

CELL BIOLOGY, GENETICS AND BIOTECHNOLOGY

II B.Sc BOTANY (ALLIED ZOOLOGY)

BY

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PLASMA MEMBRANE

- Plasma membrane is otherwise called cell membrane or plasmalemma
- The plasma membrane -the thin, elastic semipermeable living membrane that serves as a boundary for the cytoplasm
- Plasma membrane was coined by Nageli in 1855
- Plasma membrane is the outer membrane in all animal cells
- But in plant cells and bacterial cells, it is present inner to the cell wall

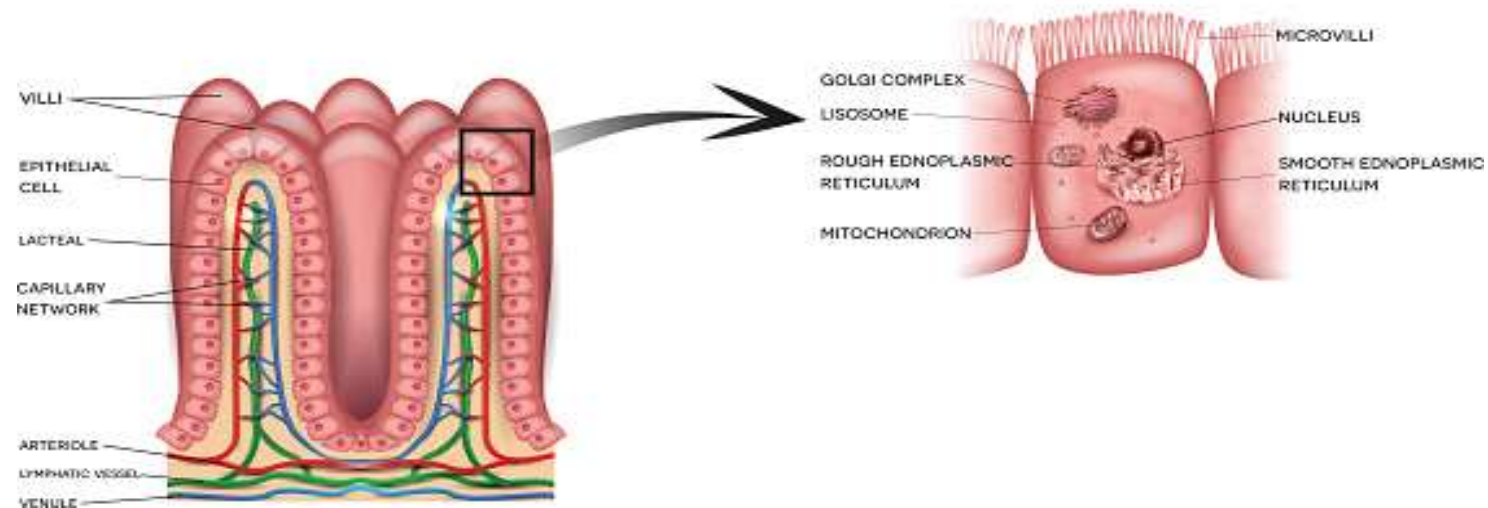
SPECIALIZATIONS OF PLASMA MEMBRANE

- The plasma membrane shows specialized structures
- Such structures include the following:
 1. Microvilli
 2. Desmosomes
 3. Gap junction
 4. Tight junction
 5. Interdigitations
 6. Basal infoldings
 7. plasmodesmata

1. Microvilli

- Microvilli are minute finger like projections arising from the surface of certain cells
- They are found on the epithelial cells of intestine, kidney and uterus
- A single cell contains about 3000 microvilli

