where protein modification takes place. This process is used to attach cell - cell recognition molecules to proteins bound for the plasma membrane. In the Golgi, a vesicle enters on the cis face carrying the protein ready for modification. This protein will move through the single folded membrane from fold to fold of the Golgi via vesicle transport. Once the protein has been modified, it will leave the Golgi in a vesicle, this time attached to a motor protein and set on a microtubule destined for the plasma membrane where it will integrate into the existing plasma membrane because both the vesicle and plasma membrane are lipid bilayer, they can merge into one.

In Mitochondria, digested food molecules, such as sucrose, are used to recharge ADP and a phosphate to form ATP, the cells main source of chemical energy for energy intensive cellular functions. Mitochondria have a double membrane. The outer membrane is not folded, but spherical as to keep in the contents of the Mitochondrion. The inner membrane is folded on itself because the inner membrane is the site of ATP recharging and with a higher surface area more ATP can be recharged per Mitochondrion. The inter membrane area (not a membrane) is where the digested food is stored and then moved through the inner membrane to recharge ATP.

Membranes, more specifically lipids, flow through the cell in a cycle that recycles are reuses parts of the membrane. Through the process of Endocytosis molecules from the exterior of the cell or large particles are pushed through the membrane, budding off part of the membrane and forming a vacuole/vesicle for transport within the cell. Vesicles also leave for the membrane in the process of membrane bound protein creation. Ribosomes in the Rough ER inject the protein into the membrane in the Rough ER where the protein buds off in a vesicle to the Golgi Apparatus where modifications are made. The protein, after completing it modifications, will leave the Golgi Apparatus in a vesicle attached to a motor protein on a microtubule bound for the plasma membrane where the contents will be forced out of the cell and the membrane will join the current plasma membrane. Lipids for the membrane are synthesized in the Smooth ER. This location is also the location of lipid metabolism, the destruction of lipids. Altogether, membranes are an important feature of cells that allow the maintenance of a specialized climate within the cell and our cells would have needed to evolve very differently without lipids and the plasma membrane.