ERASMUS PLUS
PROJECT

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The cell membrane and transport mechanisms

PRESENTATION

ITALY

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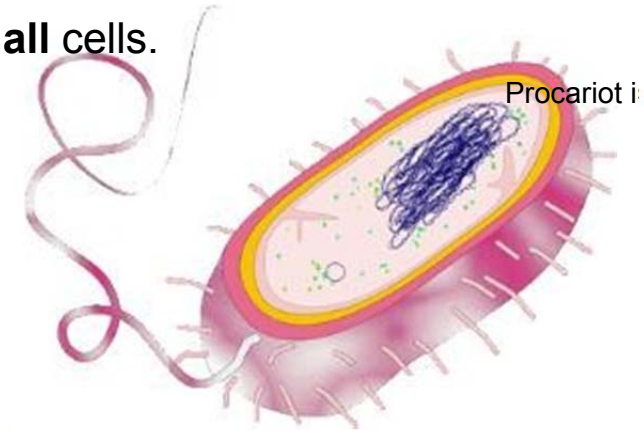
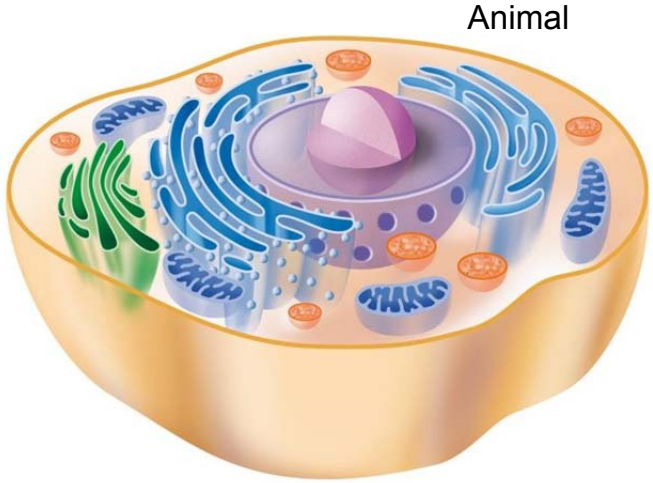
English translation by Teacher Giallombardo Rosie

The cellular membrane

What is it?

It’s the casting that covers **all** cells.



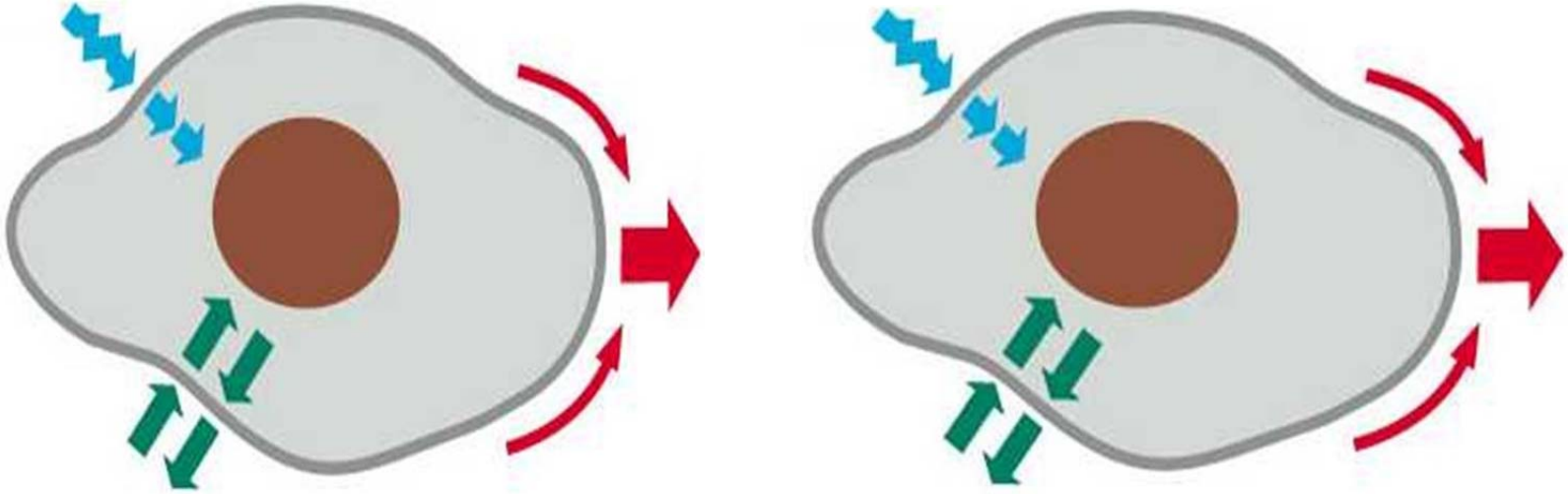


Its **Integrity is essential** and its damage leads to the **death of** the cell in a very short time.

The cellular membrane
Function

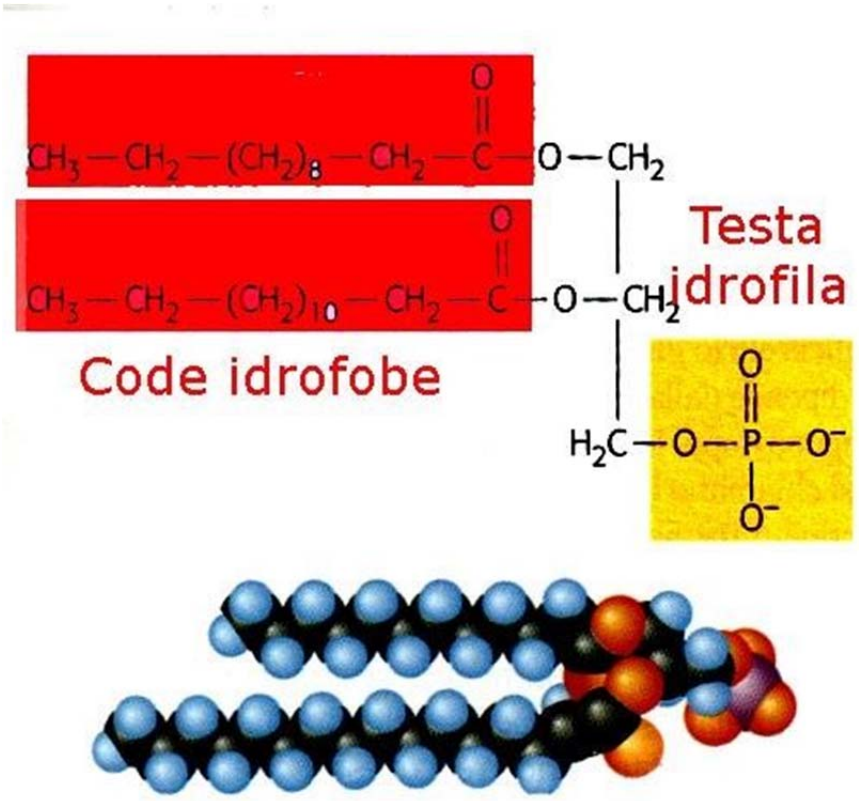
It performs basic functions.