INTESTINAL VILLI



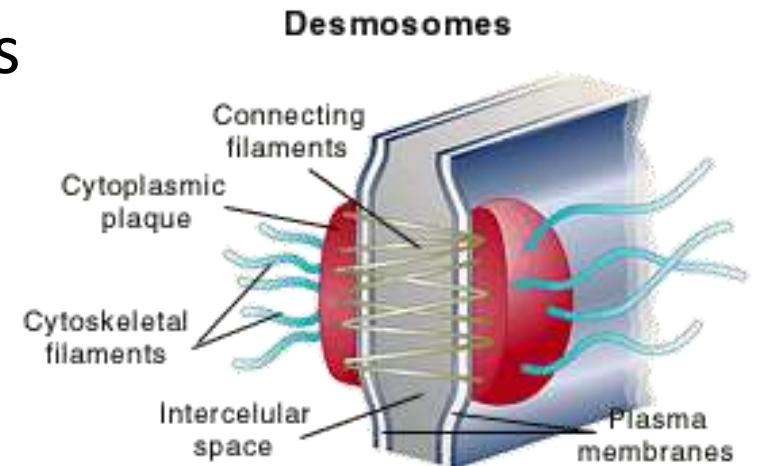
- Each micro villi is cylindrical in shape
- The microvillus is 0.6 to 0.8 micrometer long and has a diameter of 0.1 micrometer
- It has a core of cytoplasm enclosed by the plasma membrane
- The outer surface of the microvillus is covered by fuzzy coat. The fuzzy coat is composed of glycoprotein
- At the base of microvillus are joined to the network of actin-myosin microtubules

Functions

- Help in effective absorption
- The microvilli form a kind of sieve through which substances pass during the process of absorption

2. DESMOSOMES

- Desmosomes are thickened areas of plasma membranes of two adjacent cells, from which radiate fine tonofibrils
- The desmosomes glue the adjacent cells
- Desmosomes are abundant in cardiac muscle
- The desmosomes bear fine radiating filaments called tonofibrils
- The tonofibrils provide intracellular mechanical support
- In the desmosomes, the intercellular gap is filled with a dense fibrous material of acid mucosaccharides and proteins
- This material helps to glue the cells together



There are four types of desmosomes. They are the following:

1. Belt desmosomes
2. Spot desmosomes
3. Hemi desmosomes
4. Septate desmosomes

1. Belt desmosomes

- Belt desmosome is found just below the tight junction
- The belt desmosomes help to close gaps and also help in the movement and change in shape of embryonic epithelial cells

2. Spot desmosomes

- Spot desmosomes are disc-shaped points of contact between the plasma membrane of adjacent cells
- The spot desmosome is meant for mechanical attachment

3. Hemi desmosomes

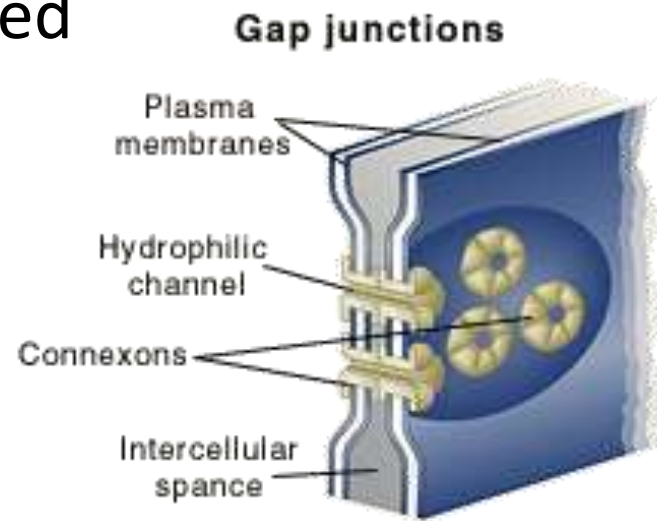
- Hemi desmosomes are half desmosomes
- They help to join the cell membrane of epithelial cells to the underlying basement membrane

4. Septate desmosomes

- It is found in the epithelial cells of invertebrates
- They help in the attachment of cells and intercellular communication

GAP JUNCTION

- Gap junction is a junctional complex between two cells
- Gap junction is a channel or pore through two cell membranes across the intercellular space between two adjacent cells
- Calcium ions help to regulate the opening and closure of the gap junction
- When the intracellular calcium ion concentration increases, the channels are closed

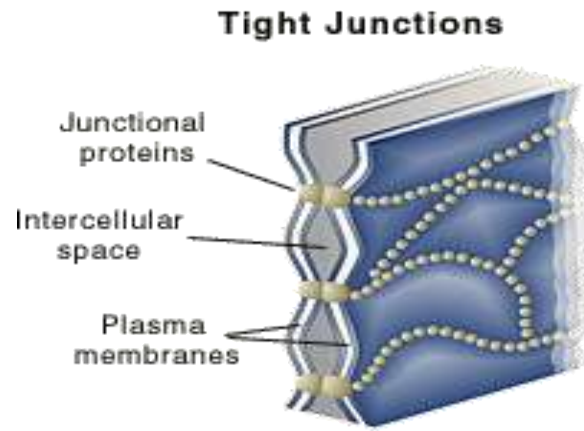


Functions

- In cardiac muscles and synapses, the gap junction conduct electrical signals
- Gap junction allow passage of ions, sugars, vitamins and nucleotides between the cells

