

The history about cells biology essay

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Passive mechanism refers to the cells which do not have to pay the energy expenses for these forms of molecular traffic. Instead, it depends on the selective permeability of the plasma membrane or the embedded proteins and lipids within the membrane. Passive mechanism is essential to maintain the cell in an isotonic way and thus avoid the cell from encountering hypertonic or hypotonic condition. Passive mechanism can be subdivided into diffusion, osmosis and facilitated diffusion. Diffusion also called simple diffusion which is the unassisted net movement of a solute from a region of higher concentration to a region of lower concentration (Hardin, Bertoni, & Kleinsmith, 2012). The difference in concentration is called concentration gradient. The magnitude of the net flux is influenced by several factors which are temperature, mass of the molecules, surface area and the medium through which the molecules are moving (Sreekumar, 2011). The higher the temperature, the higher the speed of molecular movement and the greater the net flux. Large molecules such as proteins have a greater mass and lower speed than smaller molecules thus the net flux is smaller. Net flux can improve by increasing the surface area between two regions as more spaces are available for diffusion. Molecules diffuse rapidly in air than in water because in a gas phase, collisions are less frequent. For an example, sugar (solute) is put into a glass of water (solvent). Sugar is initially remains highly concentration at the bottom of the glass. The sugar molecules move away from the area of high concentration and uniformly distributed among water molecules until they achieve equilibrium. Osmosis is the diffusion of water across a selectively permeable membrane. According to Shier, Butler, & Lewis (2003), if the concentration of solutes inside a cell is higher than that

outside, water will move in by osmosis, causing the cell to swell. Osmosis mainly consists of osmotic pressure and turgor pressure. Osmotic pressure is the ability to lift a volume of water with high pressure. A higher concentration of solute particles results in larger osmotic pressure. For example, water molecules in plant cell tend to move into the intracellular as the concentration of solute within the plant cell is higher than in the extracellular. It is proven that the plasma membrane is selectively permeable to water but not the solute. Turgor pressure is also called turgidity, occurs when the water exert pressure against the cell wall in plant cell and keep plant cells distended with water (Alberts et al., 2009). The turgor pressure holds plant stems rigid and leaves extended. Gas exchange through the stomata is regulated through turgor pressure. This pressure is mostly occurs in plant cells. Apart from that, substances that are not able to pass through the lipid bilayer require the help of membrane proteins to be transported across plasma membrane, through a process known as facilitated diffusion (Shier et al., 2003). Molecules such as sugar and amino acids which are too large in size to pass through the plasma membrane often need help of facilitated proteins. The rate of facilitated diffusion depends on the number of carrier molecules in the plasma membrane. More carrier molecules will increase the speed of the rate of facilitated diffusion. For instance, glucose molecules attach itself to a special protein carrier molecule in order to pass through the membrane. This combination of both molecules changes the shape and confirmation of the carrier. It moves glucose molecule from the region of higher concentration to the region of lower concentration. After the glucose is being released, the carrier returns to its

original shape and the process is repeated. According to Hardin et al. (2012), active mechanism requires the continuous input of energy to move the substances against the concentration gradient by using the transporter in the membrane which is often referred as " pumps". Active mechanism assists the uptake of essential nutrients from surrounding fluid even when the concentration of solutes in the cell is higher. Besides, waste products will be transported out of the cell even the concentration of waste outside the cell is higher than concentration within the cell. Furthermore, active mechanism can help to maintain a constant concentration gradient of specific inorganic ions, for example K^+ , Na^+ , Ca^+ , and H^+ . In general, active mechanism can be classified into active transport, endocytosis and exocytosis. Active transport can be subdivided into direct active transport and indirect active transport. Direct active transport involves the use of ATPase or ATPase pumps to drive the hydrolysis of ATP through a process called phosphorylation. Phosphorylation of the transporter protein (covalent modulation) is the process that changes the affinity of the transporter's solute binding site (Widmaier, Raff, & Strang, 2004). For example, the binding site of transporter is exposed to the extracellular fluid and the protein is phosphorylated by ATP. The solutes in the extracellular fluid will bind to the high-affinity binding site and make a change in the conformation of the transporter. Change in conformation will lead to the removal of phosphate group from the binding site and reduces its affinity. Therefore, the solute is transported into the other side of the membrane. Similarly, indirect active transport also needs energy to drive the process but also depends on the simultaneous transport of two solutes, with the favorable movement of

one solute down its gradient during the unfavorable movement of the other solute up its gradient (Hardin et al., 2012). Indirect active transport uses an ion concentration gradient across a membrane as energy source. The flow of ion occurs from a region of high concentration gradient to a region of low concentration gradient provides energy for movement of solutes across the plasma membrane. Indirect active transport usually transports sodium, bicarbonate, chloride or potassium which will change the affinity of the binding side. For example, sodium ion in the intracellular is low compared to the extracellular due to the direct active transport of sodium out of the cell by Na^+/K^+ -ATPase. Therefore, the sodium binding sites are found on intracellular surface of the transporter and use ATP provided by Na^+/K^+ -ATPase to create sodium concentration gradient. On the other hand, endocytosis is a process whereby region of the plasma membrane can be seen to fold into the cell, forming small pockets that pinch off to produce intracellular membrane-bound vesicles that enclose a small volume of extracellular fluid (Widmaier et al., 2004). Endocytosis comprises pinocytosis and phagocytosis. Pinocytosis can be further subdivided into fluid endocytosis and absorptive endocytosis. Pinocytosis can be considered as "cell drinking", in which the cell membrane enclosed a tiny droplet of liquid and forming a vesicle. Conversely, phagocytosis means "cell eating" that takes in solid particles and enclosed them in a molecule. For example, when a phagocyte encounters a particle, the particle will attach itself to the membrane surface and slowly detaches from cell membrane, forming a vesicle. Exocytosis occurs when membrane-bound vesicles in the cytoplasm fuse with the plasma membrane and release their contents to the outside of

the cell (Widmaier et al., 2004). Exocytosis helps to replace portions of the plasma membrane that have been removed by endocytosis and add new membrane components to the cell. Besides, exocytosis assists the secretion of impermeable molecules across the cell membrane. For example, nerve cells use exocytosis to release the neurotransmitter chemicals that in turn induce the responses in nerve cells, muscle cells or glands. This is crucial as the material stored in secretory vesicles is available for rapid secretion so that our body can quickly respond to stimulus without any delays. Movement of Materials across Plasma Membrane

Passive Mechanisms
Active Transport
Endocytosis
Osmosis
Facilitated Diffusion
Diffusion
Diffusion
Exocytosis
Active Mechanisms

Figure 1: Movement of Materials across Plasma Membrane