- Demarcates the cytoplasm form a mechanical barrier;
- Isolates the cell from the outside environment;
- Regulates the exchange of ions and molecules between the inside and the outside;
- Allows the recognition and communication between cells;

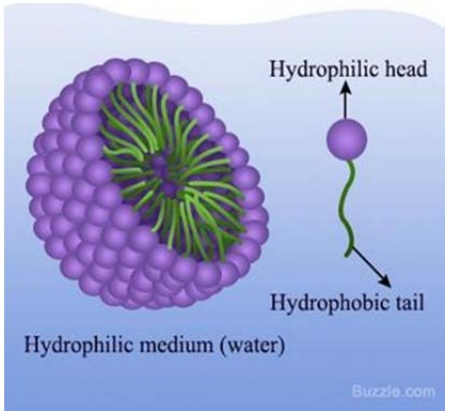


Cell Membrane
Chemical constitution

The main constituents of the membrane plasma are the phospholipids, amphipathic molecules constituted by a hydrophilic part, (the "head" consists of glycerin, a phosphate group and an amino alcohol) and by a "a polar" hydrophobic, which does not dissolves in water (the "tail" formed by fatty acids). The phospholipids can be esters of glycerol and sphingosine, a more complex alcohol.

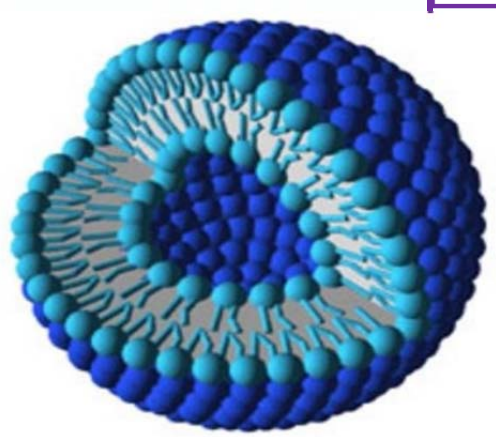


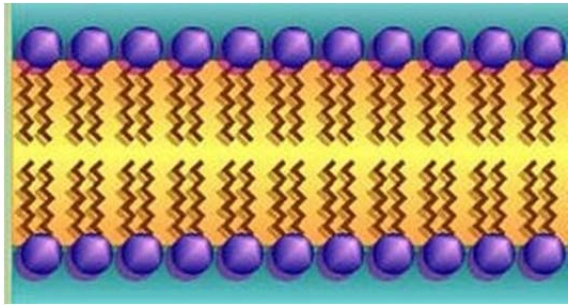
The phospholipids placed in an aqueous environment spontaneously form three types of aggregates:



micelle

lipoma





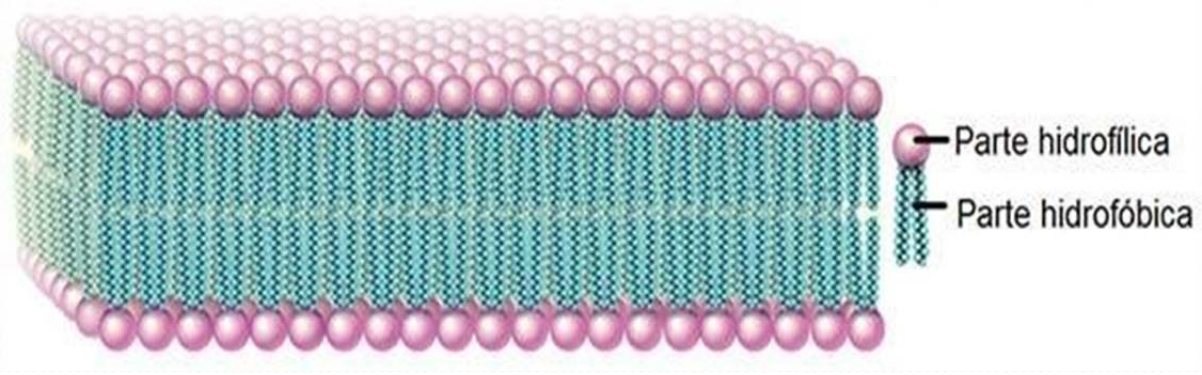
bilayer

The cell membrane

How do phospholipids place themselves?

In the constitution of the plasma membrane phospholipids spontaneously place themselves in **double layer, BILAYER** with the heads facing outwards in contact with the water and the tails facing towards the inside of the double layer, held together by weak bonds to H and interactions of Van de Waals

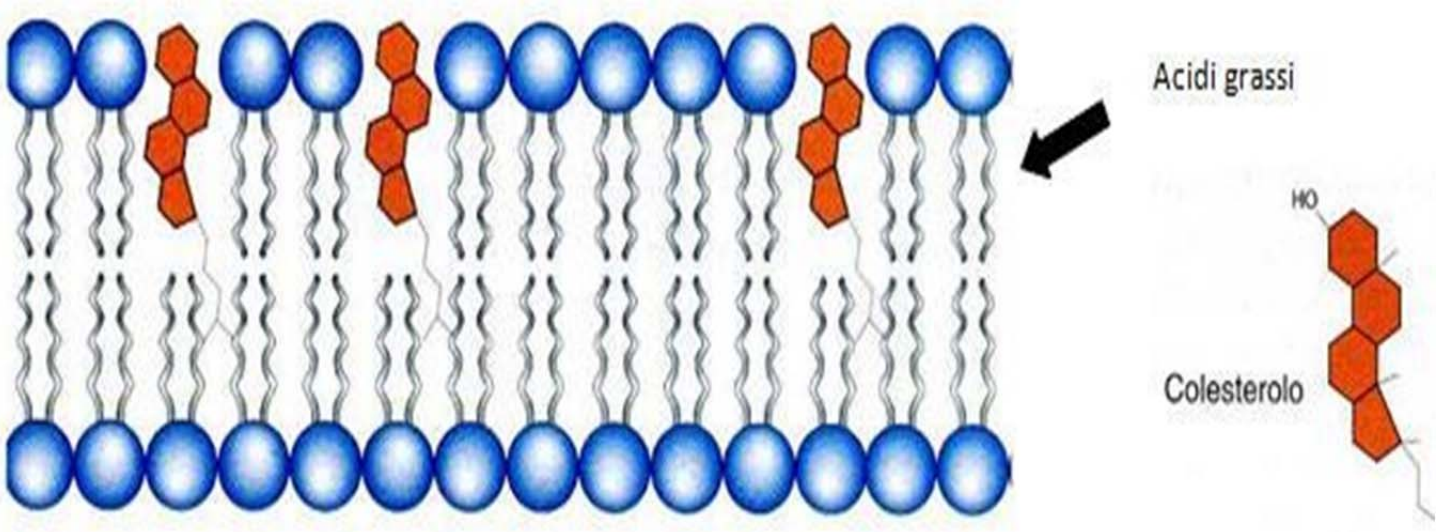
the cell's outer



cytosol

The membrane also contains Cholesterol

Cholesterol has structural and stabilizing function. It modulates the fluidity of the cell membrane, decreasing the fluidity at high temperatures and increasing it at low temperatures. It allows proteins to move both horizontally and vertical.

