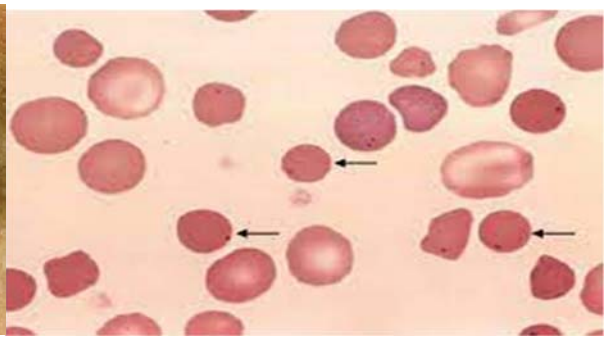
Huda is seen by her doctor for pallor and yellowish discoloration of the eyes, after clinical examination and performing some lab tests the doctor told her she has hereditary spherocytosis **(a blood disease that result from abnormal fragile RBCs with short life span due to defective cell membrane function)**



Plasma Membrane:

The plasma membrane (also known as the cell membrane or cytoplasmic membrane, and historically referred to as the **plasmalemma**) is a biological membrane that separates the interior of all cells from the outside environment (the extracellular space), so it can be also defined as a thin semi permeable membrane layer, which surrounds the cytoplasm and other constituents of the cell and regulates the materials that enter and exit the cell.

The plasma membrane thickness is ranged between 7.5 to 10 nm, visible only in the electron microscope and the line that can see some times under light microscope is formed by plasma membrane proteins of the cells and extra cellular material.

Structure of the Plasma Membrane:

The cell membrane is primarily composed of a mix of proteins and lipids. Depending on the membrane's location and role in the body, lipids can make up anywhere from 20 to 80 percent of the membrane, with the remainder being proteins. While lipids help to give membranes their flexibility, proteins monitor and maintain the cell's chemical climate and assist in the transfer of molecules across the membrane. The plasma membrane is a mosaic of phospholipids, cholesterol molecules, proteins and carbohydrates.

This **fluid mosaic model** describes the structure of a cell membrane. It indicates that the cell membrane is not solid. It is flexible and has a similar consistency to vegetable oil, so all the individual molecules are just floating in a fluid medium, and they are all capable of moving sideways within the cell membrane.

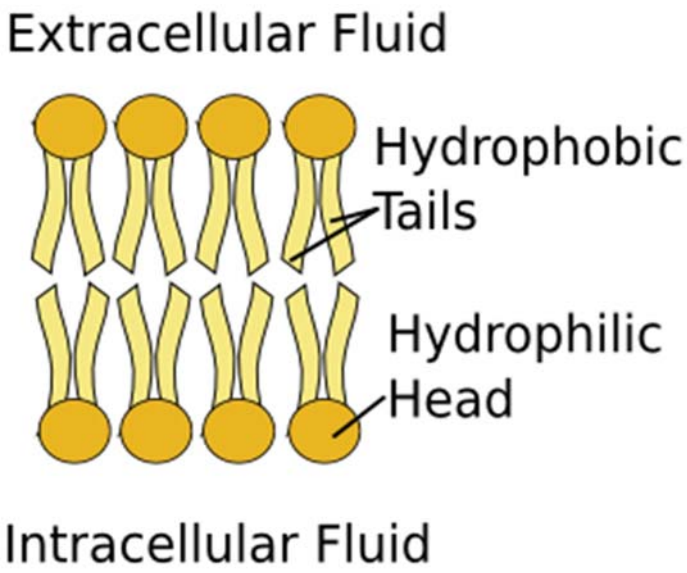
Structure of plasma membrane

Phospholipids

Phospholipids make up the basic structure of a cell membrane. Because these lipids contain the element phosphorus, they are called phospholipids. A single phospholipid molecule has two different ends: a head and a tail. The head end contains a phosphate group and is **hydrophilic** or **water- attracting**, this means that it likes or is attracted to water molecules.

The tail end is made up of two strings of hydrogen and carbon atoms called **fatty acid chains**.

