

Q10 Describe transport mechanisms across cell membranes. Give an example of each (Sept 2012)

The cellular membrane is virtually impermeable to hydrophilic and ionic substances. Specific transport mechanisms are therefore required to move many substances across the membrane. These include:

- **EXOCYTOSIS** → vesicles containing material for export bind to the internal surface of the cellular membrane, after which the area of fusion breaks down, leaving the contents of the vesicle outside the cell but the cell membrane intact. This is a calcium dependent process. Eg, secretion of virus particles from an infected cell.
- **ENDOCYTOSIS** → the reverse of exocytosis. Various types exist based on the particle size and regulatory requirements:
 - Phagocytosis → bacteria and dead tissue are engulfed by making contact with the cell membrane of cells such as polymorphic leukocytes, which then invaginates, leaving the engulfed material in the membrane-enclosed vacuole and the cell membrane intact
 - Pinocytosis → the same as phagocytosis but with much smaller vesicles and the ingested substances in solution
 - Clathrin-mediated endocytosis → occurs at membrane indentations where the protein clathrin occurs, with the clathrin forming a geometric array that surrounds the endocytotic vesicle before the vesicle is pinched off inside the cell
- **ION CHANNELS** → specific ion channels exist for K, Na, Cl and Ca, as well as many nonspecific channels. Allow the movement of ions down their concentration gradient when the channel is open.
- **DIFFUSION**
 - Simple → occurs through the cell membrane down the concentration gradient of the substance, either through the interstices of the lipid bilayer if the diffusing substance is lipid soluble, or through watery channels that penetrate all the way through some of the large transport proteins (eg, oxygen)
 - Facilitated → also called carrier-mediated diffusion because a substance transported in this manner diffuses through the membrane down its concentration gradient but using a specific carrier protein to help, eg, glucose and amino acids
- **ACTIVE TRANSPORT**
 - Primary → movement of a substance across the membrane against an energy gradient using a specific carrier protein. This requires additional energy such as ATP (eg; the Na/K ATPase pump)
 - Secondary → the energy required is derived secondarily from energy that has been stored in the form of ionic concentration differences of secondary molecular or ionic substances between the two sides of a cell membrane, created originally by primary active transport. Secondary active transport occurs via co-transport or counter transport, eg, the uptake of glucose in the gut via SGLUT-1.