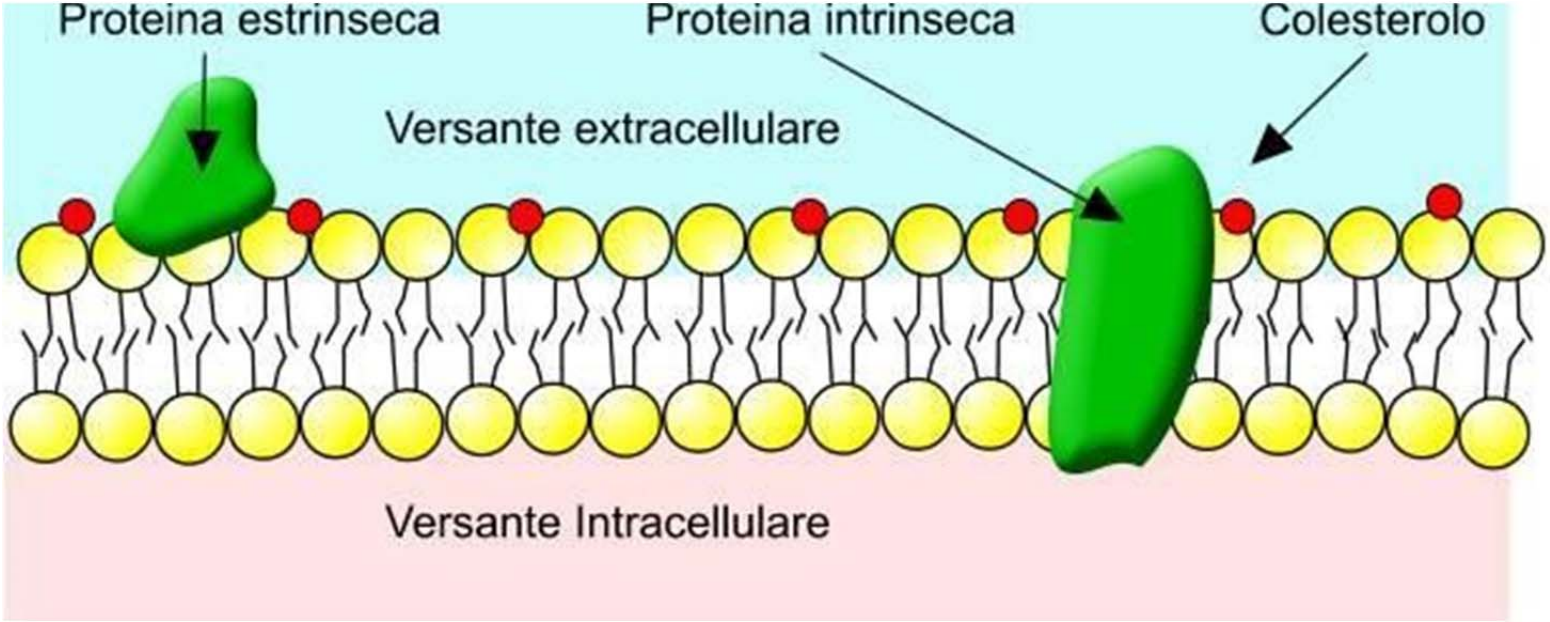


It also contains Protein

Depending on **their** location, we can distinguish:

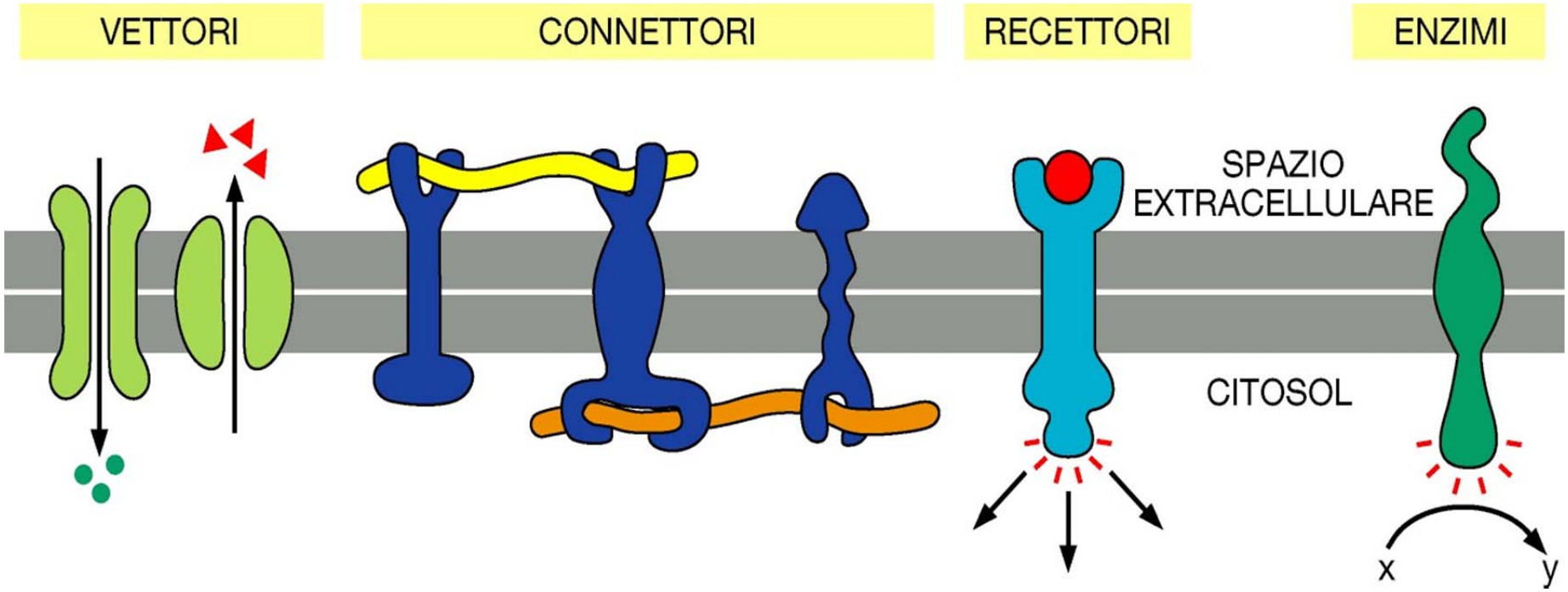
- **intrinsic or integral proteins,** if completely cross the phospholipid bilayer;

- **peripheral proteins or extrinsic,** if they penetrate it only partially or there are draped over;

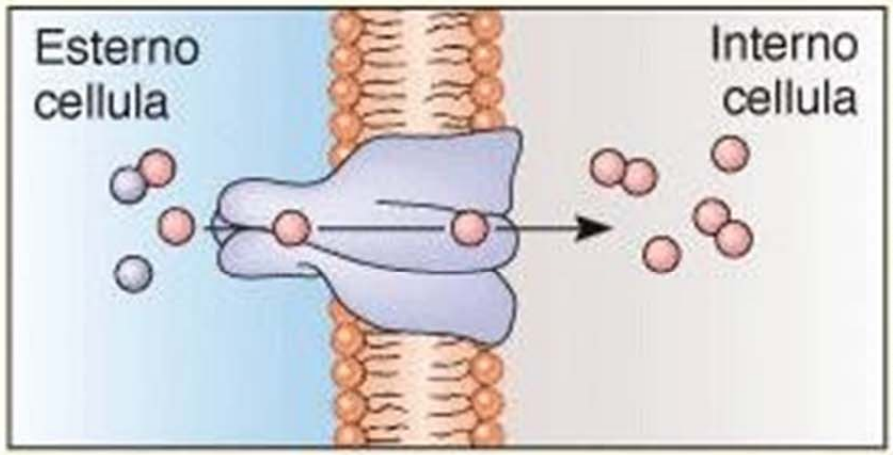


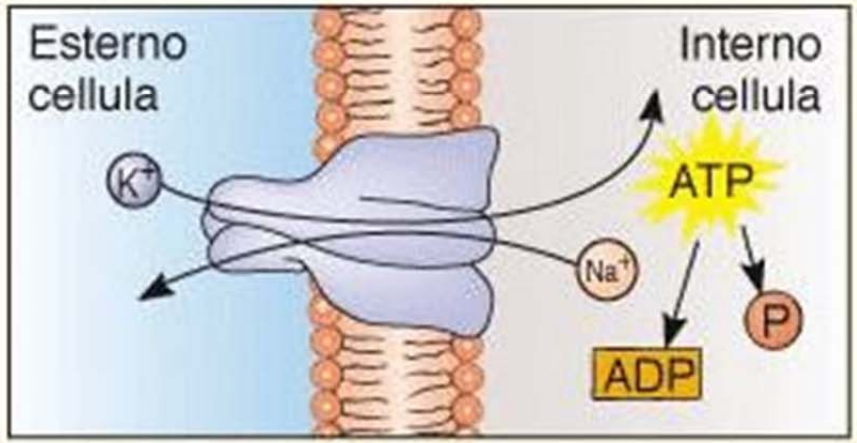
Protein membranes have different functions