These chains are **hydrophobic or water-repelling** do not like to mix with water molecules. This is just like what happens when you add vegetable oil in water. The vegetable oil will not mix with the water.



The arrangement of phospholipid molecules that make up the lipid bilayer.

(2)

The phospholipids of a cell membrane are arranged in a double layer called the **lipid bilayer**. Watery fluids are found both inside a cell (**intracellular fluid**) and outside a cell (**extracellular fluid**). The hydrophilic phosphate heads are always arranged so that they are near water, while the hydrophobic tails of membrane phospholipids are organized in a manner that keeps them away from water.

Cholesterol, Proteins and Carbohydrates

Cholesterol is a very important component of cell membranes, often at nearly a1:1 ratio with the phospholipids in plasma membrane. Cholesterol molecules are made up of four rings of hydrogen and carbon atoms. They are hydrophobic and are found among the hydrophobic tails in the lipid bilayer.

Cholesterol molecules are important for maintaining the consistency of the cell membrane, they strengthen the membrane by preventing some small molecules from crossing it and also cholesterol molecules keep the phospholipid tails from coming into contact and solidifying. This ensures that the cell membrane stays fluid and flexible.

Proteins

There are two main types of membrane proteins, proteins that located in the lipid bilayer and are called **integral proteins** which penetrate the hydrophobic core of the phospholipids bilayer and often span the membrane. They have polar amino acid side chains that associated with water molecules (hydrophilic regions), and nonpolar regions in the interior and associated with nonpolar fatty acid chain (hydrophobic regions).

Some integral proteins span the membrane one time from one side to other, they are called **one-pass transmembrane proteins** which have single hydrophobic region along the length of amino acids. The other type of integral proteins spans the plasma membrane more times, they are called **multi-pass transmembrane proteins** which have several hydrophobic amino acids sequences. Many physiology important membrane proteins including ions pumps and channels are multiple proteins.

Other proteins called **peripheral proteins** can be found on either side (inside and outside) surfaces of membranes, attached integral proteins or phospholipids and not associated with nonpolar (hydrophobic) region of the lipid bilayer.

The Functions and importance of the proteins

Membrane proteins which are located in specialized patches of membrane can function as **enzymes** to speed up chemical reactions.

Structural proteins (linkers) help to give the cell support and shape.

Cell membrane **receptor proteins** help cells to communicate with their external environment through the use of hormones, neurotransmitters, and other signaling molecules.

Transport proteins, such as globular proteins, transport molecules across cell membranes through facilitated diffusion.

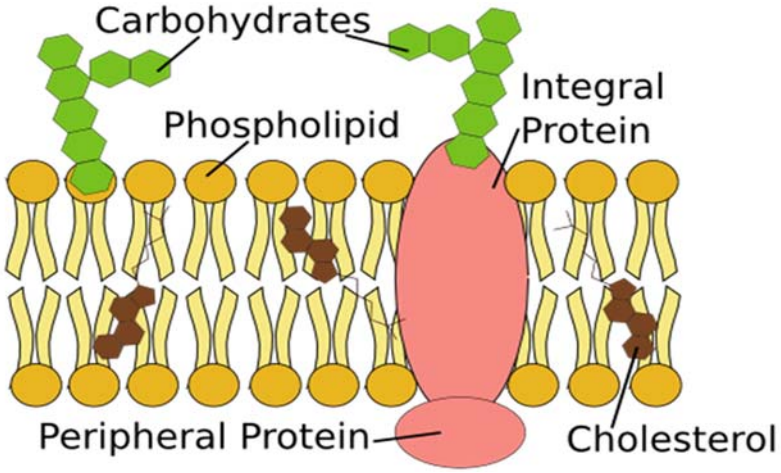
Glycoproteins have a carbohydrate chain attached to them. They are embedded in the cell membrane and help in cell to cell communications and molecule transport across the membrane.

Channels pore in the membrane that allows specific substances to enter or leave. Certain ions travel through channels in the membrane.

