**TRANSPORT PROTEIN:**

As membranes are impermeable inorganic ions and other organic hydrophilic solutes (sucrose and amino acids) proteins are required to transport protons, inorganic ions and organic solutes across the membranes. These proteins are contained by membranes and they facilitate the passage of selected ions and other polar molecules and are called transport proteins.

Transport protein

1. Carrier protein (Carriers)
2. Channel protein (Channels)
3. Pumps protein (Pumps)

**i. Channels**

These are trans-membrane protein that functions as selective pores through which molecules or ions can diffuse across membrane.

**Specificity**

These are specific and span through membrane. Some are cation channel for cations, some are anion channel for anions and some are specific for certain cations and certain anions known as nonspecific cation, nonspecific anion and (specific anion/ cation channel) specific cation/anion channel. ions are water molecule pass through channel in a single file at very rapid rates. These channels are regulated e.g. can be opened or closed.

**ii. Carriers**

These proteins attach cations/anions at their active site and physiologically carry the ions from one side to the other side. Transport is complete when the substances dissociate from carrier binding site or the other site of the membrane. The requirement for biding allows carriers to be highly selective for a particular substrate to be transported.

**iii. Pumps**

The pumps attach ions and carry it from one side to other by exertion of energy produce by itself. The membrane proteins that carry out by primary active transport are called pumps. Different types of pumps are present on plasma membrane and tonoplast.

**TYPES OF CELLULAR TRANSPORT:**

* Passive transport (along the concentration gradient)
* Active transport

**Passive transport**

It may occur within cellular compartment or across the membrane.

* **Diffusion**

It is direct without any help e.g. fat soluble anions pass through membranes or some ions through channel.

* **Facilitated diffusion**

It occurs with the help of transport protein e.g. K+ ion move through K+ carrier.

* **Osmosis**

Diffusion of water through a semipermeable membrane.

**Examples of passive transport**

* Water move through aquapotins( channel protein)
* Inophorts (channel for ions)
* Uniphorts (it is the movement of single solute along its concentration gradient)
* Symport (it is the movement of two molecules/ions in same direction)
* Antiports (it is the movement of two molecules/ions in opposite direction)

**Active transport**

It is against concentration gradient by using energy and it involves protein pumps. These are the part of membrane therefore it is called integral proteins. It is slow process as compared with the passive transport. It is physiological in nature.

**Pumps**

There are three types of pumps. i.e. ATPase, Proton pump ATPase, Proton pump pyrophosphatas

1. **ATPase:** Present on both plasma membrane and tonoplast.
2. **Proton pump ATPase (H+ ATPase):** It is present both plasma membrane and tonoplast and is most common. F-type are of plasma membrane, V-type are of tonoplast. It transfers proton to lumen by consuming energy released by ATP. Main function of proton pump is to transfer the proton against concentration gradient or in some cases along the concentration gradient across the membrane.
3. **Proton pump Pyrophosphatase (PPase):** It is present only plasma membrane. It transfers protons to lumen by using energy released inorganic pyrophosphate.

**Types of active transport**

**1. Primary active transport**

It utilizes energy directly released by the hydrolysis of ATP, inorganic pyrophosphate redox reactions of electron transport chain of mitochondria and chloroplast or absorption of light by carrier proteins to transport materials across membrane.

**2. Secondary transport**

It involves using energy indirectly firstly to establish a gradient across the cell membrane then utilizing gradient of that secondary substance to transport a molecule of interest uphill its concentration gradient along with downhill transport of other. This is carrier mediated and is driven indirectly by pumps.

**Proton motive force (pmf)**

Protons are extruded out of the cytoplasm by the proton pump ATPase at the plasma membrane and tonoplast. Therefore, electrochemical potential gradient of proton develops across the membrane which is called pmf. The energy of proton moving down its concentration gradient is used to transport another substance against its concentration gradient e.g. sucrose is loaded into phloem during photosynthesis by proton sucrose symport. Sometime K+ moves in opposite direction of sucrose then it is called antiport.