In addition to the **structural role,** as anchored to the cytoskeleton, proteins perform functions of: vectors, connectors, receptors, enzymes



protein carriers

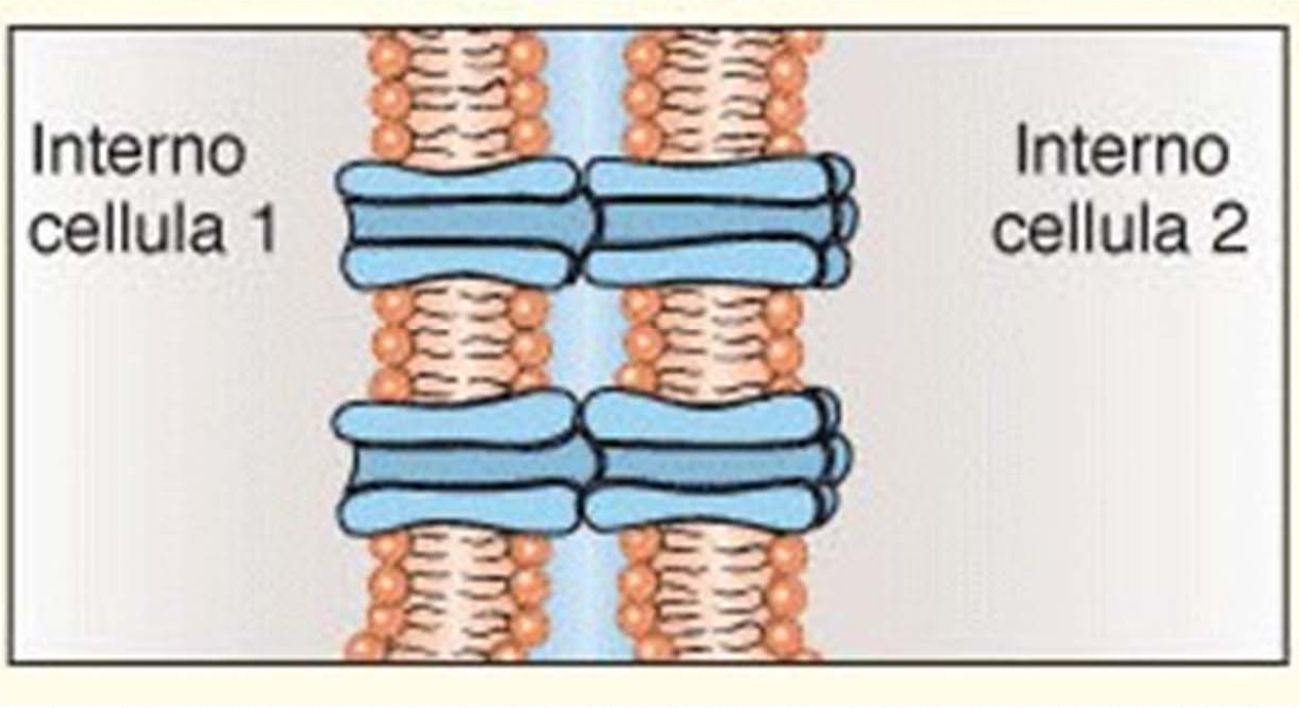




The protein carriers form the so-called protein channels, structures that allow input and / or output of specific substances that are recognized by the protein molecule and that go through the membrane due to a central channel present in the molecule which acts as the carrier.

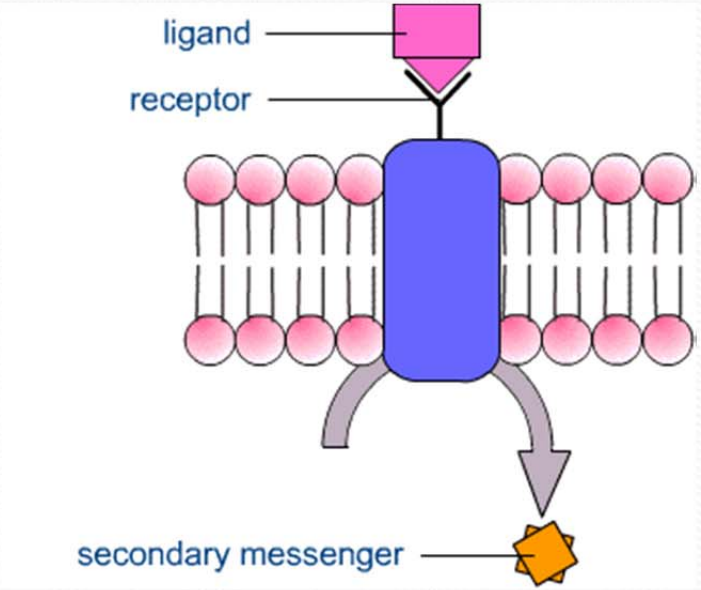
Protein connectors

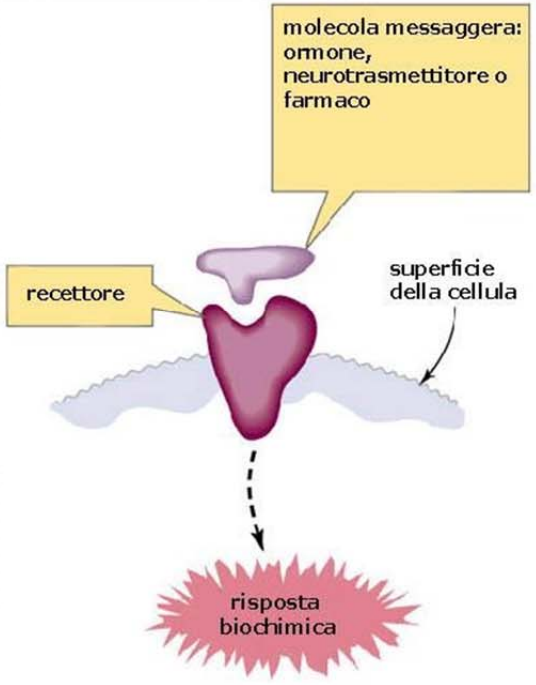
They carry out various tasks in the cell membrane, including that of maintaining linked membrane-specific molecules. A particular case is that of the connectors that ensure the elements of the cytoskeleton, or two adjacent membranes anchored to the membrane