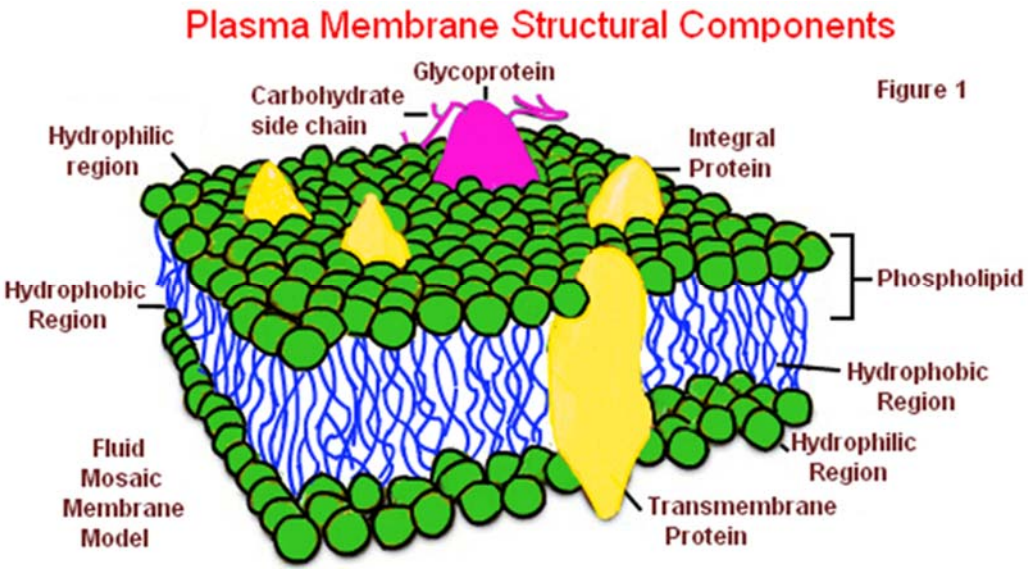
Carbohydrates, or sugars are sometimes found attached to proteins or lipids on the outside of a cell membrane. That is, they are only found on the extracellular side of a cell membrane.

The carbohydrates are important components of specific molecules called receptors. Together, these carbohydrates form the glycocalyx.

The glycocalyx of a cell has many functions it acts as a glue to attach cells together also provides cushioning and protection for the plasma membrane.



T he fluid mosaic model of a cell membrane.



Functions of plasma membrane

Plasma membrane separates the components of the cell from its outside environment.

It regulates what enters and exits the cell.

It allows only selected substances into the cell and keeps others out.

Plasma membrane has a major role in protecting the integrity of the interior of the cell.

Plasma membrane serves as a base of attachment for the cytoskeleton in some organisms and cell walls in other organisms. Thus, it supports the cell and helps in maintaining the shape of the cell.

Any defect in the structure or function in the plasma membrane can lead to pathological conditions such as hereditary spherocytosis.

Hereditary spherocytosis

Is a condition that affects red blood cells, mutation in RBC cell membrane proteins result in rigid, shortage spherical or misshapen cell instead of flattened disc shape, also the dysfunctional membrane proteins interfere with the cells ability to change shape when passing through different blood vessels (in normal RBC cells proteins that make the cell membrane maintain the cell structure and some of these proteins allow the cell to change shape without breaking when traveling from large to small blood vessels).

As a result, in hereditary spherocytosis the misshapen RBC cells are removed from circulation and taken to the spleen for destruction.

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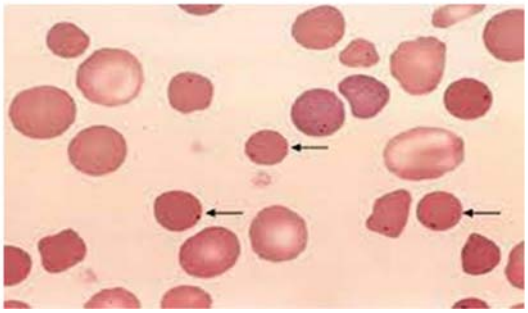

The difference between normal and abnormal RBC cells