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Cell Transport Reading and Questions

The Cell Membrane

The job of the **cell membrane** is to regulate what enters and exits the cell. The cell membrane acts in a way that is similar to the doors and windows of your house. Since some "stuff" can come in and some "stuff" must

stay out, the cell membrane is said to be selectively permeable. The cell membrane regulates what enters and leaves the cell and also provides protection and support.

Nearly all cell membranes are made of a doubled layered sheet called a **phospholipid lipid bilayer**. The bilayer gives the cell membrane a tough flexible structure that forms a strong barrier between the cell and its surroundings.



The cell membrane is made of three major

molecules; lipids, proteins, and carbohydrates. The lipids are what forms main part of the membrane around the cell. The proteins are scattered throughout the cell membrane and form channels or pumps to help move materials across the membrane. The carbohydrates are attached to the outside of the cell membrane and act like chemical identification cards, allowing cells to identify one another.

Passive Transport

For the most part, your cell membrane does not have to work very hard in order to perform its job. Small molecules and molecules that do not have a charge can easily pass through the cell membrane without any energy required by the cell. This type of movement, when no energy is required, is called **Passive Transport**.



Passive Transport always happens when molecules that are in a high concentration area (crowded area) move to a lower concentration area (less crowded area). Molecules will always move to areas where it is less crowded for them, without any energy needed. This movement of molecules from a high concentration area to a low concentration area is called "moving down the concentration gradient". If you think about it, don't all things move "down" without any energy required?

There are 3 types of passive transport that you will have to know - Diffusion, Osmosis and Facilitated Diffusion. Remember that all 3 are passive transport - no energy required, all movement is from high concentration to low concentration! <u>Diffusion</u> is when **any molecule** moves from high to low concentration. <u>Osmosis</u> is when **water** moves from high to low concentration. <u>Facilitated Diffusion</u> is when large or charged molecules move **through a channel protein** in the cell membrane. The channel protein is similar to a "doggie door" in your house - it is just the right size hole for your dog to enter or exit without any energy required by you! Since molecules will always move from high to low concentrations, living things use this mechanism of transport for most substances. When you breathe in air with a high concentration of oxygen in it, yet your blood has a lower concentration of oxygen - the oxygen will simply **diffuse** into your blood cells! If your blood fluid has a higher concentration of water than your cells, then **osmosis** will occur into your cells! If your blood sugar concentration is higher than your muscle cells, then **facilitated diffusion** will occur through channel proteins!

In addition, because of this natural movement of molecules, living things must keep water, sugar, salts, etc. at a constant level (homeostasis) to prevent major problems from occurring. Your body tries to maintain fluids in your body that are <u>Isotonic</u> to your cells (same concentrations). That way movement still happens in and out of the cell but it is in equilibrium - same amounts are going in as coming out. If your body fluids became <u>Hypotonic</u> (high water concentration, little sugars & salts) compared to the cells, the cells would fill up with too much water and burst. If your body fluids became <u>Hypertonic</u> (low water concentration, and lots of sugars & salts), water would leave your cells and your cells would shrivel up and die!



Active Transport

Even though cells use passive transport to move most molecules into the cell, there are times when it is necessary for a cell to move molecules **against the concentration gradient**. <u>Active transport</u> is the movement of molecules from a low concentration area (less crowded) into a high concentration area (more crowded). This type of movement **requires energy**.

To remember the difference between active versus passive transport, you can think of it like riding a bike up or down a hill. If you are riding a bike uphill (from low to high) it requires energy - like Active Transport. If you are riding a bike downhill (from high to low) it does not require energy - like Passive Transport!

There are many times that the cell must move stuff against the concentration gradient. For example, your nerve cells will only send signals if there is a high concentration of sodium ions outside the cell and a high concentration of potassium ions inside the cell. In order to move molecules into high concentrations, the cell uses <u>protein pumps</u>. <u>These pumps</u> <u>require energy (ATP)</u> to force these ions through the cell membrane into already high concentrations. Think of it as stuffing lots of people into an already full elevator.



When molecules are just way too big to fit through the cell membrane or even through a membrane protein, your cell must do some serious work to get that stuff in or out. Some cells have the ability to wrap the cell membrane around a particle in order to pull it into the cell. This process is called endocytosis. During endocytosis, the membrane forms a pocket around a particle outside of the cell and the pocket pinches closed forming a vesicle and brining the particle into the cell. When your cells use endocytosis to pull in solid particles it is called **phagocytosis**. When your cells use endocytosis to pull in liquid particles, it is called **pinocytosis**. Your body's immune system utilizes phagocytosis to catch foreign invaders. You have white blood cells that will simply engulf bacteria or other foreign invaders by phagocytosis!



(a) Endocytosis



(b) Exocytosis

You also have many cells that produce large proteins for export from the cell. Your cell will release large quantities molecules in a process called **exocytosis**. In exocytosis, a vesicle inside the cell carries a particle to the cell membrane and the vesicle sticks to the membrane and becomes a part of it so that the particle is forced out of the cell. Exocytosis is basically the reverse of endocytosis - <u>exo</u>cytosis = <u>exit</u>ing the cell; <u>endo</u>cytosis = <u>into</u> the cell.

In short, all methods of active transport must push molecules against their concentration gradients **using energy**. Protein pumps move smaller molecules through the cell membrane. Endocytosis and Exocytosis, use the cell membrane to engulf substances then move them in or out of the cell. All of these methods use energy (ATP)!!



Analysis Questions

- 1. Why is the cell membrane said to be "selectively permeable"?
- 1.
 2.
 3.
 3. What is the role of each molecule in the cell membrane?
 1. Lipids 2. Proteins-

2. What are the three molecules the cell membrane is primarily made of?

- 3. Carbohydrates-
- 4. Define Passive Transport
- 5. What are 3 types of passive transport?
- 6. Describe the three types of passive transport.
- 1. Diffusion-
- 2. Osmosis-
- 3. Facilitated Diffusion-
- 7. What does it mean to "move down the concentration gradient"?
- 8. What types of molecules can diffuse through the cell membrane, without using a channel protein?
- 9. Why is it so important for your body to maintain water or sugar homeostasis?

- 10. Why do your fingers look like prunes after swimming for a long time?
- 11. Why can't Nemo live in a fish tank filled with goldfish? Explain.
- 12. What would happen to your cells if you tried to drink ocean water? Why?
- 13. Why is <u>facilitated diffusion</u> a form of passive transport? What types of molecules need this type of help getting into the cell?
- 14. What direction are molecules being moved in active transport?
- 15. Where in the cell are <u>Protein Pumps</u> located?
- 16. What is the difference between Endocytosis and Exocytosis?
- 17. Why is it important that you have white blood cells that perform endocytosis?
- 18. What transport method do you think the Golgi apparatus uses to ship packages of proteins out of the cell?
- 19. What is the difference between Phagocytosis and Pinocytosis?
- 20. Use the bicycle analogy to explain the differences between active and passive transport.

Phosphate Heads	Carbohydrate Chains
Integral Transport Protein	Fatty Acid Tails
Peripheral Proteins (there are two!)&	Phospholipid Bilayer
Draw and lehal a Phagner	linid in the space below

Match the letter that matches the structure of the cell membrane below.

Draw and <u>label</u> a Phospholipid in the space below. (Labels to Use: phosphate head, fatty acid tails, hydrophobic, hydrophilic)

Color the picture of the Phospholipid Membrane above using the following instructions. Phosphate Heads= Orange Integral Transport Protein= Purple Peripheral Proteins (there are two!)= Green Carbohydrate Chains= Blue Fatty Acid Tails= Yellow