Receptor Proteins

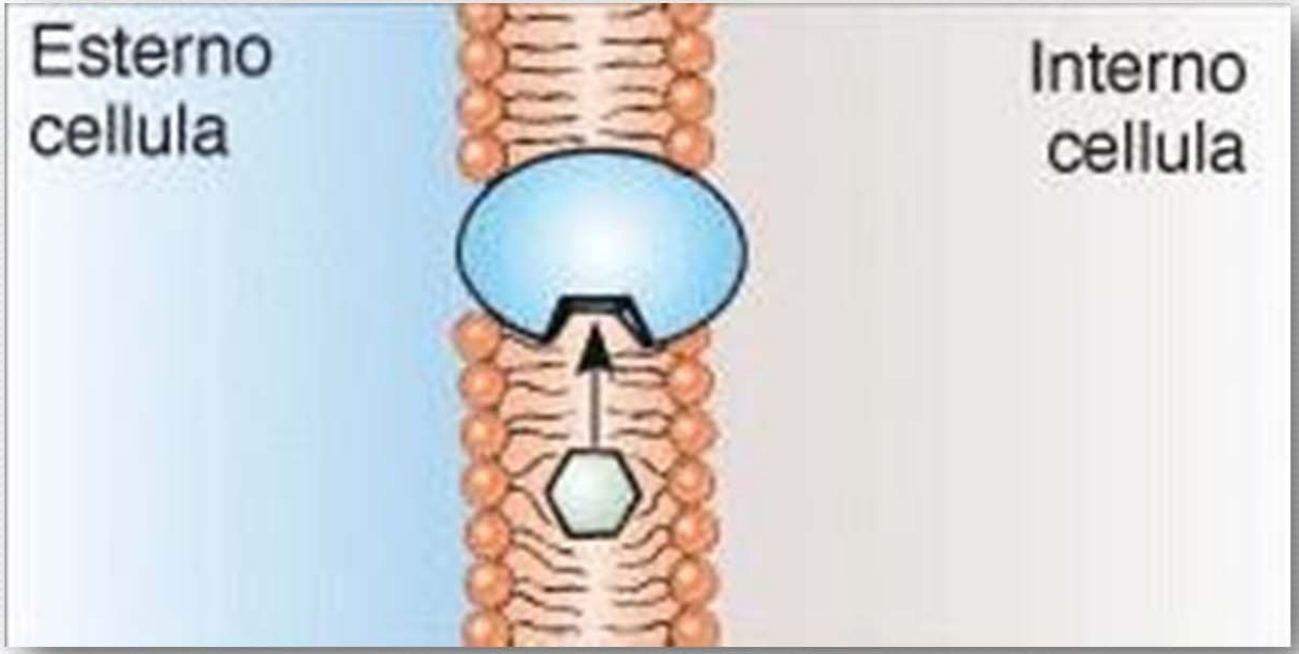
They bind signaling molecules as hormones and transmit the information within the cell, preventing the substance from entering into the cell itself. When a signal molecule binds to its specific receptor, it changes its three-dimensional structure, and this change initiates a series of reactions in chains, that can profoundly affect the metabolism of the cell.





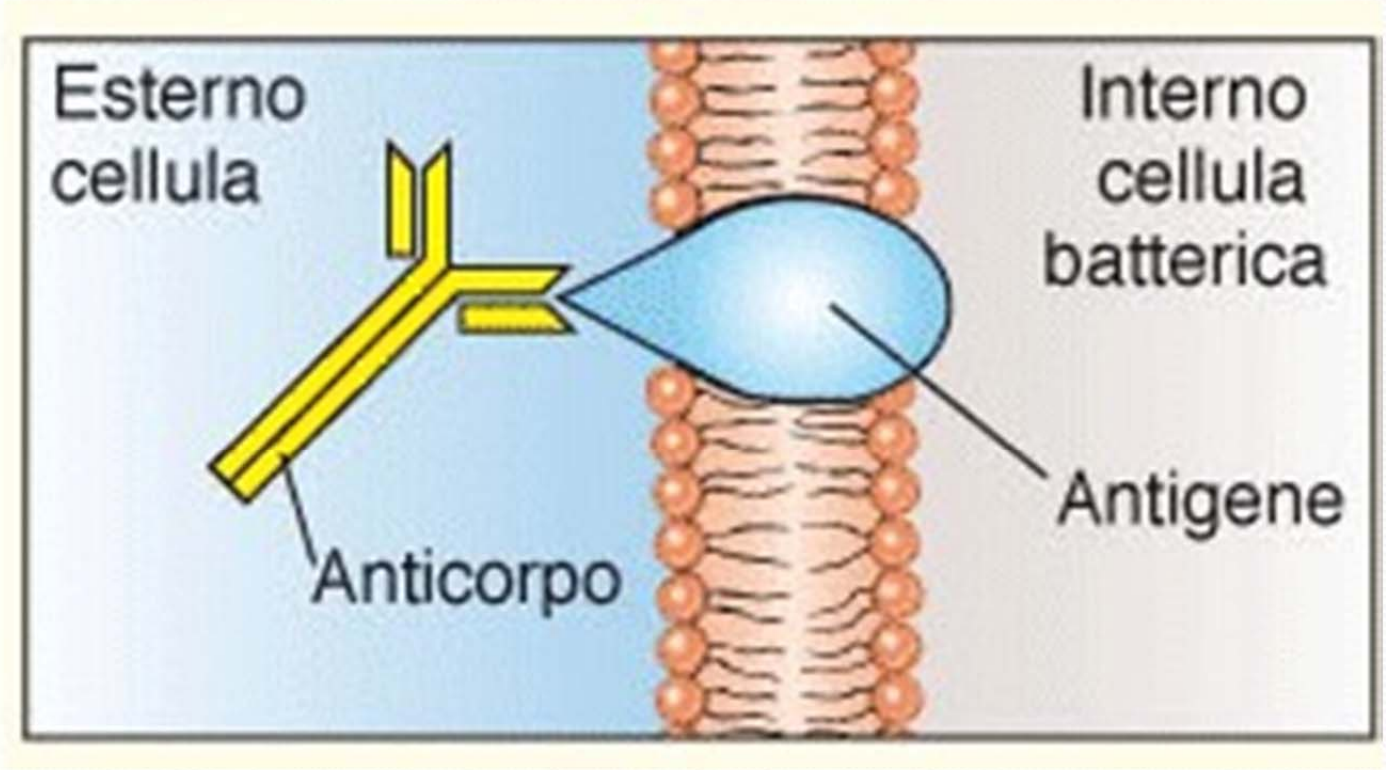
Enzymatic proteins

The cell membrane is also the seat of numerous chemical reactions that , as normally happens in living systems, are catalyzed by specific enzymes. The enzymatic proteins anchored to the plasma membrane catalyze reactions that take place inside or on the surface of the membrane.



Recognition proteins

They serve as identification markers, e.g. bacterial cells possess specific proteins, or antigens that are recognized as foreign by the human cells.



The Cellular membrane

What else does it contain? Glycolipids

Last but not least we have the carbs, associated with lipids and proteins to respectively form glycolipids and glycoproteins.