TIGHT JUNCTION

- Tight junction is a junctional complex where the plasma membranes of adjacent cells fuse together so intimately, that the intercellular space disappears
- The tight junctions occur in intestinal cells, gland cells, gall bladder and brain cells
- The tight junction consists of an interlocking network of ridges are called sealing strands
- Each sealing strand is formed of a double row of protein particles

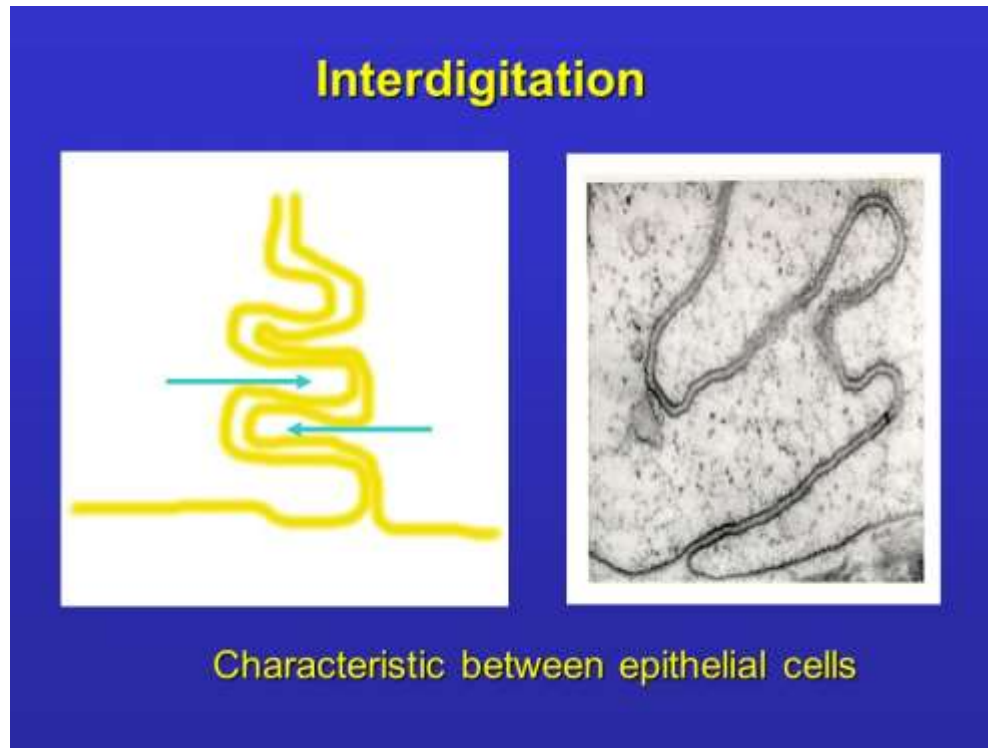


Functions

- Tight junctions prevent the passage of materials to and from the cells
- They prevent the leakage of pancreatic secretory products into the blood

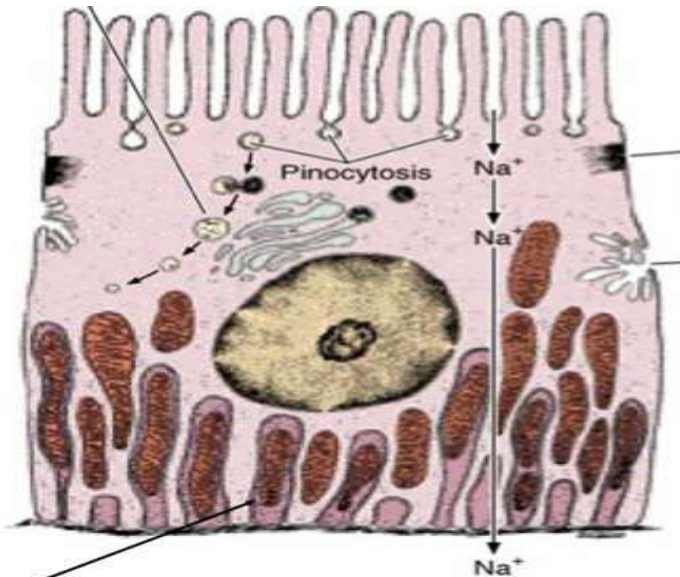
INTER-DIGITATIONS

- The plasma membranes of adjacent cells project into the cytoplasm as finger like projection called inter-digitations
- The interdigitations help to compartmentalise the cytoplasm



