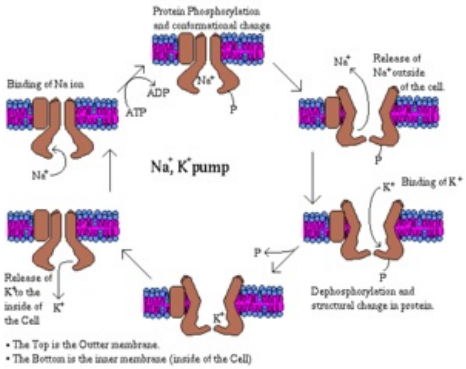
Mechanically activated channels

Mechanically activated channels are considered a subgroup of ion channels. They are found in many groups of tissues and organisms and fulfill the function of sensors in a wide range of systems - primarily sensory, e.g. touch, hearing, balance, they also play a role in osmotic homeostasis or regulation of events in the cardiovascular system. They occur in all three basic types of cells - bacteria, archea i eukaryotes. Their discovery was first published in 1984.

ion channels in general are protein channels of the cell membrane with the ability to pass certain inorganic ions. In principle, they are integral membrane proteins. Transport using these proteins is a passive process, so it does not require the supply of energy. To be considered mechanically gated, an ion channel must respond to mechanical deformation of the membrane. Mechanical changes include changes in membrane tension, thickness, or curvature. A mechanically activated channel responds to these stimuli by switching from a closed to an open state or vice versa. The properties of these channels are typically used in inner ear hair cells and some touch sensory neurons.

Division



Mechanically activated channels are divided according to the type of ions they pass. One type of channel only lets cations through, mainly sodium, potassium or calcium. The second type serves to transport anions and the third type is not selective (it is found mostly in prokaryotes, only rarely in eukaryotes).

Bacterial mechanically activated channels were discovered during experiments with the bacterium E.coli. They play an essential role in the regulation of turgor in bacterial cells. They are activated by changes in osmotic pressure.

Eukaryotic mechanically controlled channels are very numerous and form an essential part of the mechanism of sensory perception (sense perception), see below.

Principle of function

All mechanically activated channels, despite minor differences in structure, function very similarly - in a process called gating, they open a passage into the intracellular space. This process is triggered by the mechanical irritation mentioned above. The channel can open either due to a change in the mechanical tension in the complete lipid bilayer, or by applying a force directly to the channel or to a structure closely connected to the channel.

Function of mechanically activated channels

The main task of mechanically controlled channels in prokaryotes is the regulation of turgor, i.e. the internal pressure exerted on the cell membrane. In eukaryotes, channels are involved in the function of all 5 senses, especially hearing - in the inner ear (more specifically in the organ of Corti of the cochlea) there are hair cells with numerous stereocilia on the surface. From a physical point of view, sound is a mechanical wave, so it acts as a mechanical irritation. If the stereocilia are deflected by the sound wave, they cause the channel to open and allow ions to pass through.

Mechanically activated canals in the inner ear

The hair cells in the inner ear (organ of Corti) are able to respond to different sound frequencies with different effects, so they function as audio receptors. Their membrane contains a high number of mechanically activated ion channels that are activated by the advancing sound wave. This process enables the conversion of sound into a nerve signal, which is spread to the central nervous system for processing and evaluation via nerve pathways (n. vestibulocochlearis) via synapses.

Links

Related Articles

- Cell membrane
- Ion pumps

References

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