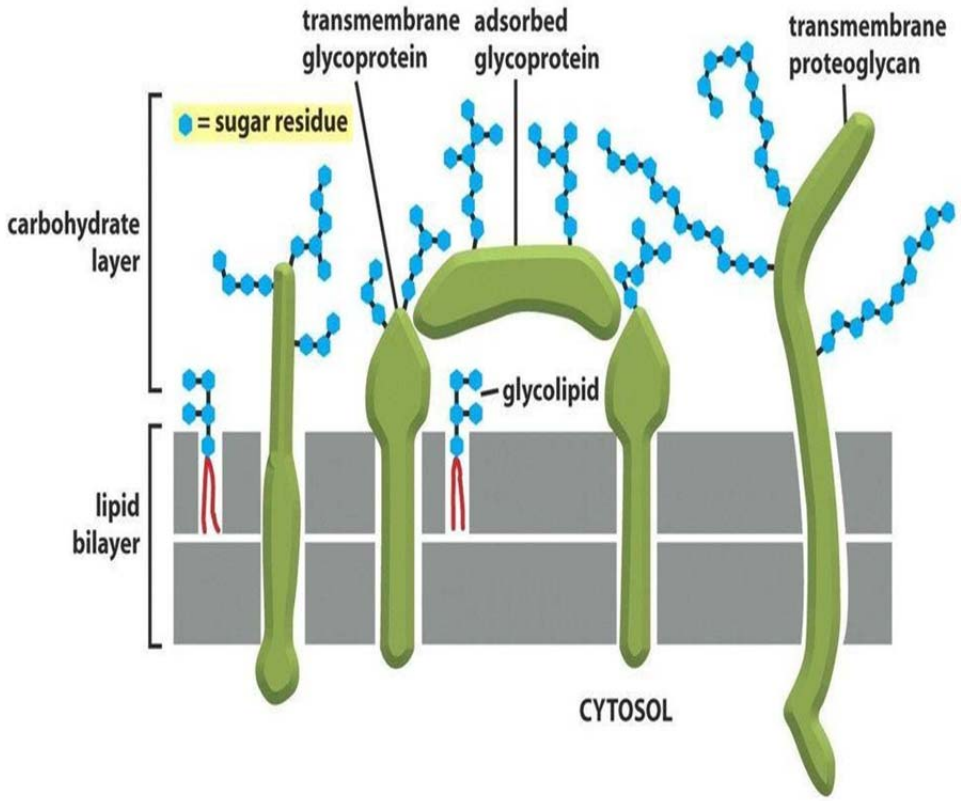
Glycolipids are similar to phospholipids but in the third carbon of the glycerol, instead of a phosphate group, glucid is bound **(**mono, di or oligosaccharide).

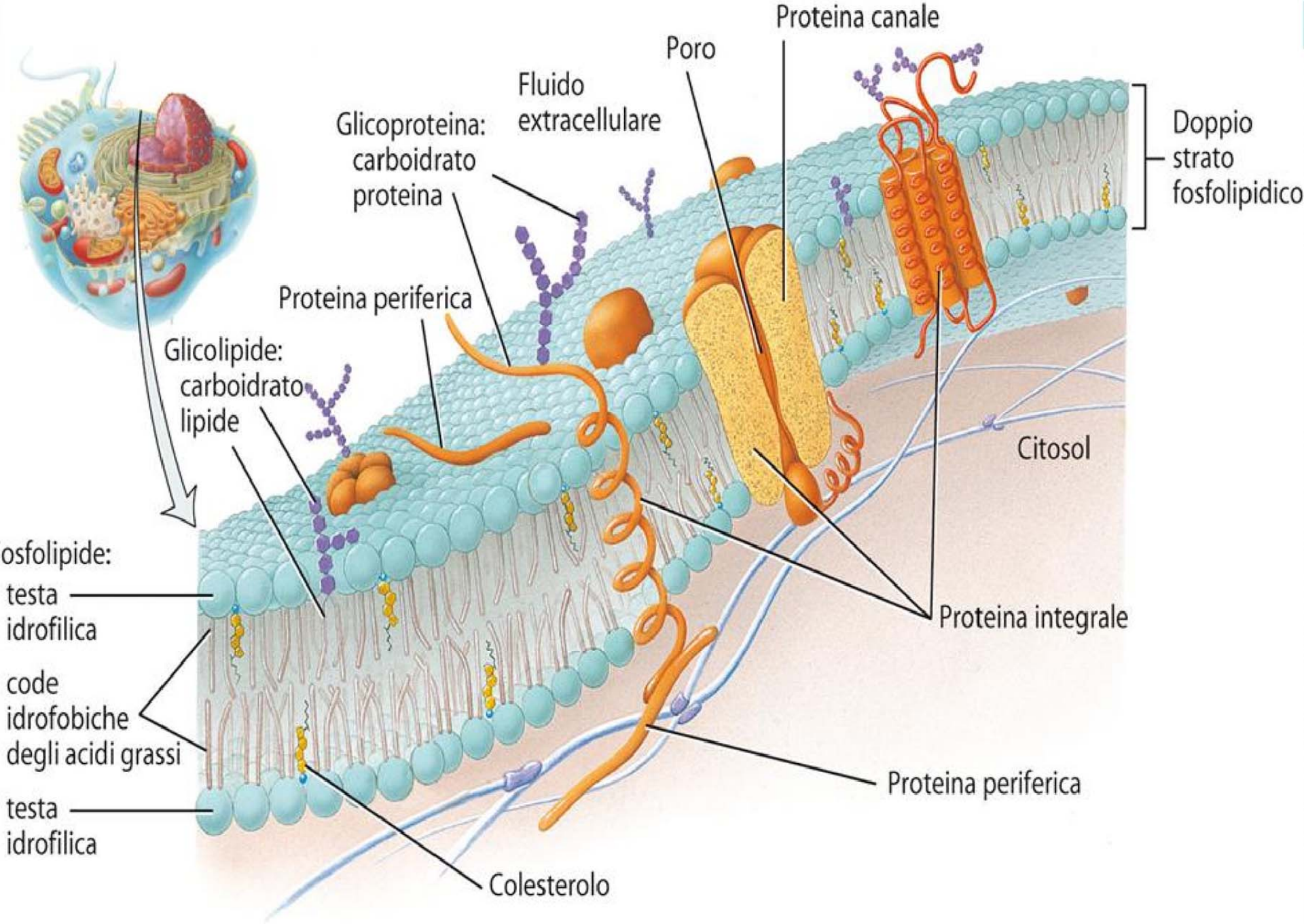
They are found only on the outer surface of the membranes and play an important role in the activity of nerve cells and also in the functionality of some organelles.

The Cellular membrane

What else does it contain? Glycoproteins

The **glycoproteins** are also on the outer face of the membrane. The carbohydrate chains form the glycocalyx, a casing that plays a vital role in the recognition between cells that must interact with each other in a multicellular organism and in the cell adhesion.