BASAL INFOLDINGS

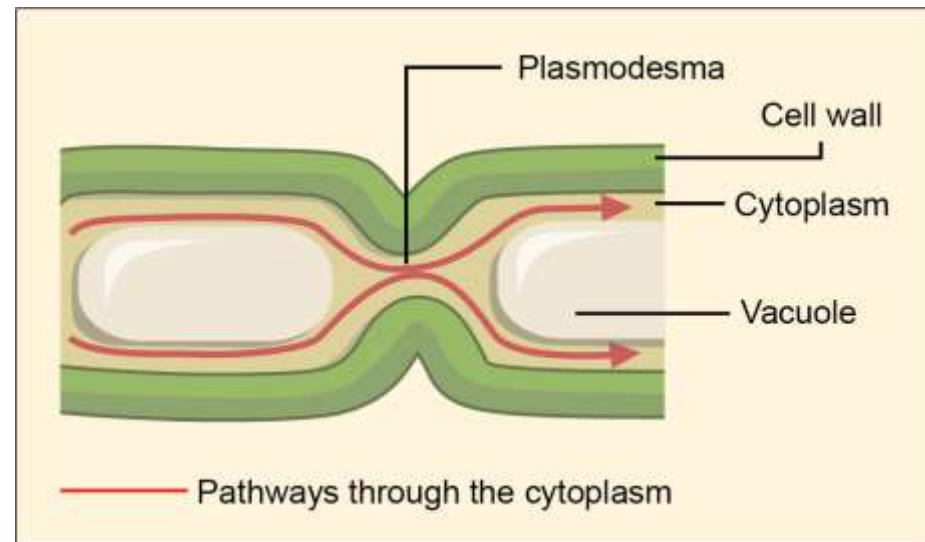
- Basal infoldings are finger like invaginations of the plasma membrane into the cytoplasm from the base of the cell
- They are found in kidney cells
- The basal infoldings enclose many mitochondria
- They are concerned with the active transport of materials

