Membrane potential

Membrane potential in general is the electrical potential of the inner side of the cell membrane relative to the outer surface of the cell membrane.

At rest, a negative charge predominates on the inner side of the cytoplasmic membrane, therefore in most cells the numerical value of the membrane potential is of the order of −70 mV (depends on the type of cell and the given organ).

Over time, the membrane potential can specifically change, thereby transmitting information.

The membrane is composed of phospholipid bilayer, making it is almost impossible for most biologically significant substances to pass through it. this results in an uneven distribution of ions outside and inside the membrane.

nerve cells tranposrt electric information. When a nerve cell is irritated, the distribution of ions starts to changes.

What is electric potential and voltage?

electric potential-

Electric potential is the **ability of an electric field to act on a unit charge**. In simple terms, we can say that it is the degree of action of the electric field in a given place on an electron. The stronger the electric field, the more intense it will act on the electron. The further the electron is from the field source, the less the field will act on it. It is defined as the **work that would need to be done to move a unit charge in an electric field from a point of zero potential to a point under investigation.**

> For a better understanding, the example of Earth's gravitational potential can be used. It is basically the potential energy **Ep** of a 1 kg body. The only problem is the definition of the point with zero potential. Usually, for general physics principles, it is used as a point of zero potential, a place infinitely far from the Earth (where the Earth's gravity no longer acts). However, we use the Earth's surface as a place of zero potential to calculate the potential energy. If we use the second definition, we see that the statement that the gravitational potential is equal to the energy required to move a body of mass 1 kg from a place of zero potential (the surface of the Earth) to a given place works.

The higher the mass of the Earth (when hypotheticly it is not constant), the higher the gravitational potential would be in a given location (the potential gradient is expressed by the gravitational acceleration). If we define a point of zero potential as a point at infinity, we see that the sign before its value is reversed because the direction of motion is reversed.

The place with zero potential is usually taken to be an infinitely distant point for other quantities, and for the electric field it is usually the surface of the Earth. However, in the case of the electric potential of the inner side of the membrane, the outer surface of the cell is assumed to be the place with zero potential due to historical context.

voltage-

Generally speaking, voltage is **the potential difference between two points** . However, in the case of the membrane potential, the **concepts** *of voltage on the membrane* and *membrane potential are* **synonymous** - the potential is determined relative to a reference point on the outer surface of the cell, whose potential is defined as 0 V. It is therefore the same as voltage - the difference between the potentials of both sides of the membrane.

Depending on the action of forces (positive or negative charge at a given location), the signs of the potential change. If the negative charge predominates on the inside, the membrane potential will be negative and vice versa. for example, in resting phase, the membrane potential is -70 beacuse it more negative in the inside then it is on the outside. Therefore, it is necessary to distinguish between increasing (× decreasing) the voltage (i.e. increasing the difference between the two potentials) and increasing (× decreasing) the potential (which *may* or may not be interpreted as shifting to more positive values, i.e. more often reducing the difference).

Conditions of origin and determining factors

Several basic requirements must be met for the formation of a membrane potential, including an intact semipermeable membrane, a functional cell, and sufficient energy.

The current value of the membrane potential depends mainly on:

- current selective permeability of the membrane for different ions,
- intracellular and extracellular concentration of ions for which the membrane is permeable (i.e. *transmembrane concentration gradient*),
- non-diffusible anions inside the cell (proteins),
- effect of Na^+/K^+ ATPases .

The membrane potential changes significantly even with very small amounts of ions, so even with large changes in potential, it is almost impossible to observe a change in ion concentrations.

Distribution of membrane potentials

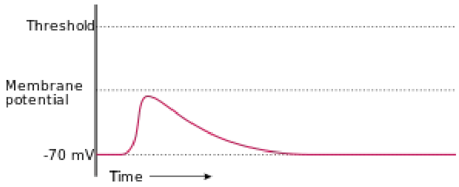
Membrane potentials can be divided according to the properties of the membrane into:

- **passive:**
  - resting membrane potential (KMP, syn. resting potential RP),
  - postsynaptic potentials (PSPs):
    - excitatory (EPSP) - glutamate,
    - inhibitory (IPSP) - GABA;
- **active:**
  - Action potential (AP).

The active property of the membrane means that the excitation propagates across the membrane using voltage-gated channels.

See the Resting Membrane Potential page for more detailed information .

KMP is the membrane potential of all cells of the human body in a resting state. It is determined by the dynamic balance of the flow of ions into and out of the cell. Its value depends mainly on the concentration of K + ions and is around −70 mV.



Postsynaptic membrane potential

Postsynaptic potentials

See Postsynaptic potentials for more detailed information .

PSPs are potentials created around the synapse as a result of the opening of specific chemically controlled ion channels by the action of a neurotransmitter . Their spread occurs with *decrement* – its strength decreases with increasing distance from the source of irritation.

Action potential

See Action potential (physiology) for more detailed information .

AP occurs only in cells containing voltage-gated ion channels, thanks to which the change in membrane voltage propagates without decrement.

Links

Related Articles:

- Action potential
- Action potential versus postsynaptic potential
- Meaning of action and postsynaptic potential
- Goldmann equation

resources:

TROJAN, Stanislav – TROJAN, Stanislav, et al. *Lékařská fyziologie.* 4. edition. Praha : Grada, 2003. 772 pp. ISBN 80-247-0512-5.