Proteina canale
Poro
Fluido extracellulare
Glicoproteina: carboidrato proteina
Doppio strato fosfolipidico
Proteina periferica
Glicolipide: carboidrato lipide
Citosol
osfolipide:
testa idrofilica
Proteina integrale
code idrofobiche degli acidi grassi
Proteina periferica
testa idrofilica
Colesterolo

Membrane transport

Transport is a fundamental membrane function, both from and towards the inside of specific molecules. The passage of substances through the membrane may take place for:

- **passive transport**
- **active transport**

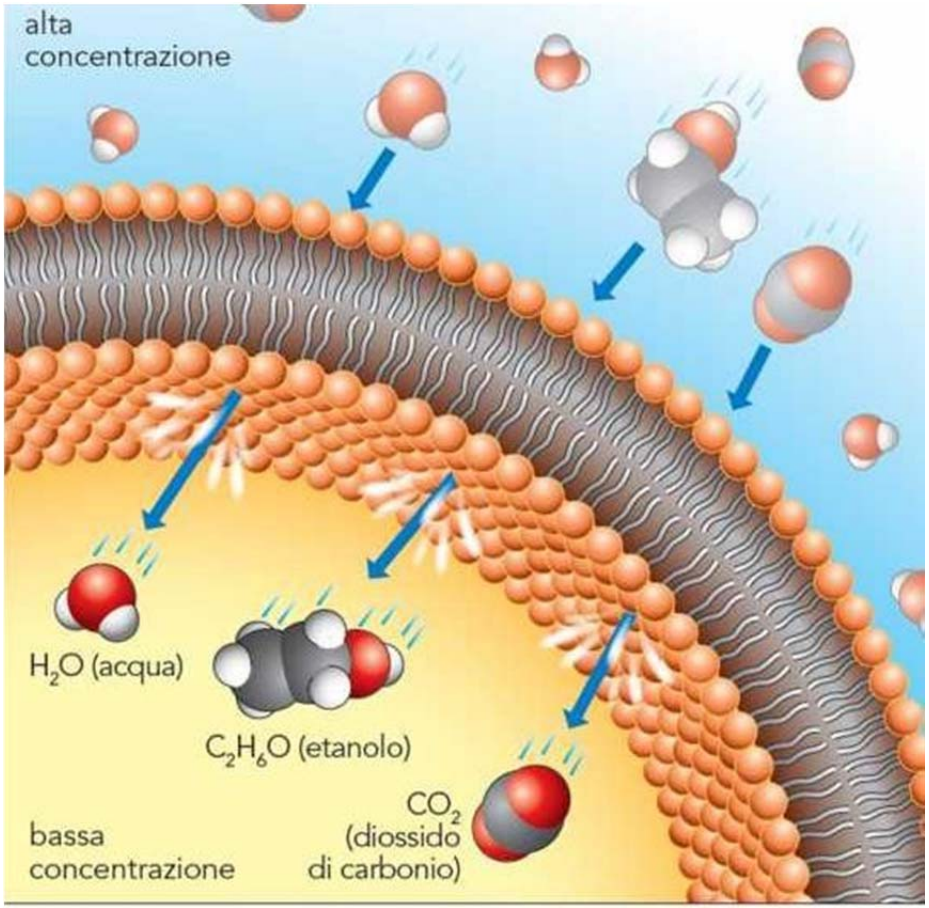
Passive:

- It takes place according to the concentration gradient;
- From a region in which the concentration of the molecules is greater to a region in wherein the concentration is less;
- Does not involve expenditure of energy for the cell;

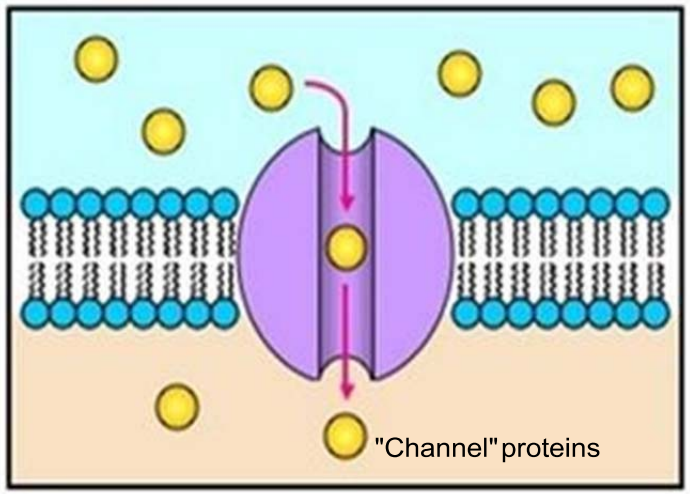
Examples of passive transport are: **simple dissemination, facilitated diffusion and osmosis**

Passive transport (simple diffusion)

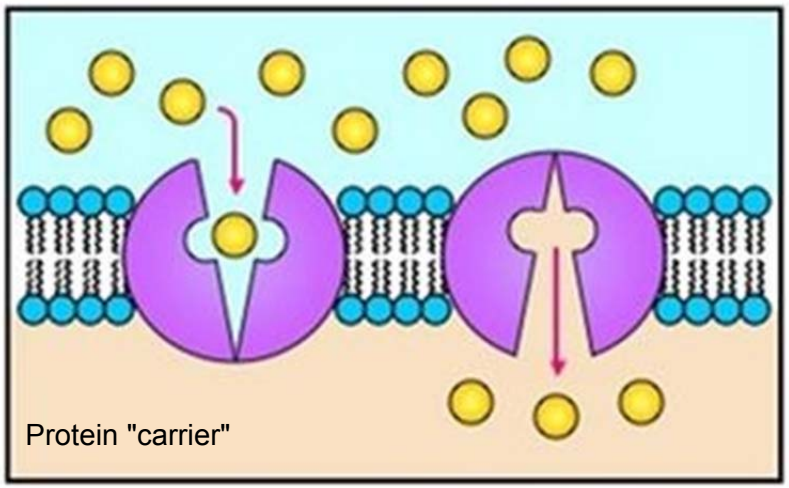
water, oxygen, carbon dioxide, and fat-soluble substances (soluble in the lipids forming the cell membrane) are the substances that diffuse through the membrane through simple diffusion.



Passive transport (facilitated diffusion**)**

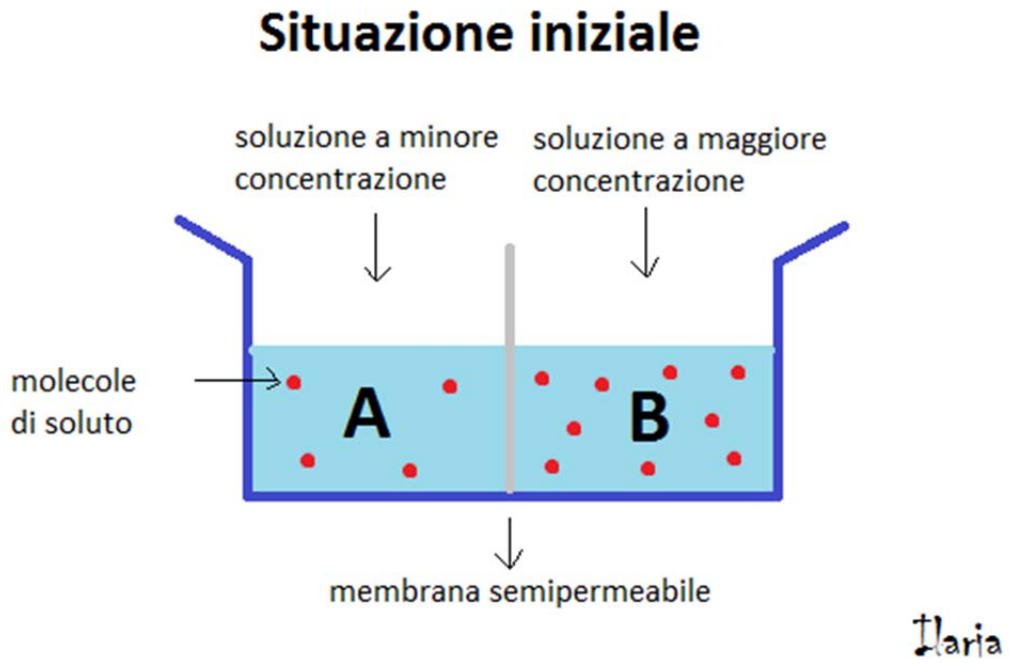


The water-soluble molecules (glucoses, ions and large macromolecules) go through the membrane due to facilitated diffusion by means of **"Channel"** proteins or **"Carrier" proteins.**