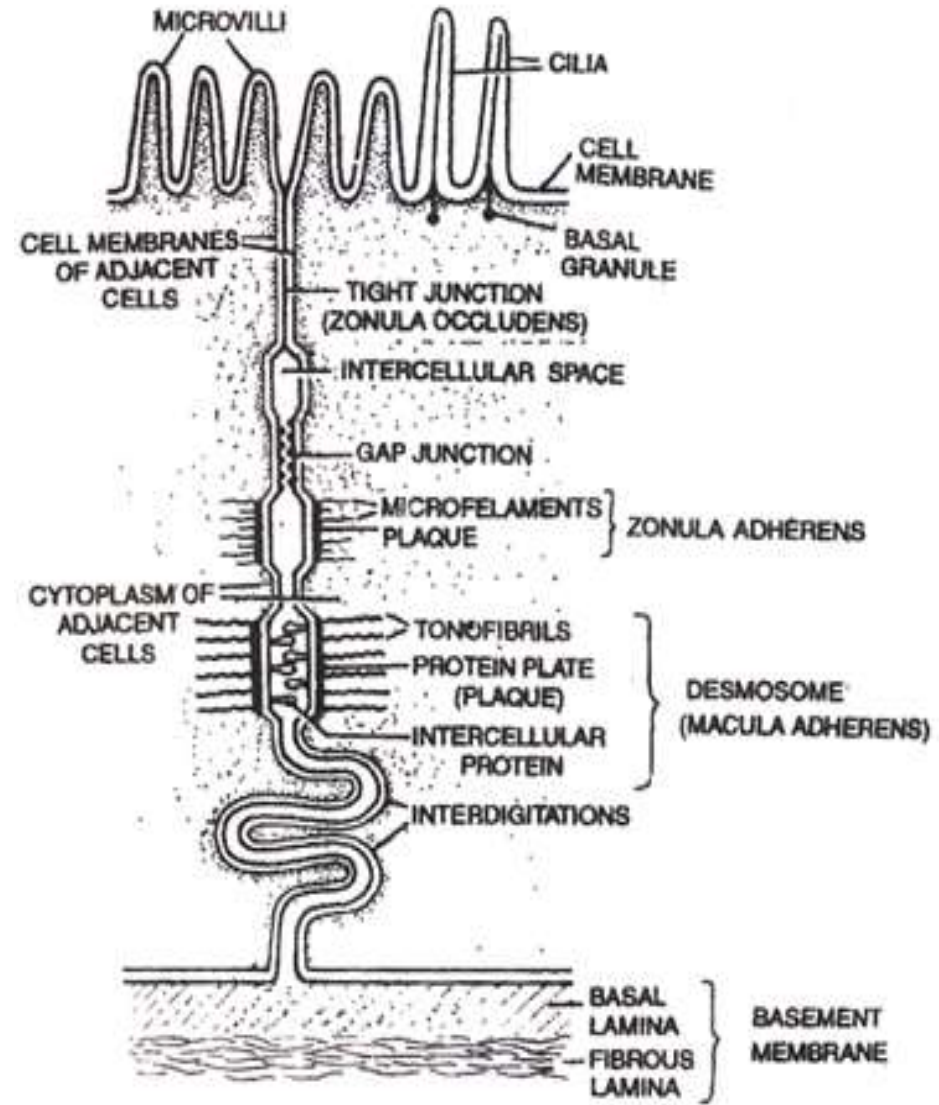


Basal Plasma membrane infoldings

PLASMODESMATA

- Plasmodesma is a cytoplasmic bridge connecting adjacent cells
- Plasmodesmata are found in plant cells
- The cell wall contains many small openings.
- The adjacent cells are connected by cytoplasmic bridges through these pores





FUNCTIONS OF PLASMA MEMBRANE

1. Mechanical support

- Plasma membrane gives the shape to the cell
- It protects the cell contents

2. Exchange of materials

- Plasma membrane regulates the exchange of materials into and out of the cell
- It allows the needed materials to enter the cell and sends out the unwanted materials from the cell
- This property of the cell membrane is said to be selective permeability

3. Biogenesis of cell organelles

- Certain cell organelles like endoplasmic reticulum, nuclear membrane develop from plasma membrane

4. Absorption

- The microvilli of intestinal cells increase the absorption

5. Cell recognition

- Mammalian WBC identify foreign cells like bacteria and engulf them by phagocytosis

6. Antigenic specificity

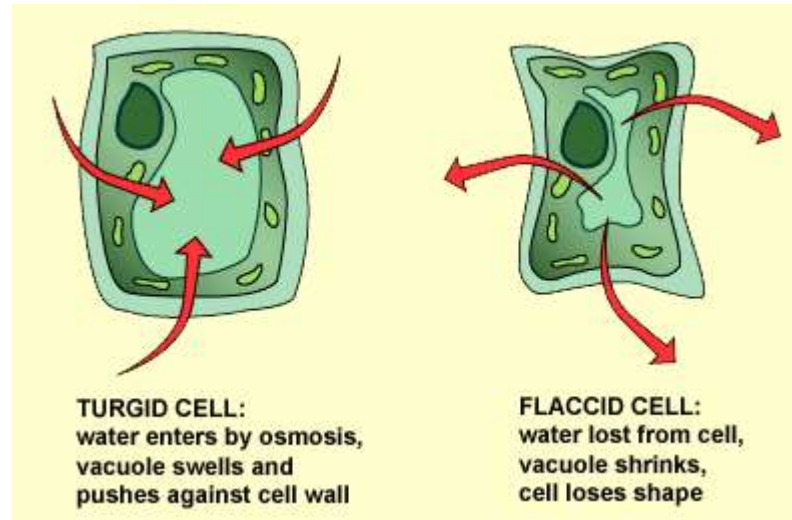
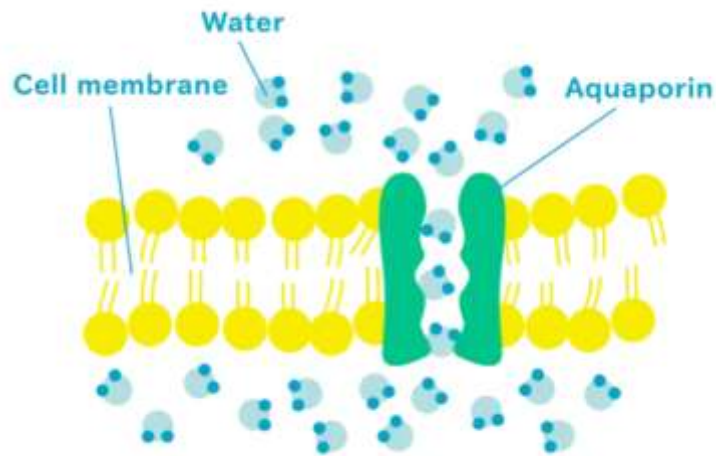
- The antigen specificities of the cells are located on the surface of the plasma membrane
- The rejection of transplanted tissues is determined by antigens located on the cell membrane

7. Transmission of impulses

- The plasma membrane of nerve fibres transmits nerve impulses

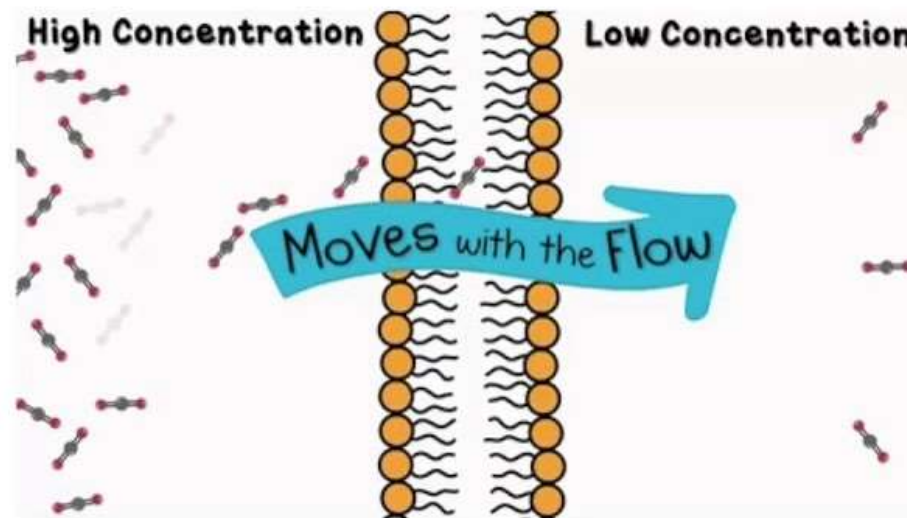
8. Osmosis

- The plasma membrane allows the free movement of water.
- The process of movement of water molecules from the region of higher water concentration to the region of lower water concentration is known as osmosis
- The process in which the water molecules enter the cell is known as endosmosis and the reverse process is known as ex osmosis



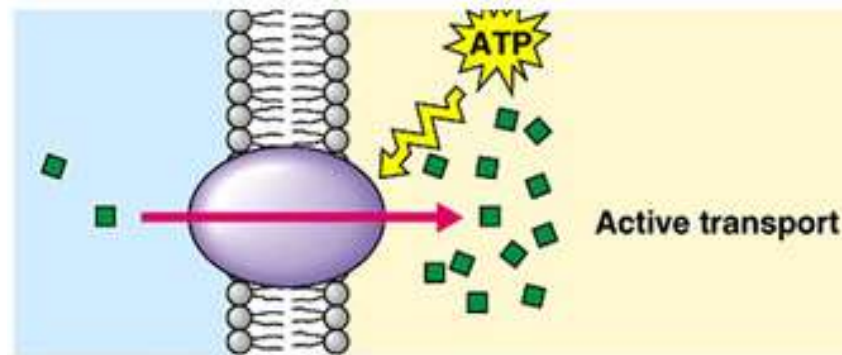
9. Passive transport or diffusion

- The movement of molecules across the plasma membrane from the region of higher concentration to a region of lower concentration is called passive transport or diffusion
- This process does not utilize energy
- Hence this process is also called down hill movement



10. Active transport

- The movement of molecules and ions from the region of lower concentration to the region of higher concentration called active transport
- It is also called as uphill movement
- It needs energy
- The energy is provided by the mitochondria