Osmosis

It is the passage of water through a semipermeable membrane from a more diluted environment to a more concentrated one. Practically, the water tends to dilute the more concentrated environment



Active transport

- It takes place against a concentration gradient
- From a region in which the concentration of the molecules is smaller to a region in which the concentration is lower.
- It Involves an expenditure of energy for the cell. Some example of active transport are

The Na + / K + ATPase

The pump H + / K + ATPase

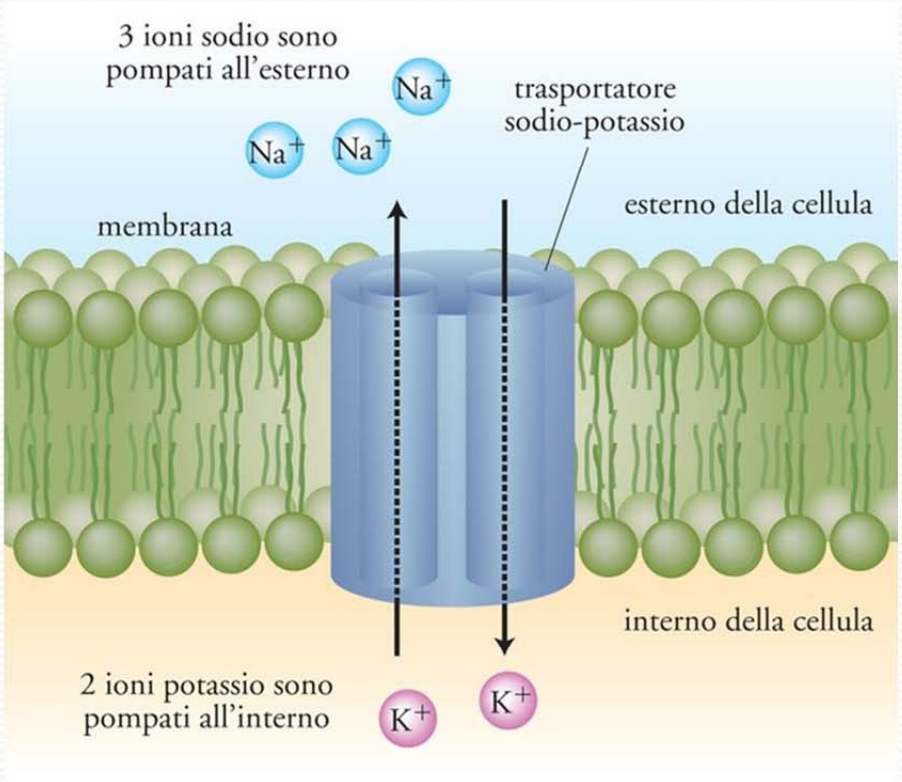
The Ca2 + ATPase of striated muscle cells

The pump protein NA-K

In each cell there are differences in the concentration of each ion between the inside and outside of the cell. The concentration of K is greater inside, compared to the extracellular environment. Vice versa there Na concentration is greater outside.

This difference of concentration is maintained by the Na + / K
+ ATPase

At each cycle the pump expels 3 Na + ions and it carries two K ions $^{+}$ inside, consuming energy.



Mediated transport of vesicles.

Molecules and particles of large size cannot pass through the membrane with the mechanisms described. However, the cell expels and incorporates inward large particles, through the transmembrane transport. In this case the transport is mediated by vesicles and always requires an input of energy.

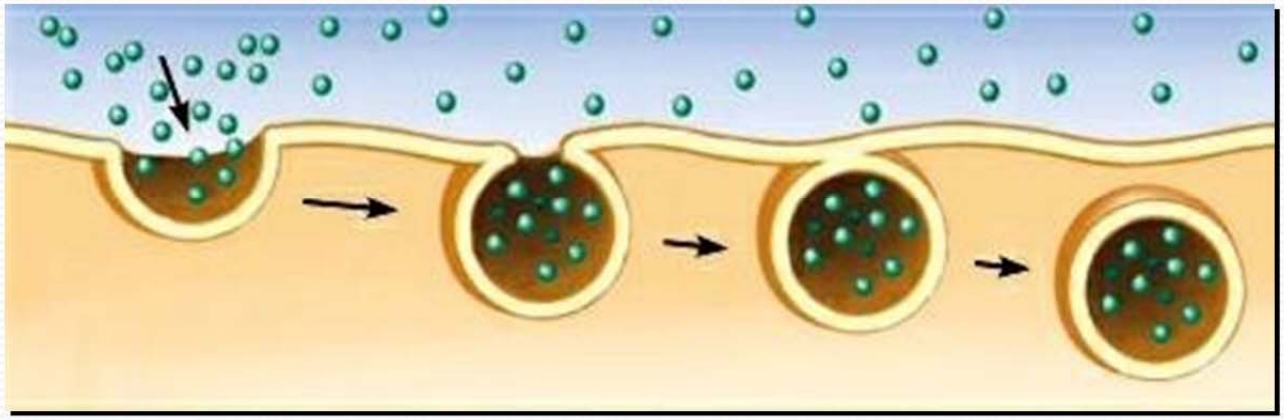
The mechanisms used are

- The endocytosis
- The exocytosis.

Endocytosis

Endocytosis is the cellular process by which the material to be **introduced** in the cell is surrounded by membrane vesicles or vacuoles and poured into the cytoplasm.

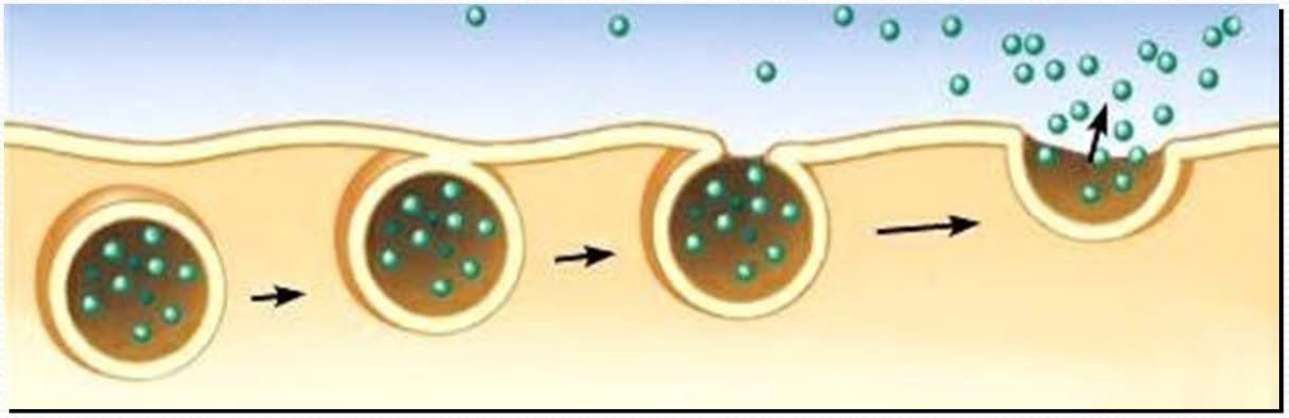
So, if the cell incorporates liquid we talk about **pinocytosis; if** it incorporates large structures (bacterium), we talk about **phagocytosis**



- endocytosis

Exocytosis

The cell can expel material outside by exocytosis. In this case the vesicles containing the material to be expelled are close to the plasma membrane and merge with it.



- exocytosis

Thanks for the attention