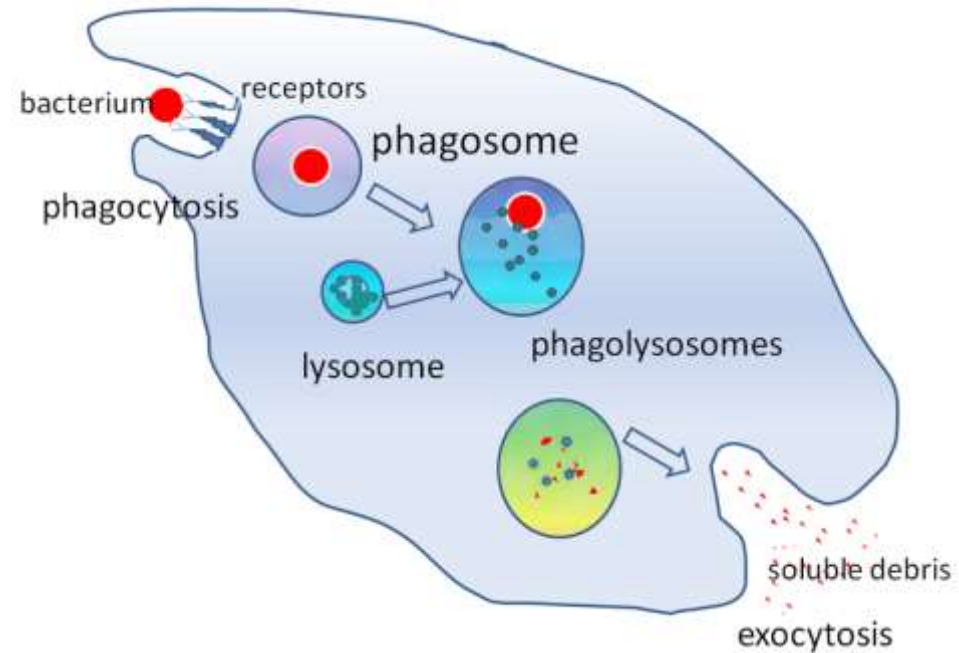
11. Endocytosis

- Endocytosis is the engulfing of food or foreign particles through the plasma membrane
- The endocytosis can be differentiated into phagocytosis and pinocytosis

1. Phagocytosis or cell eating

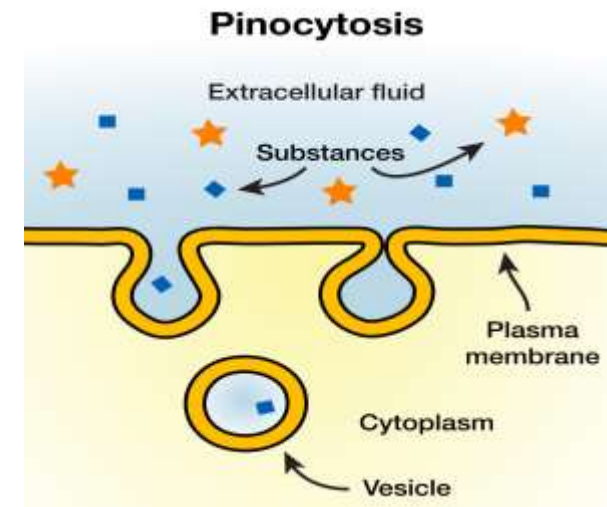
- Phagocytosis is the engulfing of solid particles through the plasma membrane
- It is also called cell eating
- The cells exhibiting phagocytosis are called phagocytes
- During the process the food particles are adsorbed at the surface of the membrane
- Later on they are taken into the cytoplasm by the infolding of the plasma membrane

- The plasma membrane at the infoldings gets pinched off in the form of a small vesicle called phagosomes
- Then the phagosomes fuse with lysosomes to form the digestive vacuoles
- The food is digested inside the vacuole and the digested food diffuses into the cytoplasm



2. Pinocytosis or cell drinking

- Pinocytosis is the process of engulfing of fluid particles through the plasma membrane
- During pinocytosis, the plasma membrane is invaginated to form sac like structure
- The fluid food is drawn into the sac
- Then the sac is pinched off from the plasma membrane, forming a vesicle called pinosome
- The pinosome later fuses with lysosome
- The digested food diffuses into the cytoplasm



12. Exocytosis or cell vomiting

- The process of exuding the secretory products from the secretory cells to the outside of the cell cytoplasm is known as exocytosis or cell vomiting
- This process is also called reverse endocytosis

